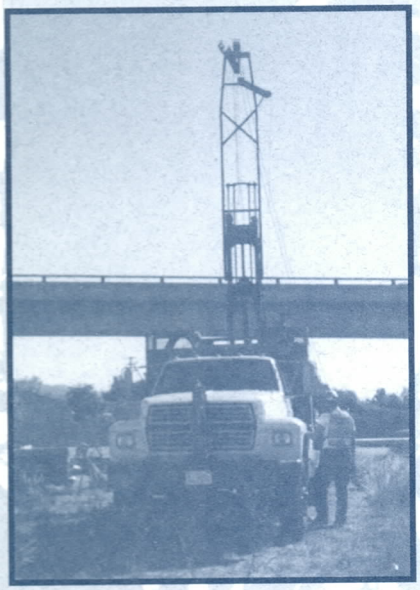
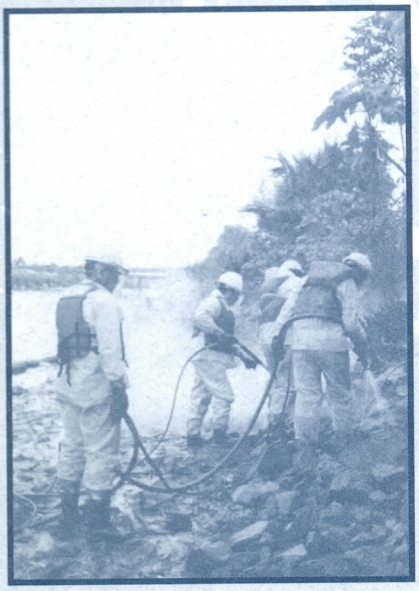
GEOTECHNICAL EVALUATION
CAMELBACK ROAD STORM DRAIN
59TH AVENUE TO 75TH AVENUE
GLENDALE, ARIZONA





Geotechnical

and

Environmental

Sciences

Consultants

Ninyo & Moore

GEOTECHNICAL EVALUATION
CAMELBACK ROAD STORM DRAIN
59TH AVENUE TO 75TH AVENUE
GLENDALE, ARIZONA

PREPARED FOR:
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October 29, 2009
Project No. 602455001

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Mr. Jeff Ford P.E.
Olsson Associates
7250 North 16th Street, Suite 210
Phoenix, Arizona 85020

Subject: Geotechnical Evaluation
Camelback Road Storm Drain
59th Avenue to 75th avenue
Glendale, Arizona

Dear Mr. Ford:

In accordance with our proposal dated December 8, 2008, and your authorization, Ninyo & Moore has performed a geotechnical evaluation for the above-referenced site. The attached report describes our evaluation methodology and presents our findings, conclusions, and recommendations regarding the geotechnical conditions at the project site.

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

Sincerely,
NINYO & MOORE

Jeff S. Rodgers, R.G.
Senior Staff Geologist

REGISTERED GEOLOGIST CERTIFICATE NO. 49080 JEFF S. RODGERS Date Signed 10.29.09 ARIZONA, U.S.A.
EXPIRES 3/31/12

Steven D. Nowaczyk, P.E.
Principal Engineer

Registered Professional Engineer (Civil) CERTIFICATE NO. 34966 STEVEN D. NOWACZYK Date Signed 10.29.09 ARIZONA, U.S.A.
EXPIRES 6/30/12

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Distribution: (3) Addressee

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1. INTRODUCTION

In accordance with our proposal dated December 8, 2008, and your authorization, we have performed a geotechnical evaluation for the proposed storm drain to be located along Camelback Road, between 59th Avenue and 75th Avenue in Glendale, Arizona. The purpose of our evaluation was to assess the subsurface conditions at the project site in order to formulate geotechnical recommendations for design and construction of proposed storm drain. This report presents the results of our evaluation and our geotechnical conclusions and recommendations regarding the proposed construction.

2. SCOPE OF SERVICES

The scope of our services for the project generally included:

- Conducting a visual geologic reconnaissance of the project area and reviewing background information including geologic maps and aerial photographs.
- Conducting a site visit to select and mark the boring locations and notifying Arizona Blue Stake of the boring locations prior to drilling.
- Obtaining City of Glendale right-of-entry permits to do the field work.
- Drilling, logging, and sampling 20 small-diameter exploratory borings to depths of approximately 25 feet below ground surface (bgs). The boring logs are presented in Appendix A.
- Performing laboratory tests on selected samples obtained from the borings to evaluate in-situ moisture content and dry density, gradation analysis, Atterberg limits, consolidation (response-to-wetting behavior) and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfate and chloride content). The results of the laboratory testing are presented on the boring logs and/or in Appendix B.
- Coring in existing roadway pavement at four locations along the proposed alignment. Photographic documentation of the pavement cores is presented in Appendix C.
- Preparing this report presenting our findings, conclusions, and recommendations regarding the construction of the project.

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 site is situated in Township 2 North, Range 1 East (along the border of Sections 13 and 24) and in Township 2 North, Range 2 East (along the border of Sections 18 and 19) in Glendale, Arizona. The segment of pipeline along 67th Avenue is situated in Township 2 North along the border of Ranges 1 East and 2 East (Sections 13 and 18, respectively). The segment of pipeline along 59th Avenue is situated in Township 2 North, Range 2 East (along the border of Sections 18 and 17). The approximate project location is depicted on Figure 1. The Grand Canal is situated near the western limits of the pipe alignment.

At the time of our evaluation, Camelback Road was an asphalt paved roadway with two lanes in each direction and a center-turn lane. The roadway in this segment was surrounded primarily by residential development. The roadways associated with the storm drain segments to be located along 59th Avenue and 67th Avenue consisted of four-laned (two lanes in each direction), asphalt paved roads. There was a center-turn lane and landscaped median along 67th Avenue. These roads were primarily surrounded by commercial development.

According to the Phoenix North (1988), Arizona-Maricopa Co., 7.5-Minute United States Geological Survey (USGS) Topographic Quadrangle Map the site elevation ranges from approximately 1,095 feet relative to mean sea level (MSL) near the western limits to approximately 1,121 feet MSL near the eastern limits of the project. Based on the information from this topographic map, the topography within the vicinity of the project site generally slopes from northeast down to the southwest, towards the Grand Canal.

Several aerial photographs were reviewed for this project. Specifically, aerial photographs from the Flood Control District of Maricopa County (FCDMC) website from 1949, 1959 and 1964 depicted the site as being part of agricultural land. Camelback Road was depicted as a dirt access

road. A 1979 FCDMC aerial photograph showed Camelback Road and the cross streets as paved roadways surrounded by residential or commercial development. A series of photographs from the Maricopa County Assessor's website during a period from 1999 to 2005 depicted the site as being very similar to its current conditions.

4. PROPOSED CONSTRUCTION

The project consists of the design and construction of a new storm drain that will be situated within the Camelback Road corridor. The proposed storm drain alignment will traverse approximately 2 miles, from approximately 59th Avenue to approximately 75th Avenue. In addition, lateral storm drain pipes will be included along 59th Avenue and 67th Avenue. The new storm drain will vary in size ranging from 84 inches to 102 inches in diameter, and will extend about 20 feet bgs. The pipeline will be installed using traditional cut and cover techniques; however, trenchless technologies will probably be utilized near the new alignment's crossings at 59th Avenue and 67th Avenue because of utility conflicts and to maintain traffic through the intersections during construction.

5. FIELD EXPLORATION AND LABORATORY TESTING

From February 9 through 12, 2009, Ninyo & Moore conducted a subsurface evaluation at the site in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing. Our evaluation consisted of the drilling, logging, and sampling of 20 small-diameter borings, denoted as B-1 through B-20. The borings were advanced using a Diedrich D-50 truck-mounted drill rig equipped with hollow-stem augers, to depths of approximately 25 feet bgs. Bulk and relatively undisturbed soil samples were collected at selected intervals. Detailed descriptions of the soils encountered are presented on the boring logs in Appendix A. The general locations of the borings are depicted on the Boring Location Maps (see Figures 2A through 2H).

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

behavior), and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfate and chloride). The results of the in-situ moisture content and dry density tests 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 Holocene to latest Pleistocene (0 to 10,000 years) channel and terrace deposits. These deposits consist of well-sorted sand, silt and fine gravel. The soils are characterized by minimal development with the most strongly developed profiles containing cambic horizons over stage I and II calcic horizons (Demsey, 1988). Descriptions of the soils encountered during our evaluation are presented in the following section.

6.2. Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on the results of our field exploration and laboratory testing, and our general understanding of the 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. Asphalt Concrete, Aggregate Base, and Concrete

Asphalt concrete (AC) was encountered at the surface of each of our borings, and generally ranged in thickness from approximately 2.5 to 6 inches thick. Aggregate base (AB) was encountered under the AC in our borings, and generally ranged in thickness from approximately 5 to 9.5 inches. Underlying the AB in our boring B-19, we encountered portland cement concrete that was approximately 6 inches thick.

To further evaluate the thickness of the AC, four pavement cores were taken. The approximate thickness of these cores are depicted in the table below. Photographs of these pavement cores are depicted in Appendix C.

Table 1 – Asphalt Pavement Thickness

Core No.	Core Location	Approximate Thickness		
		Surface Course (in)	Base Course (in)	Total Thickness (in)
C-1	B-4	1.5	2.5	4.0
C-2	B-8	1.5	2.5	4.0
C-3	B-12	1.5	2.0	3.5
C-4	B-16	1.25	2.0	3.25

6.2.2. Fill

Man-placed fill was encountered under the pavement section described above in each of our borings, except for borings B-17 through B-19, where fill material was not encountered in our borings. The fill generally ranged in thickness from approximately 2 to 5 feet and generally consisted of clay and silty sand in our borings.

6.2.3. Alluvium

Native alluvium was encountered underlying the fill in each of our borings, except for borings B-17 through B-19, where it was encountered underlying the pavement section described above, and extended to the total depth explored. The alluvium generally consisted of moist, loose/soft to dense/hard clay, silty clay, silt, silty sand, and clayey sand in our borings. Scattered caliche filaments and nodules were encountered in our borings at various depths.

6.3. Groundwater

Groundwater was not encountered in our borings. Based on well data provided by the Arizona Department of Water Resources (ADWR, 2006), the depth to the regional groundwater table has been estimated to be 140 feet bgs or deeper. Groundwater levels can fluctuate due to seasonal variations, irrigation, groundwater withdrawal or injection, and other factors. In general, groundwater is not expected to be a constraint to the construction of the project.

7. GEOLOGIC HAZARDS

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

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). From 1948 to 1983, excessive groundwater withdrawal has been documented in several alluvial valleys where groundwater levels have been reportedly lowered by up to about 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 known earth-fissures underlying the subject site. Based on fissures maps published by the Arizona Geological Survey, the closest reported unconfirmed earth fissures to the site are located approximately 6 miles to the northeast of the project site, near Luke Air Force Base (Shipman, 2007). Continued groundwater withdrawal in the area may result in subsidence and the formation of new fissures or the extension of existing fissures. While the future occurrence of land subsidence and earth fissures cannot accurately be predicted, these phenomena are not expected to be a constraint to the construction of this project.

7.2. Faulting and Seismicity

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 and on our review of readily available published geological maps and literature, there are no known active faults underlying the subject site or adjacent areas. The closest known Quaternary fault to the site is the Sand Tank fault, located approximately 40 miles to the south of the site (Pearthree, 1998). Less than 2 meters of late Quaternary displacement has occurred along this fault. Middle to late Pleistocene deposits are faulted; however no offset was observed within early Holocene to latest Pleistocene deposits.

Based on a Probabilistic Seismic Hazard Assessment for the Western United States, issued by the USGS (2008), the site is located in a zone where the peak ground accelerations that

have 10 percent and 2 percent probability of being exceeded in 50 years are 0.04g, and 0.09g respectively. These ground motion values are calculated for "firm rock" sites, which correspond to a shear-wave velocity of approximately 2,500 feet per second in approximately the upper 100 feet of earth materials. Different soils or rock types may amplify or de-amplify these values. Seismic design parameters according to the 2006 International Building Code (IBC) are presented in Table 1.

Table 2 – Seismic Design Parameters

Parameter	Value	2006 IBC Reference
Site Class Definition	D	Table 1613.5.2
Site Coefficient F_a	1.6	Table 1613.5.3(1)
Site Coefficient F_v	2.4	Table 1613.5.3(2)

7.3. Liquefaction Potential

Based on the Standard Penetration Test (SPT) values recorded at various depths in our exploratory borings, the lack of near-surface water, and the low ground motion hazard (relatively low peak ground accelerations), the likelihood or potential for liquefaction is considered to be negligible and, therefore, liquefaction is not a design consideration.

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 the design and construction of the proposed project, as appropriate. Geotechnical considerations include the following:

- The on-site soils should generally be excavatable using heavy earthmoving construction equipment in good working condition.
- Imported soils and soils generated from on-site excavation activities that exhibit a low plasticity and a low to very low expansion potential can generally be used as engineered fill.
- Near surface clayey soils may offer poor pavement support characteristics and may be difficult to compact under moist conditions.

- Groundwater was not observed in our borings. The regional groundwater table has been historically encountered at approximately 140 feet bgs.
- No known or reported geologic hazards are present underlying, or immediately adjacent to, the site.
- The on-site soils may be corrosive to ferrous materials, however, the soils have a negligible effect on concrete due to sulfate attack.

9. RECOMMENDATIONS

The following sections present our geotechnical recommendations for the proposed construction. If the proposed construction is changed from that discussed in this report, Ninyo & Moore should be contacted for additional recommendations.

9.1. Earthwork

The following sections provide our earthwork recommendations. The earthwork specifications contained in Maricopa Association of Governments (MAG), *Uniform Standard Specifications and Details for Public Works Construction (2009)*, and any City of Glendale requirements are expected to apply except as noted.

9.1.1. Excavations

Our evaluation of the excavation characteristics of the on-site materials is based on the results of 20 exploratory borings, our site observations, and our experience on similar projects. In our opinion, excavation of the on-site materials can be accomplished with heavy earthmoving equipment in good operating condition. However, scattered to numerous caliche filaments and nodules were observed in some of the borings, which could be more difficult to excavate depending on the actual size and degree of cementation encountered during construction.

9.1.2. Temporary Slope Stability

We recommend that trenching and excavating be performed in accordance with Occupational Safety and Health Administration (OSHA) guidelines. These guidelines provide

trench sloping and shoring design parameters for trenches up to 20 feet deep based on the soil types encountered. Trenches over 20 feet deep should be designed by the contractor's engineer based on alignment-specific geotechnical analyses. For planning purposes, we recommend that the following OSHA soil classification be used, due to the abundance of sand in our borings:

Alluvium	*Type C*

Upon making the excavations, soil classifications and excavation performance should be evaluated in the field by the geotechnical consultant in accordance with the OSHA guidelines. Some layers of loose to very loose soil were encountered in our borings and should be expected during construction. These loose to very loose soils could adversely affect temporary slope stability mentioned above.

In general, temporary slopes and excavations in alluvium should be inclined no steeper than 1½:1 (horizontal to vertical). Temporary excavations that encounter any surface seepage may need shoring or may be stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis.

9.1.3. Temporary Shoring

Based upon the proximity of the adjacent roadway, underground utilities, structures, and because of the recommended side slope configurations and the anticipated width of the excavations, we are of the opinion that a temporary earth retention system will need to be incorporated for much of this project. Temporary earth retention systems may include braced systems, such as trench boxes or shields with internal supports or cantilever systems like soldier piles and lagging; however, the risk of excessive lateral deflection may render the cantilever shoring system inappropriate for the project.

Braced temporary earth retention systems should be designed using the lateral earth pressure parameters presented on Figure 3. The recommended design earth pressures

are based on the assumptions that the shoring system will be constructed without raising the ground surface elevation behind shoring system, that there are no surcharge loads, such as soil stockpiles and construction materials, and that no loads acting above a 1:1 (horizontal: vertical) plane extending up and back from the dredge line. For earth retention systems subjected to the above-mentioned surcharge loads, the contractor should include the effect of these loads on the design lateral earth pressures.

We anticipate that settlement of the ground surface will occur behind shoring systems during excavation. The amount of settlement depends heavily on the type of shoring system used, the contractor's workmanship, and soil conditions. We recommend that roadways, utilities, and structures in the vicinity of the planned shoring installation be reviewed with regard to foundation support and tolerance to settlement. To reduce the potential for distress to adjacent structures, we recommend that the retaining system be designed to limit the ground settlement behind the shoring system to ½-inch or less. Possible causes of settlement that should be addressed include settlement during excavation for structure construction, construction vibrations, de-watering, and removal of the support system. We recommend that shoring installation be evaluated carefully by the contractor prior to construction and that ground vibration and settlement monitoring be performed during construction.

The contractor should retain a qualified and experienced engineer to design the shoring system. The contractor should evaluate the adequacy of the shoring parameters presented in this report, and make the appropriate modifications for their design. We recommend that the contractor take appropriate measures to protect the workers. OSHA requirements pertaining to workers safety should be observed.

If the utility line is to be installed near or beneath the foundation of an existing structure or utility, the existing structure or utility should be supported or underpinned to reduce construction related damage, and, if needed, the waterline encased in concrete to accommodate imposed structural loads.

9.1.4. Bottom Stability

The proposed excavations are not anticipated to encounter significant groundwater (with the possible exception of surface run-off or perched zones) or loose or soft materials at their base. Therefore, trench bottom stability problems during construction are not anticipated at this site.

9.1.5. Construction Dewatering

No significant seepage from the groundwater table is anticipated on site during construction. However, groundwater seepage could occur where the alignment crosses or abuts existing drainage courses. Stream flow and surface run-off will vary seasonally depending on rainfall in the site vicinity.

Given the relatively low probability of encountering significant seepage on the site, we anticipate that the excavations that do encounter seepage or surface run-off could be dewatered by pumping the water from the bottom of the excavation. However, heavily saturated units or perched groundwater zones, if encountered, may call for more aggressive means of dewatering and consultation with a qualified expert. Discharge of water from the excavations to natural drainage channels may entail securing a special permit.

9.2. Pipe Bedding and Modulus of Soil Reaction (E')

We recommend that the new pipelines be supported on graded granular bedding material such as sand and gravel, or crushed rock with a particle size of 1 1/2-inch or less and 3 to 15 percent passing the No. 200 sieve (pea gravel or crushed chips are not acceptable). This bedding/pipe-zone backfill should extend 1 foot above the pipe crown, and the thickness below the bottom of pipe should be as noted in Table 3 below. Pipe bedding guidelines are illustrated on Figure 4. Care should be taken not to allow voids to form beneath the pipe, (i.e., the pipe haunches should be continuously supported), to avoid damaging the pipelines. This may involve fill placement by hand or small compaction equipment. The bedding/pipe zone 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 above the laboratory optimum.

Table 3 – Pipe Bedding Thickness Below Pipelines

Pipe Diameter (inches)	Granular Bedding Thickness Below the Pipeline (inches)
84	7, or more
90	7.5, or more
96	8, or more
102	8.5, or more

When backfilling, care should be taken to fill voids with compacted material so that excessive settlement of the backfill will not occur. Settlement can be mitigated by backfilling with granular material that is easy to compact or by using a Controlled Low Strength Material (CLSM), sometimes referred to as Controlled Density Fill. More detailed recommendations regarding the use of CLSM are provided in Section 9.4.

The modulus of soil reaction (E′) is used to characterize the stiffness of soil backfill placed on the sides of buried pipelines for the purpose of evaluating deflection caused by the weight of the backfill over the pipe. We anticipate that the invert depth of the water transmission mains will generally be about 10 to 20 feet bgs, or slightly shallower. For granular backfill soils for water transmission mains, we recommend using an E′ value of 2,000 pounds per square inch (psi).

9.3. Trench Backfill

Backfilling should generally be accomplished in a manner consistent with the standards provided by the MAG (2009). The soils encountered along the alignments, as well as any crushed materials generated during construction, should generally be suitable for re-use as trench backfill, provided they are free of organic material, clay lumps, debris, and rocks more than 4 inches in diameter. Some screening of larger particles may be needed to meet the MAG specifications.

On site and imported soils that exhibit relatively low plasticity indices and very low to low expansive potential are generally suitable for re-use as engineered fill in the upper portion of trench backfill (shallower than 3 feet below finished grade). Relatively low plasticity indices are defined as a Plasticity Index (PI) (by the American Society for Testing and Materials [ASTM] 4318) value of 20 or less. Very low to low expansive potential soils are defined as having an Expansion Index (by ASTM D 4829) of 50 or less. The Atterberg limits tests performed on selected soil samples resulted in a PI ranging from 0 (non-plastic) to 25, demonstrating variable low to moderate expansion potential. As such, it is our opinion some of the on-site soils will not be suitable for re-use in the upper 3 feet of the trench zone during construction. Additional field sampling and laboratory testing should be conducted during construction to better evaluate these unsuitable soils.

Imported fill, if utilized, should consist of granular material with a very low or low expansion potential. Import material in contact with ferrous metals should have a low corrosion potential (minimum resistivity more than 2,000 ohm-cm, chloride content less than 25 parts per million [ppm]). In lieu of this, protective measures such as pipe wrapping, cathodic protection, etc, can be used to protect the pipe. Import 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.

Backfill should be moisture conditioned to a moisture content generally near its laboratory optimum and mechanically compacted to a relative compaction of 95 percent as evaluated by ASTM D 698. The backfill in the upper 2-foot zone below pavement sections should, however, be placed at a relative compaction of 100 percent. Lift thickness for backfill will be dependent upon the type of compaction equipment utilized, but should generally be placed in lifts not exceeding 9 inches in loose thickness. Special care should be exercised to avoid damaging the pipe or other structures during the compaction of the backfill. Jetting or water saturation compaction should not be used as a compaction technique on this project.

9.4. Controlled Low Strength Material

As an alternative soil backfill, it is our opinion that the trench backfill zone can be filled with either Controlled Low Strength Material (CLSM). CLSM consists of a fluid, workable mixture of aggregate, Portland cement, and water. The use of CLSM has some advantages:

- A narrower trench can be used, thereby minimizing the quantity of soil to be excavated and possibly reducing disturbance to the near-by traffic;
- The support given to the pipe is generally better, and increased values of modulus of soil reaction (E'=3000 psi) can be used to design the pipe;
- Because little compaction is needed to place CLSM, there is less risk of damaging the pipe; and
- CLSM can be batched to flow into irregularities in the trench bottom and walls.

It should be noted that for this application, the trench will probably need to be opened for a longer duration of time to allow the CLSM to set-up during construction. In addition, the cost associated with using CLSM is generally higher than re-using on-site soil as backfill.

The CLSM design mix should be in accordance with the MAG (2009) or Standard Specifications for Public Works Construction (APWA, 1991). The 28-day strength of the material should be no less than 150 psi and no more than 200 psi.

Buoyant or uplift forces on the piping should be considered when using CLSM and prudent construction techniques may result in multiple pours to avoid inducing excessive uplift forces. The construction methods should not allow the water transmission mains to displace laterally or vertically during placement of CLSM. Sufficient time should be provided to allow the CLSM to cure before placing additional lifts of CLSM or trench backfill.

9.5. Trenchless Installation

As indicated earlier, trenchless technologies may be utilized to cross under the intersections of 59th Avenue and 75th Avenue. Based on the information from our borings, trenchless techniques may be appropriate for these areas. However, the presence of caliche observed near the pipe elevations in our borings could slow the rate of construction depending on the

actual degree of cementation encountered during construction. Based upon the spacing of our borings, and the relative size of our samples compared to the planned excavations, variations from the boring logs should be anticipated.

Caving of the pipe shaft may occur, particularly where relatively loose surface soils are present. For stability and safety purposes, and to reduce ground movement, a perimeter shaft support system (carrier casing) should be installed as the excavation progresses.

Following the installation of the utility inside the carrier casing, the annulus space should be in-filled with fine gravel or sand that is blown in with air from the ends. A portion of the gravel or sand could be blown in first (so as to fill under the haunches of the utility) to reduce the potential for future movement of the pipe.

We recommend that the contractor be responsible for the design of access shaft geometry and ground support systems for the launching and receiving pit excavations so that such design can be compatible with his construction equipment and methods. Soldier piles with lagging or other types of shored excavations may serve as a suitable system for this project. Driven sheeting may be difficult to install because of hard ground conditions and the possibility of encountering buried gravel or caliche cemented soils. In addition, driven sheeting may cause real and perceived damage by vibrations to nearby structures.

Reaction force is developed by the action of the trenchless operation against the surface of the opposite wall of the launching pit. At the time of this report, the launching pit geometry was not available, so we were not able to estimate ultimate passive resistance pressures. When calculating the allowable resistance pressures, a factor of safety of 1.5 to 2.0 should be used.

Surface subsidence associated with these operations was not evaluated as part of our analysis. Nevertheless, the contractor should implement a monitoring program during these operations to observe any ground movement above and adjacent to the pipe being installed. If signs of land subsidence or disturbance are noted, construction operations should be

stopped to address the ground movement. The integrity of nearby utilities, roadways and canal lining will need to be protected during these operations.

9.6. Pavements

The following sections present our design assumptions and recommendations for new flexible pavement sections along Camelback within the project limits. In providing these recommendations, we assumed that AC pavement will be used and that the subgrade preparation recommendations outlined below will be employed.

9.6.1. Traffic

The traffic information used to conduct the pavement design for Camelback Road within the project limits was based on traffic volumes obtained from the Maricopa Department of Transportation. Based on this information, the flexible pavement was designed for an average weekday traffic count of 23,000 vehicles. The resulting 20-year Equivalent Single Axle Loads (ESALs) was estimated to be approximately 12,000,000. We assumed a growth factor of 5 percent per year, and 10 percent heavy trucks for the design of new flexible pavement.

9.6.2. R-value

The soils encountered in our borings generally consisted of loose/soft to dense/hard clay, silty clay, silt, silty sand, and clayey sand. A design R-value of 20 was assumed for this project. We recommend soils placed within 3 feet of the finished roadway subgrade will exhibit an R-value of 20 or more. If the project needs fill from an offsite source, we recommend the soils used for subgrade support should also have an R-value of 20 or more.

9.6.3. Resilient Modulus

As discussed in the preceding section, a design R-value of 20 was used for new pavement section. Based on Figure 202.02-2 obtained from ADOTM, correlating the R-

value and a seasonal variation factor of 1.0 taken from Table 202.02-4 in the ADOTM, resilient modulus value of 12,000 was estimated.

9.6.4. Drainage Coefficient

A drainage coefficient of 1.0 was established from Table 202.02-7 in the ADOTM, based on a seasonal variation factor of 1.0 and good drainage conditions.

9.6.5. Recommended Asphalt Pavement Sections

Based on the traffic count and the resilient modulus of the subgrade soils, the calculated asphalt pavement section is presented in Table 4 below. The AASHTO method was used to evaluate bituminous layer thicknesses given below.

Table 4 – Recommended Pavement Sections for Camelback Road

Location	Layer	Thickness (inches)
Camelback Road from 59th Avenue to 75th Avenue	Bituminous Surface Course (12.5 mm mix)	2.0*
	Bituminous Base Course (19 mm mix)	5.0
	Aggregate Base Course	11.0

* Rubberized asphalt concrete per MAG Section 322 can be utilized in place of hot-mix asphalt concrete if desired.

The AC mentioned above should meet the MAG specifications. The AB mentioned above should meet Section 702 of the MAG specifications requirements, as shown in Table 5. Pulverized AC may be used as AB material for this project. We recommend that the AB material as well as any pulverized AB used for this project as AB material meet Section 702 of MAG specifications, as shown in Table 5.

Table 5 – Recommended Aggregate Base Gradation

Sieve Size (per ASTM D422-63)	Percent Passing by Weight
1 1/8 inch	100
No. 4	38-65
No. 8	25-60
No. 30	10-40
No. 200	3-12
P.I. Max.	5

AB material should be compacted to a relative compaction of 100 percent of the maximum dry density, as evaluated by ASTM D 698, at a moisture content generally near the optimum.

9.7. Corrosion

The corrosion potential of the on-site materials was analyzed to evaluate its potential effect on the underground utilities and structures. Corrosion potential was evaluated using the results of laboratory testing of three samples obtained during our subsurface evaluation that were considered representative of soils at the subject 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 soil pH values of the selected samples tested ranged from 6.3 to 7.0, which is considered to represent an acidic to neutral environment. The electrical resistivity values measured in the laboratory ranged from 821 ohm-cm to 1,984 ohm-cm, indicating an environment that may be corrosive environment to ferrous metals. The chloride contents of the samples tested ranged from 12 ppm to 33 ppm, which is also considered to be corrosive to ferrous materi-

als. The soluble sulfate contents of the soil samples were measured to range from 0.001 to 0.012 percent, which represents a negligible sulfate exposure for concrete.

The results of the laboratory testing indicate that the on-site soils could be corrosive to ferrous metals. Therefore, special consideration should be given to the use of heavy gauge, corrosion protected, steel pipes or culverts (if any culvert pipes are planned). As an alternative, plastic pipe or reinforced concrete pipe could be considered.

To minimize corrosion of buried metallic utilities, we recommend that topsoil, organic soils, existing fill soils, and mixtures of sand and clay not be placed adjacent to buried metallic utilities. Rather, we suggest a sand and/or grave bedding be placed around buried metal piping in the pipe zone. Also, buried utilities of different metallic construction should be electrically isolated from each other to minimize galvanic corrosion problems. In addition, new piping should be electrically isolated from old piping so that the old metal will not increase the corrosion rate of the new metal. A corrosion specialist should be consulted for further recommendations.

9.8. Concrete

Laboratory chemical tests performed on selected samples of the on-site soils indicated a sulfate content ranging from 0.001 to 0.012 percent by weight. Based on the following American Concrete Institute (ACI) table, the on-site soils are considered to have a negligible sulfate exposure to concrete.

Table 6 – 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 Valley wide 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 0.5 by weight for normal weight aggregate concrete. The structural engineer should ultimately select the concrete design strength based on the project specific loading conditions. However, higher strength concrete may be selected for increased durability and resistance to shrinkage cracking.

9.9. Site Drainage

Surface drainage should be provided to divert water away from the paved surfaces. Surface water should not be permitted to pond on pavement areas. Positive drainage for this project

is defined as a slope of 2 percent or more over a distance of 5 feet or more away from the pavements. To deter accumulation of water below new pavement sections, the overexcavations below the new pavement sections should be sloped away from the center of the roadway.

9.10. Pre-Construction Conference

We recommend that a pre-construction conference be held. Representatives of the owner, 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.

9.11. Construction Observation and Testing

During construction operations, we recommend that a qualified geotechnical consultant perform observation and testing services for the project. These services should be performed to evaluate exposed subgrade conditions to evaluate the suitability of proposed on-site or borrow materials for use as fill and to observe and test placement of compacted 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.

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

American Concrete Institute, 2005, Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary (ACI 318R-05).

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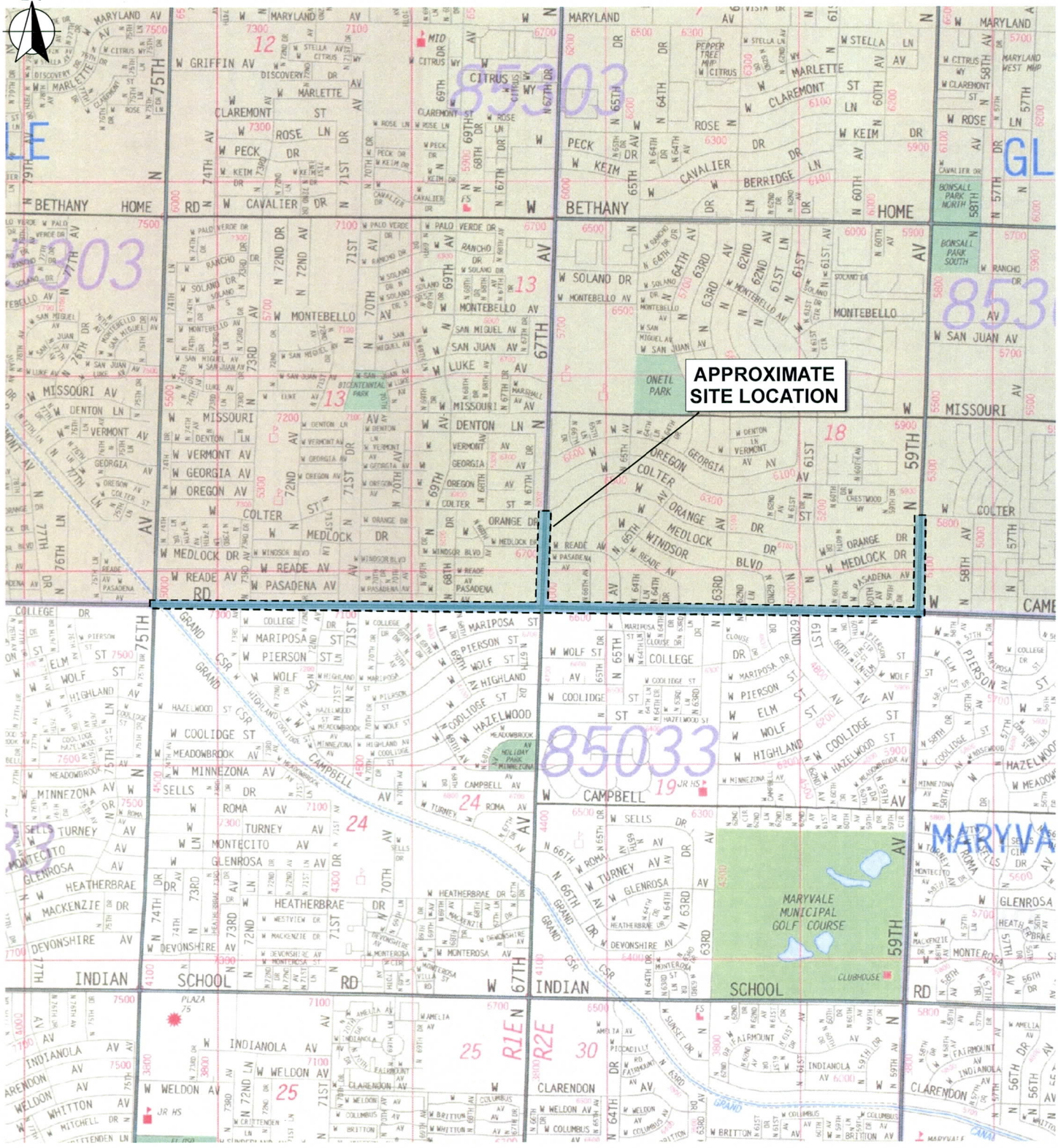
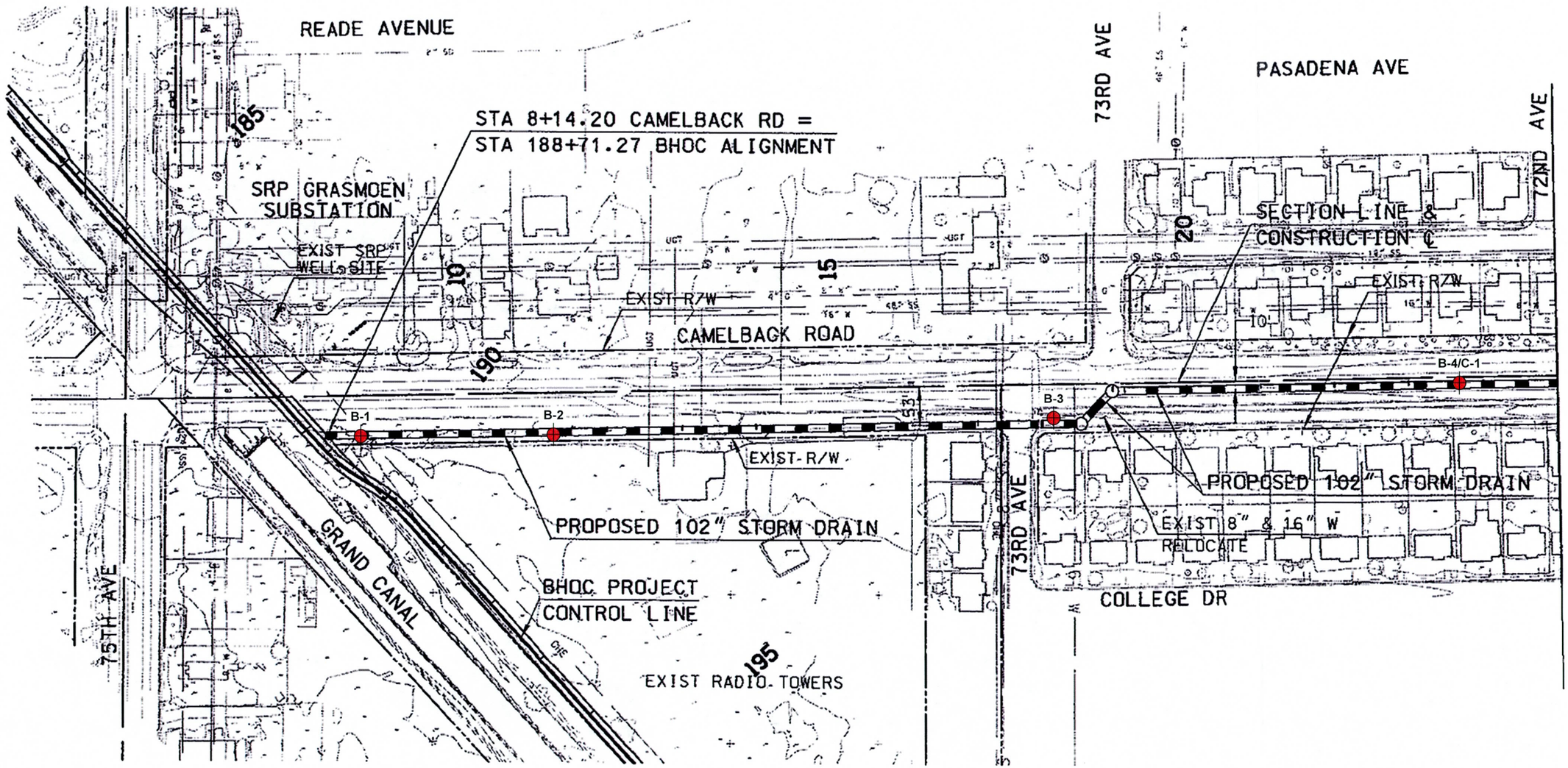
Ninyo & Moore



Source: The Thomas Guide, Phoenix Street Guide, 2008.

Ninyo & Moore		SITE LOCATION MAP	FIGURE 1
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	

file no: 2455vmap0209



LEGEND

B-4 — Approximate Boring Location

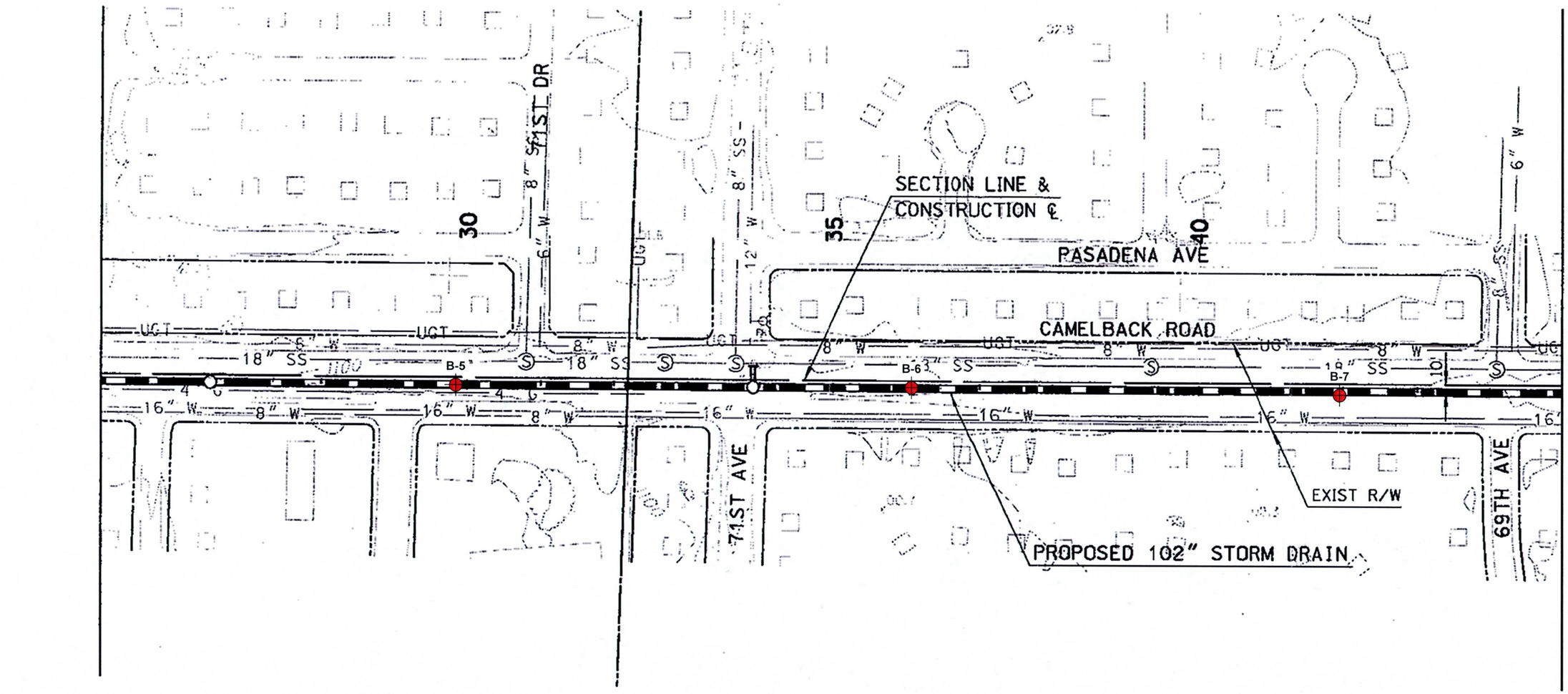
C-1 — Denotes Approximate Coring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore	BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001 / DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2A

file no: 24555bm0209a



LEGEND

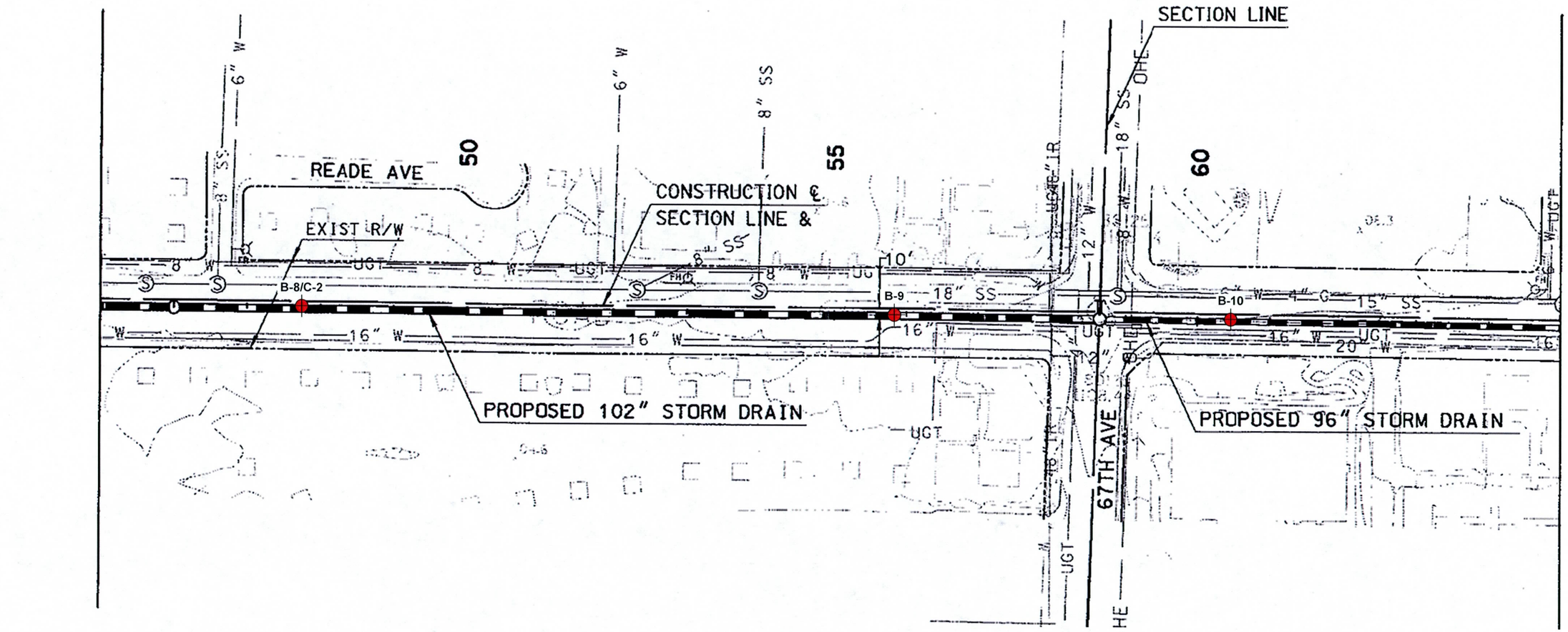
B-7 ⊕ Approximate Boring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore		BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2B

file no. 2455m02209b



LEGEND

B-4 ⊕ Approximate Boring Location

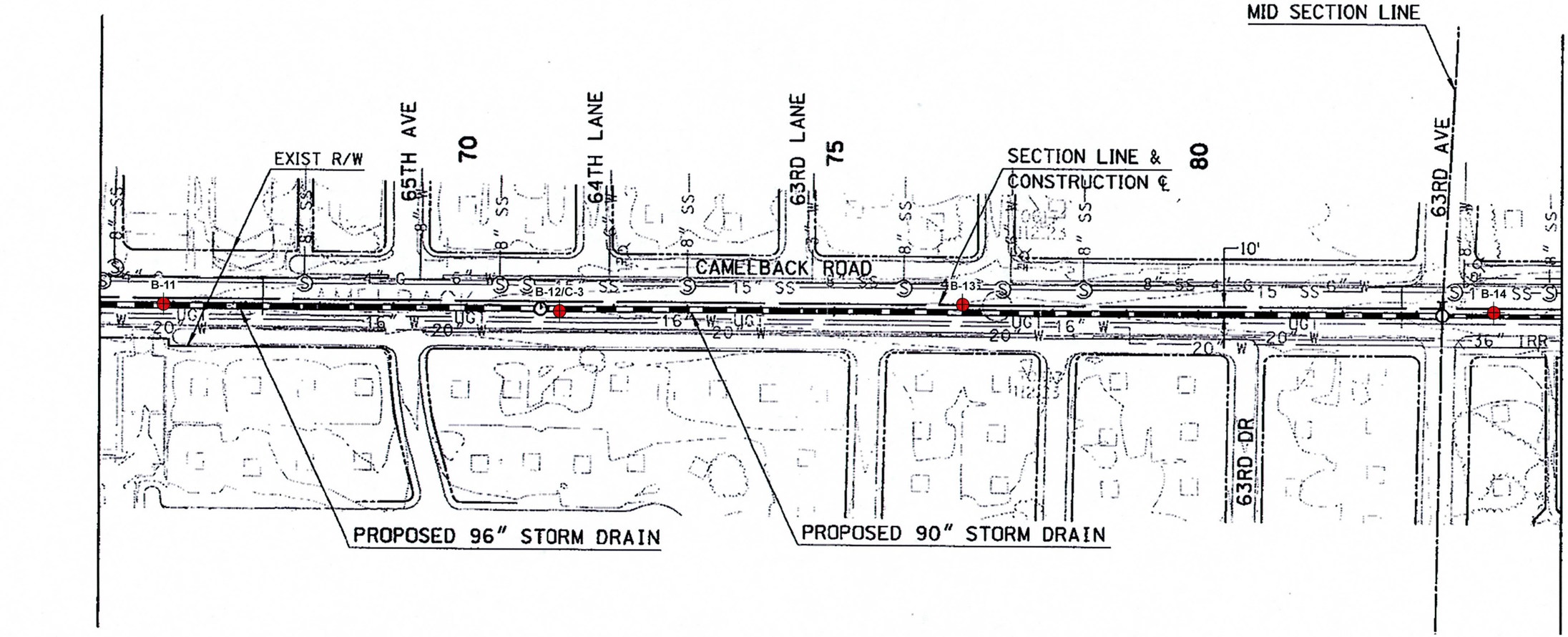
C-2 Denotes Approximate Coring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore		BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2C

file no. 2455blm0209c



LEGEND

B-4	Approximate Boring Location
C-3	Denotes Approximate Coring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore	BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2D

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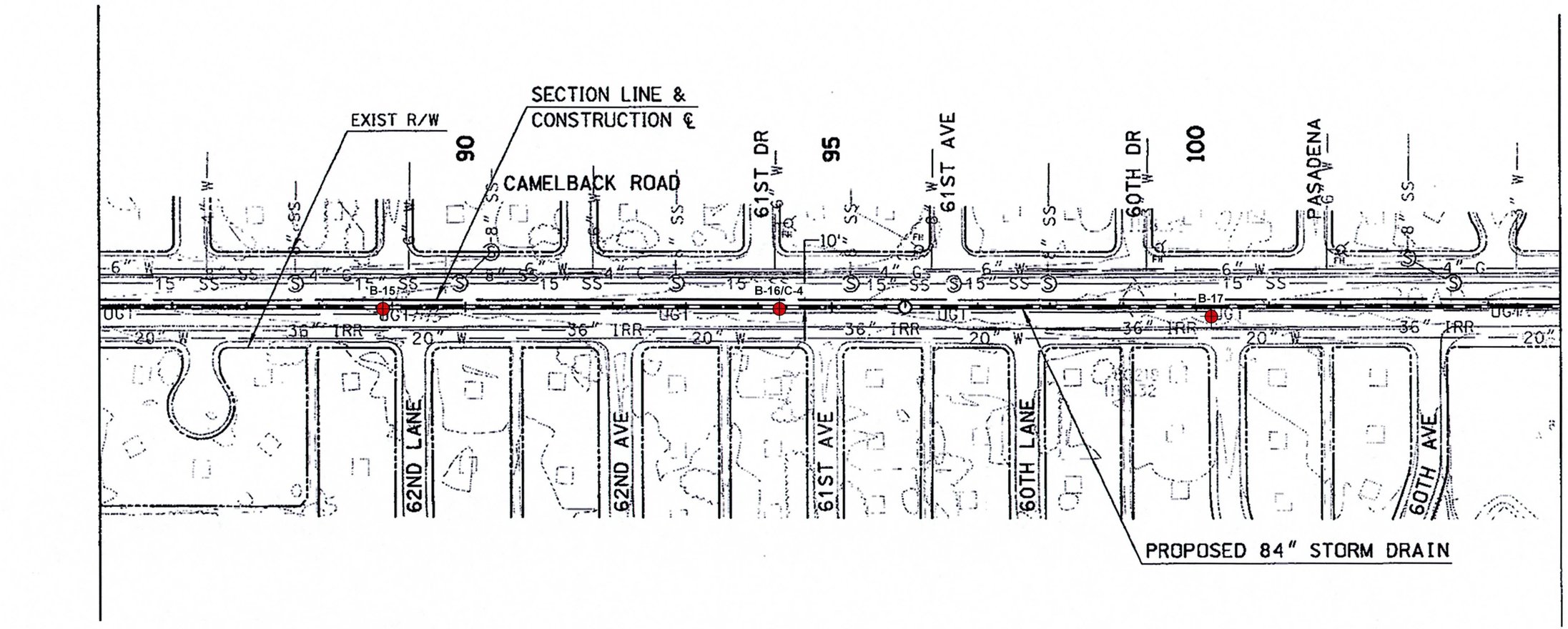


LEGEND

B-4 — Approximate Boring Location

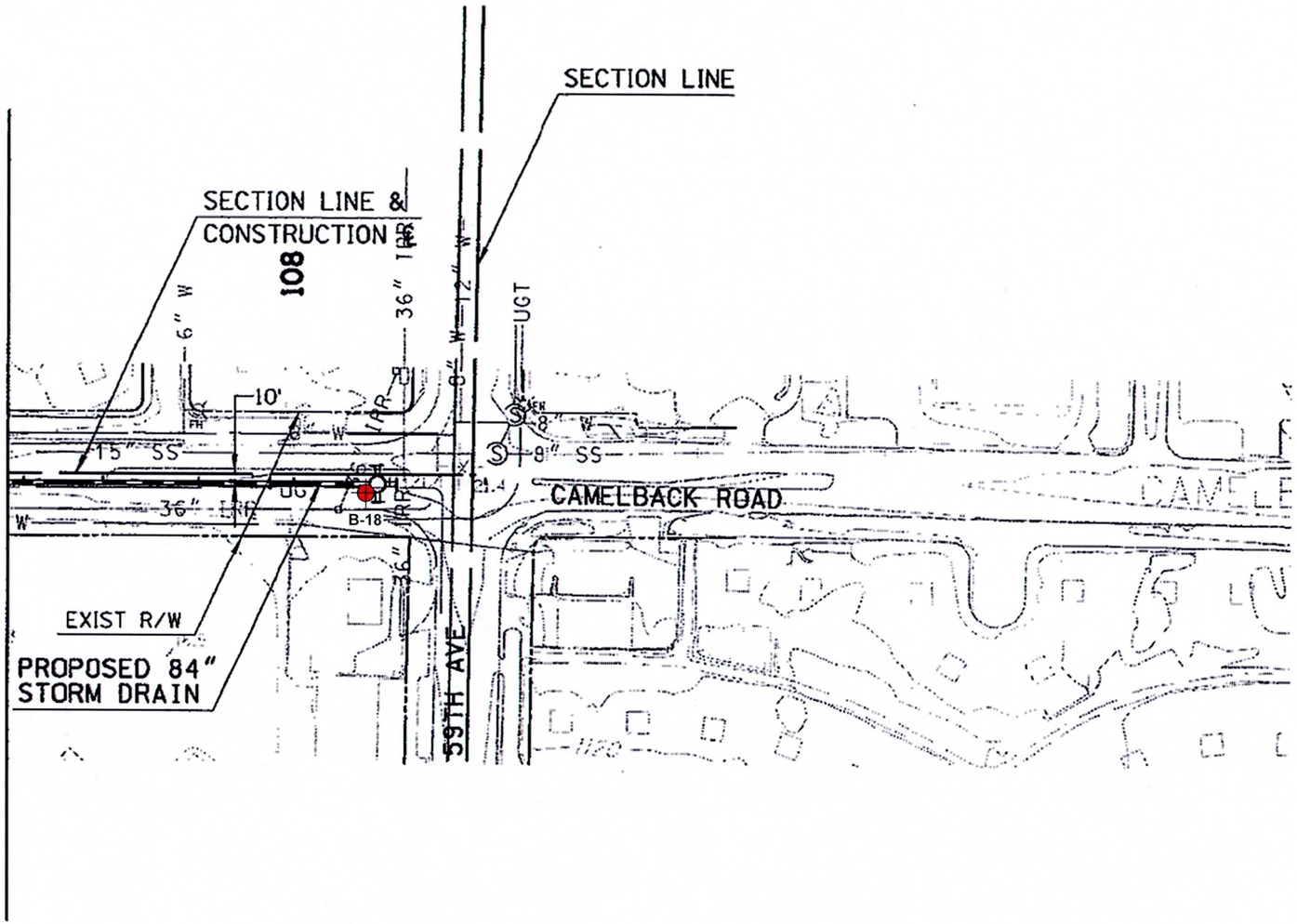
C-4 — Denotes Approximate Coring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore	BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001 / DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2E

file no. 2455blm0209e



LEGEND

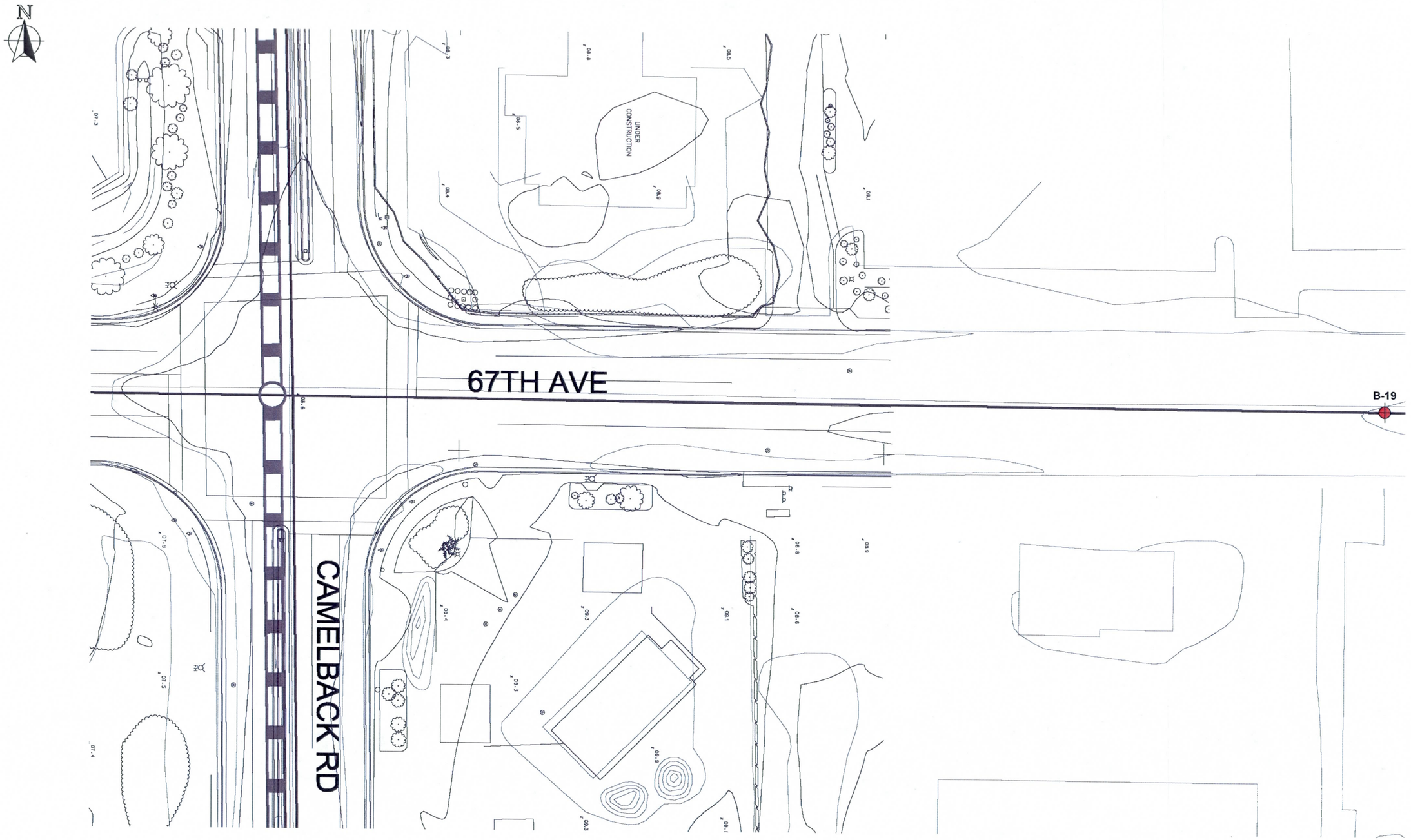
B-18 ⊕ Approximate Boring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore		BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2F

file no. 24355lm0209f



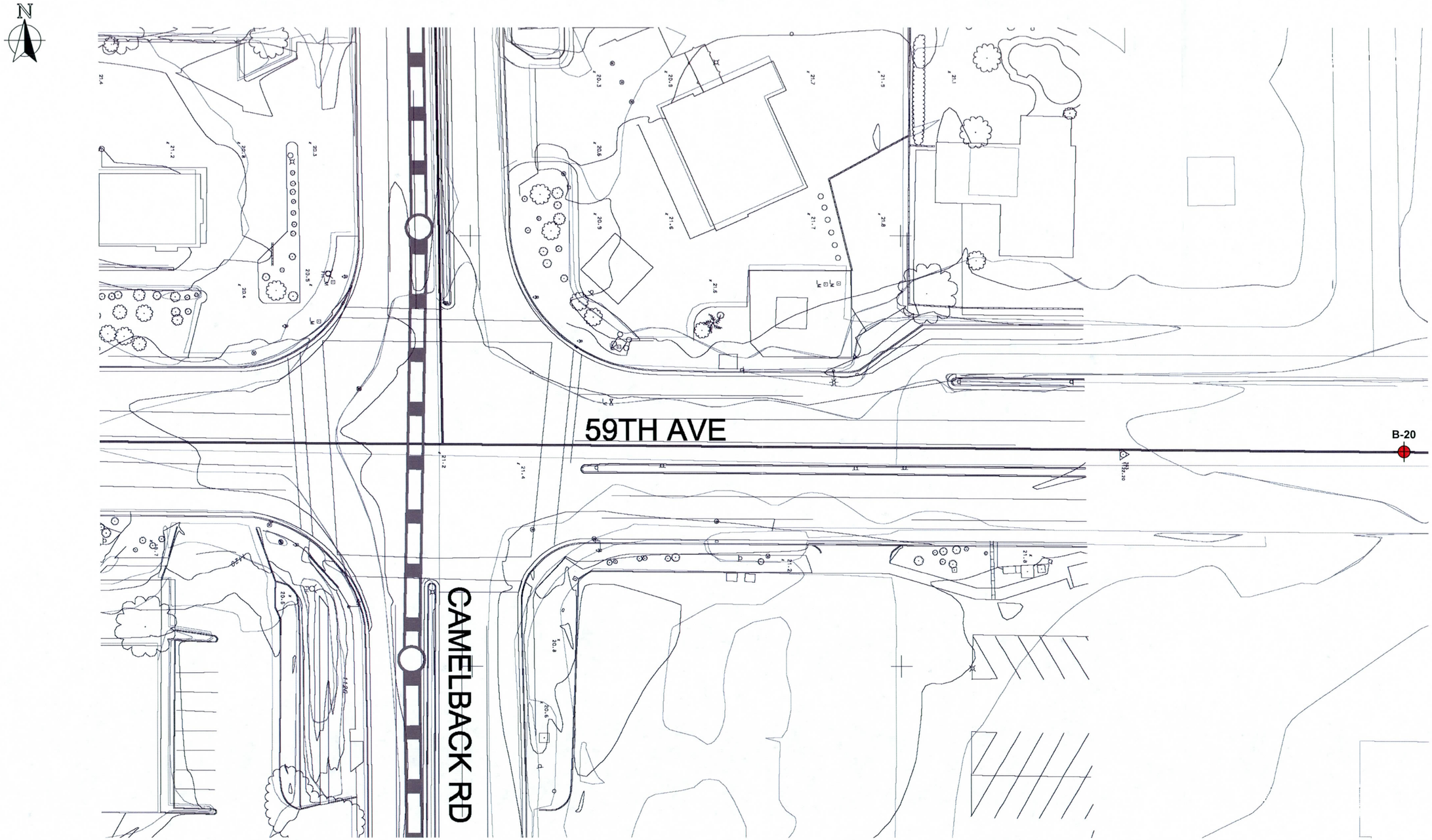
LEGEND

B-19 ⊕ Approximate Boring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore	BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001 / DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2G



LEGEND

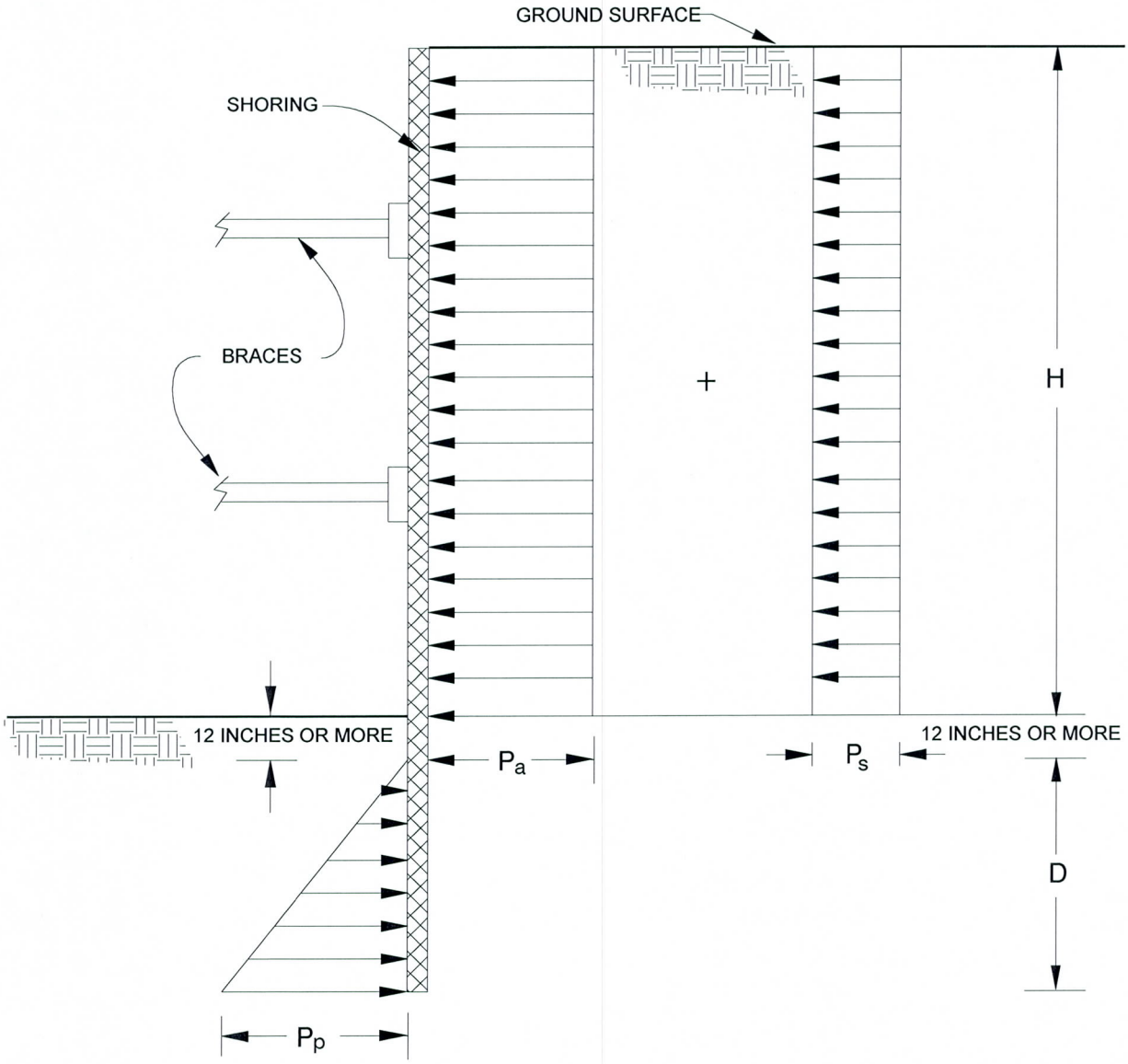
B-20 ⊕ Approximate Boring Location

NOT TO SCALE

Source: Basemap modified after DMJM Harris.

Ninyo & Moore		BORING LOCATION MAP	FIGURE
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	2H

file no. 2455bllm02090H



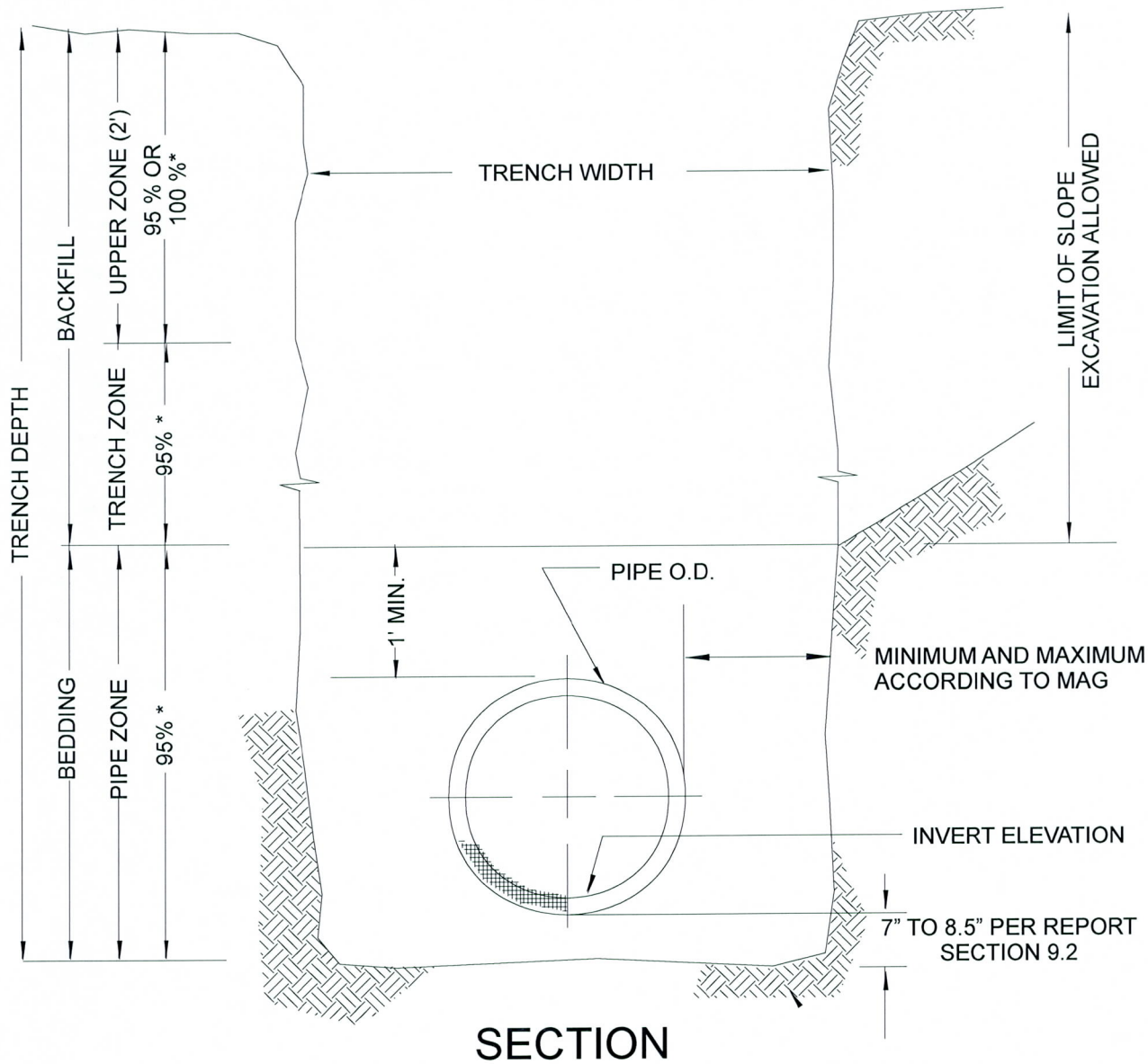
NOTES:

1. APPARENT LATERAL EARTH PRESSURE, P_a
   P_a = 25 H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P_s
   P_s = 120 psf
3. PASSIVE LATERAL EARTH PRESSURE, P_p
   P_p = 300 D psf
4. ASSUMES GROUNDWATER IS NOT PRESENT
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6. H AND D ARE IN FEET

NOT TO SCALE

Ninyo & Moore	LATERAL EARTH PRESSURES FOR BRACED EXCAVATION	FIGURE 3
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA

file no: 2455dtl0209b



SECTION

NOTE

* Indicates minimum relative compaction (see report for details).

Upper zone required for pavement areas only.

Diagram not drawn to scale.

Ninyo & Moore		PIPE BEDDING GUIDELINES	FIGURE 4
PROJECT NO: 602455001	DATE: 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	

file no: 2455dtl0209a

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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) Spoon

Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test spoon 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 spoon was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling 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 spoon, 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 hammer or the kelly bar of the drill rig 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 or bar, 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.

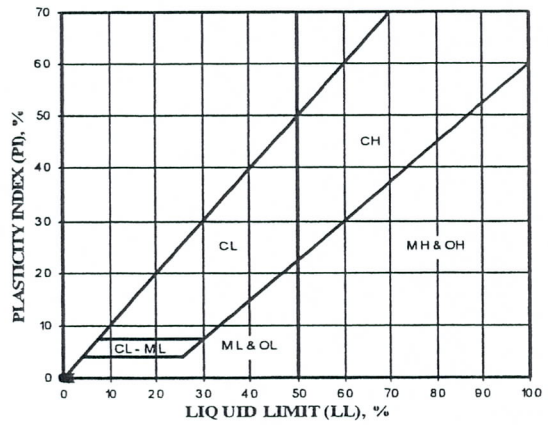
U.S.C.S. METHOD OF SOIL CLASSIFICATION

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
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean
		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

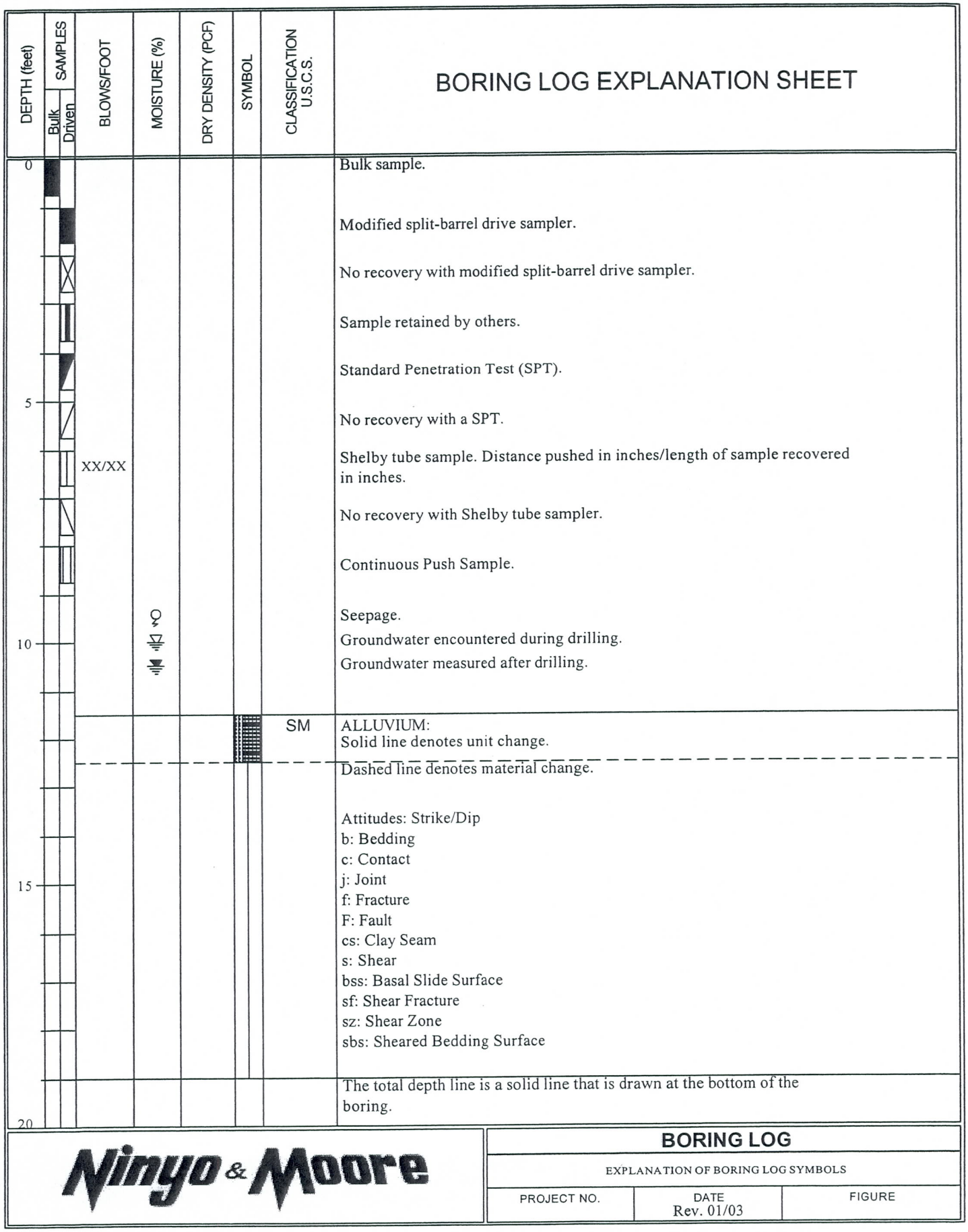
GRAIN SIZE CHART

CLASSIFICATION	RANGE OF GRAIN SIZE	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 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



Ninyo & Moore | U.S.C.S. METHOD OF SOIL CLASSIFICATION


DEPTH (feet)
SAMPLES
Bulk
Driven
BLOWS/FOOT
MOISTURE (%)
DRY DENSITY (PCF)
SYMBOL
CLASSIFICATION U.S.C.S.
BORING LOG EXPLANATION SHEET
0
5
10
15
20
XX/XX
SM
Bulk sample.
Modified split-barrel drive sampler.
No recovery with modified split-barrel drive sampler.
Sample retained by others.
Standard Penetration Test (SPT).
No recovery with a SPT.
Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
No recovery with Shelby tube sampler.
Continuous Push Sample.
Seepage.
Groundwater encountered during drilling.
Groundwater measured after drilling.
ALLUVIUM:
Solid line denotes unit change.
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: Sheared Bedding Surface
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
Rev. 01/03
FIGURE

DATE DRILLED 2/13/09 BORING NO. B-1

GROUND ELEVATION 1,095' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 7 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		43	8.8	116.7			FILL: Brown, damp, dense, silty fine to coarse SAND; trace gravel.
						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
		6					
5							
		14					Loose to medium dense.
						ML	Brown, damp, loose, sandy SILT.
		5					
10							
		45					Dense.
15							
						CL	Brown, damp, very stiff, sandy CLAY.
		13					
20							

Ninyo & Moore

BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-1

DATE DRILLED 2/13/09 BORING NO. B-1

GROUND ELEVATION 1,095' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, very stiff, sandy CLAY.
		66				SM	Brown, damp, dense, silty fine to coarse SAND with gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/13/09 promptly after completion of drilling. 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.
30							
35							
40							

Ninyo & Moore

BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-2

DATE DRILLED 2/9/09 BORING NO. B-2

GROUND ELEVATION 1,096' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 5 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		10					FILL: Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
		19					
5						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
		5					
						ML	Brown, moist, medium dense, sandy SILT.
		18	24.1	85.2			
10							
		9					Trace fine gravel.
15							
						CL	Brown, damp, hard, sandy CLAY; scattered caliche nodules.
		28					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-3

DATE DRILLED 2/9/09 BORING NO. B-2

GROUND ELEVATION 1,096' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, hard, sandy CLAY; scattered caliche nodules.
		32				SM	Brown, damp, dense, silty fine to coarse SAND with gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/9/09 promptly after completion of drilling. 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

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-4

DATE DRILLED 2/9/09 BORING NO. B-3

GROUND ELEVATION 1,098' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 5 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		20					FILL: Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
		5					Loose.
5						CL	ALLUVIUM: Brown, moist, very stiff, sandy CLAY.
		20					
		3					Soft to firm.
10							
		29	17.8	97.5			Trace gravel.
15							
						SC	Brown, moist, medium dense, clayey fine to coarse SAND.
		17					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-5

DATE DRILLED 2/9/09 BORING NO. B-3

GROUND ELEVATION 1,098' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SC	ALLUVIUM: (Continued) Brown, moist, medium dense, clayey fine to coarse SAND.
						SM	Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
	Driven	36					
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/9/09 promptly after completion of drilling. 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

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-6

DATE DRILLED 2/9/09 BORING NO. B-4

GROUND ELEVATION 1,099' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 5 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		10					FILL: Brown, damp, medium dense, silty fine to coarse SAND.
						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
		10					
5							
		5					
		15					Medium dense.
10							
		7					Loose to medium dense.
15							
						SC	Brown, damp, very dense, clayey fine to coarse SAND; scattered caliche nodules.
		50/6"					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-7

DATE DRILLED 2/9/09 BORING NO. B-4

GROUND ELEVATION 1,099' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SC	ALLUVIUM: (Continued) Brown, damp, very dense, clayey fine to coarse SAND; scattered caliche nodules.
		17				SM	Brown, damp, medium dense, silty fine to coarse SAND.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/9/09 promptly after completion of drilling. 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

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-8

DATE DRILLED 2/10/09 BORING NO. B-5

GROUND ELEVATION 1,100' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 5 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		27	11.8	108.8			FILL: Brown, moist, medium dense, silty fine to coarse SAND.
						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
		6					
5							
		14					Loose to medium dense.
		5					Loose.
10							
		19					Medium dense.
15							
						SC	Brown, damp, dense, clayey fine to coarse SAND; trace gravel; scattered caliche nodules.
		25					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-9

DATE DRILLED 2/10/09 BORING NO. B-5

GROUND ELEVATION 1,100' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							SC	ALLUVIUM: (Continued) Brown, damp, dense, clayey fine to coarse SAND; trace gravel; scattered caliche nodules.
		■	50	11.4	102.0			
25								Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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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CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-10

DATE DRILLED 2/10/09 BORING NO. B-6

GROUND ELEVATION 1,102' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 7 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		8					FILL:
							Brown, damp, medium dense, silty fine to coarse SAND.
		16					
5							
						SM	ALLUVIUM:
		5					Brown, damp, loose, silty fine to coarse SAND.
		18					Medium dense.
10							
		14					
15							
						SC	Brown, damp, very dense, clayey fine to coarse SAND; scattered caliche nodules.
		50/6"					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-11

DATE DRILLED 2/10/09 BORING NO. B-6

GROUND ELEVATION 1,102' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SC	ALLUVIUM: (Continued) Brown, damp, very dense, clayey fine to coarse SAND; scattered caliche nodules.
		15				SM	Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-12

DATE DRILLED 2/10/09 BORING NO. B-7

GROUND ELEVATION 1,104' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 9.5 inches thick. Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		17				SM	FILL: Brown, damp, medium dense, silty fine to coarse SAND.
		4				CL-ML	ALLUVIUM: Brown, damp, firm, silty CLAY; few to little sand.
5		17	16.5	85.6			Very stiff.
		5					Firm to stiff.
10							
		26				SC	Brown, damp, medium dense, clayey fine to coarse SAND.
15							
		28					Dense; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-13

DATE DRILLED 2/10/09 BORING NO. B-7

GROUND ELEVATION 1,104' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SM	ALLUVIUM: (Continued) Brown, damp, dense, clayey fine to coarse SAND; scattered caliche nodules.
		50/6"	9.1	105.3			Very dense.
							Total Depth = 24 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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.
25							
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35							
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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-14

DATE DRILLED 2/10/09 BORING NO. B-8

GROUND ELEVATION 1,105' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 7.5 inches thick.
							Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		8				CL	FILL: Brown, damp, stiff, sandy CLAY.
		13				CL	ALLUVIUM: Brown, moist, stiff to very stiff, sandy CLAY.
5		3					Soft to firm.
		15	38.2	71.1		ML	Brown, moist, medium dense, sandy SILT.
10		6					Loose.
15		78				CL	Brown, damp, hard, sandy CLAY; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-15

DATE DRILLED 2/10/09 BORING NO. B-8

GROUND ELEVATION 1,105' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, hard, sandy CLAY; scattered caliche nodules.
		27					
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-16

DATE DRILLED 2/10/09 BORING NO. B-9

GROUND ELEVATION 1,107' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 6 inches thick.
						CL	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		14	21.3	102.0			FILL: Brown, moist, very stiff, CLAY; few to little sand.
		4				CL	ALLUVIUM: Brown, moist, firm, sandy CLAY.
5		13				SM	Brown, damp, loose, silty fine to coarse SAND.
		3				CL	Brown, moist, soft to firm, sandy CLAY.
10		12					Stiff.
15						SC	Brown, moist, medium dense, clayey fine to coarse SAND; scattered caliche nodules.
		14					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-17

DATE DRILLED 2/10/09 BORING NO. B-9

GROUND ELEVATION 1,107' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SC	ALLUVIUM: (Continued) Brown, moist, medium dense, clayey fine to coarse SAND; scattered caliche nodules.
		42	17.1	107.8			Dense.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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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CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-18

DATE DRILLED 2/12/09 BORING NO. B-10

GROUND ELEVATION 1,109' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 9 inches thick. Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		10				CL	FILL: Brown, damp, stiff to very stiff, sandy CLAY; scattered black filaments.
		9	10.8	102.2		SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
5		4					
						CL	Brown, moist, stiff, sandy CLAY; scattered caliche nodules.
		9					
10							
		3					Soft to firm; scattered caliche filaments and nodules.
15							
		54					Hard.
20							

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CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-19

DATE DRILLED 2/12/09 BORING NO. B-10

GROUND ELEVATION 1,109' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, hard, sandy CLAY; scattered caliche filaments and nodules.
		27				SC	Brown, damp, dense, clayey fine to coarse SAND; trace gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/12/09 promptly after completion of drilling. 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.
30							
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CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-20

DATE DRILLED 2/10/09 BORING NO. B-11

GROUND ELEVATION 1,110' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2.5 inches thick.
							AGGREGATE BASE: Approximately 7.5 inches thick.
						CL	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		15					FILL: Brown, moist, very stiff, sandy CLAY.
						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
5		4					
		11					
						ML	Brown, damp, loose, sandy SILT.
		5					
10							
		12					
15							
						CL	Brown, damp, very stiff, sandy CLAY.
		19					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-21

DATE DRILLED 2/10/09 BORING NO. B-11

GROUND ELEVATION 1,110' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, very stiff, sandy CLAY.
		50/6"					Hard; scattered caliche nodules.
							Total Depth = 24 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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.
25							
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-22

DATE DRILLED 2/10/09 BORING NO. B-12

GROUND ELEVATION 1,111' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 7 inches thick.
						CL	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		12					FILL: Brown, damp, very stiff, sandy CLAY.
						SM	ALLUVIUM: Brown, damp, loose, silty fine to coarse SAND.
5		10					
		4					
						CL	Brown, moist, stiff to very stiff, sandy CLAY.
		13	19.9	81.5			
10							
		14					Very stiff.
15							
		27					Hard; trace gravel.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-23

DATE DRILLED 2/10/09 BORING NO. B-12

GROUND ELEVATION 1,111' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, damp, hard, sandy CLAY; trace gravel.
		50				SM	Brown, damp, very dense, silty fine to coarse SAND with gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/10/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-24

DATE DRILLED 2/11/09 BORING NO. B-13

GROUND ELEVATION 1,113' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 9 inches thick.
							Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		20				CL	FILL:
							Brown, damp, very stiff, sandy CLAY.
						SM	ALLUVIUM:
		3					Brown, damp, very loose to loose, silty fine to coarse SAND.
5							
		14					Loose to medium dense.
						CL	Brown, moist, soft to firm, sandy CLAY; trace gravel.
		3					
10							
		29	18.8	99.9			Hard.
15							
		6					Stiff.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-25

DATE DRILLED 2/11/09 BORING NO. B-13

GROUND ELEVATION 1,113' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, moist, stiff, sandy CLAY; trace gravel.
		40					Hard.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-26

DATE DRILLED 2/11/09 BORING NO. B-14

GROUND ELEVATION 1,114' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 8.5 inches thick.
							Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
						SM	FILL:
		10					Brown, damp, medium dense, silty fine to coarse SAND; few gravel.
		13					
5							
						CL	ALLUVIUM:
		5					Brown, moist, firm to stiff, sandy CLAY.
		14					Very stiff.
10							
		8					Stiff.
15							
		50/5"					Hard; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-27

DATE DRILLED 2/11/09 BORING NO. B-14

GROUND ELEVATION 1,114' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, moist, hard, sandy CLAY; scattered caliche nodules.
		37					
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-28

DATE DRILLED 2/11/09 BORING NO. B-15

GROUND ELEVATION 1,115' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 8 inches thick.
						SM	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		23	9.8	122.2			FILL: Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
		8					
5						CL	ALLUVIUM: Brown, moist, stiff, sandy CLAY.
		12					
		5					Firm to stiff.
10						ML	Brown, moist, loose, sandy SILT.
		10	24.4	75.1			
15						CL	Brown, moist, very stiff, sandy CLAY; scattered caliche nodules.
		18					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-29

DATE DRILLED 2/11/09 BORING NO. B-15

GROUND ELEVATION 1,115' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, moist, very stiff, sandy CLAY; scattered caliche nodules.
		48					Hard.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-30

DATE DRILLED 2/11/09 BORING NO. B-16

GROUND ELEVATION 1,118' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 9 inches thick. Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		7				SM	FILL: Brown, damp, loose to medium dense, silty fine to coarse SAND.
		7	15.9	92.0		ML	ALLUVIUM: Brown, moist, loose, sandy SILT.
5		4					
		14					Loose to medium dense.
10							
		9				CL	Brown, moist, stiff, sandy CLAY.
15							
		26				ML	Brown, moist, medium dense, sandy SILT; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-31

DATE DRILLED 2/11/09 BORING NO. B-16

GROUND ELEVATION 1,118' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						ML	ALLUVIUM: (Continued) Brown, moist, medium dense, sandy SILT; scattered caliche nodules.
		17				SM	Brown, damp, medium dense, silty fine to coarse SAND; trace gravel.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-32

DATE DRILLED 2/11/09 BORING NO. B-17

GROUND ELEVATION 1,119' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 5 inches thick.
						ML	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		14	26.1	96.1			ALLUVIUM: Brown, moist, very stiff, SILT; trace to few sand; trace gravel.
		2					Soft.
5		9					Stiff.
						CL	Brown, moist, soft to firm, sandy CLAY.
		3					
10							
		9					Stiff.
15							
		16					Very stiff; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-33

DATE DRILLED 2/11/09 BORING NO. B-17

GROUND ELEVATION 1,119' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							CL	ALLUVIUM: (Continued) Brown, moist, very stiff, sandy CLAY; scattered caliche nodules.
			31				SM	Brown, moist, medium dense, silty fine to coarse SAND; trace to few gravel.
25								Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30								
35								
40								

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-34

DATE DRILLED 2/11/09 BORING NO. B-18

GROUND ELEVATION 1,121' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 4.5 inches thick.
						GM	AGGREGATE BASE: Approximately 9 inches thick. Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		8				ML	ALLUVIUM: Brown, moist, stiff, SILT; trace sand.
		6	23.0	83.2			
5		4					Firm.
		8					Stiff.
10							
		3				CL	Brown, moist, soft to firm, sandy CLAY; scattered caliche nodules.
15							
		14				SC	Brown, damp, medium dense, clayey fine to coarse SAND; trace fine gravel.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-35

DATE DRILLED 2/11/09 BORING NO. B-18

GROUND ELEVATION 1,121' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						SC	ALLUVIUM: (Continued) Brown, damp, medium dense, clayey fine to coarse SAND; trace fine gravel.
		20					Medium dense to dense.
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/11/09 promptly after completion of drilling. 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.
30							
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40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-36

DATE DRILLED 2/13/09 BORING NO. B-19

GROUND ELEVATION 1,110' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 6 inches thick. Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
							CONCRETE: Approximately 6 inches thick.
						ML	ALLUVIUM: Brown, moist, very loose to loose, sandy SILT.
		3					
5							
		12					Loose.
		4					
10							
						CL	Brown, moist, stiff, CLAY with sand; trace gravel.
		10	24.9	89.6			
15							
		7					
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-37

DATE DRILLED 2/13/09 BORING NO. B-19

GROUND ELEVATION 1,110' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							CL	ALLUVIUM: (Continued) Brown, moist, stiff, CLAY with sand; trace gravel.
							SM	Brown, damp, medium dense, silty fine to coarse SAND with gravel.
			31	3.9	120.8			
25								Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/13/09 promptly after completion of drilling. 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.
30								
35								
40								

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-38

DATE DRILLED 2/12/09 BORING NO. B-20

GROUND ELEVATION 1,124' ± MSL SHEET 1 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

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.
						GM	AGGREGATE BASE: Approximately 6 inches thick.
						CL	Brown, damp, medium dense, silty fine to coarse GRAVEL with sand.
		8					FILL: Brown, damp, stiff, sandy CLAY.
						ML	Brown, damp, loose, sandy SILT.
		10					
5							
						SM	Brown, damp, loose, silty fine to coarse SAND.
		6					
						CL	ALLUVIUM: Brown, moist, very stiff, CLAY; trace sand.
		16	21.2	78.8			
10							
		6					Stiff.
15							
		50/4"					Hard; scattered caliche nodules.
20							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-39

DATE DRILLED 2/12/09 BORING NO. B-20

GROUND ELEVATION 1,124' ± MSL SHEET 2 OF 2

METHOD OF DRILLING Diedrich D-50, 8" Diameter Hollow-Stem Auger (D & S Drilling)

DRIVE WEIGHT 140 lbs. (Automatic) DROP 30"

SAMPLED BY DM LOGGED BY DM REVIEWED BY JSR

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (Continued) Brown, moist, hard, sandy CLAY; scattered caliche nodules.
		59					
25							Total Depth = 25 feet. Groundwater not encountered during drilling. Backfilled and asphalt patched on 2/12/09 promptly after completion of drilling. 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.
30							
35							
40							

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BORING LOG

CAMELBACK ROAD STORM DRAIN
GLENDALE, ARIZONA

PROJECT NO.	DATE	FIGURE
602455001	10/09	A-40

APPENDIX B

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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 presented on Figures B-1 through B-12. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System.

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 Unified Soil Classification System. The test results and classifications are shown on Figures B-13 through B-14.

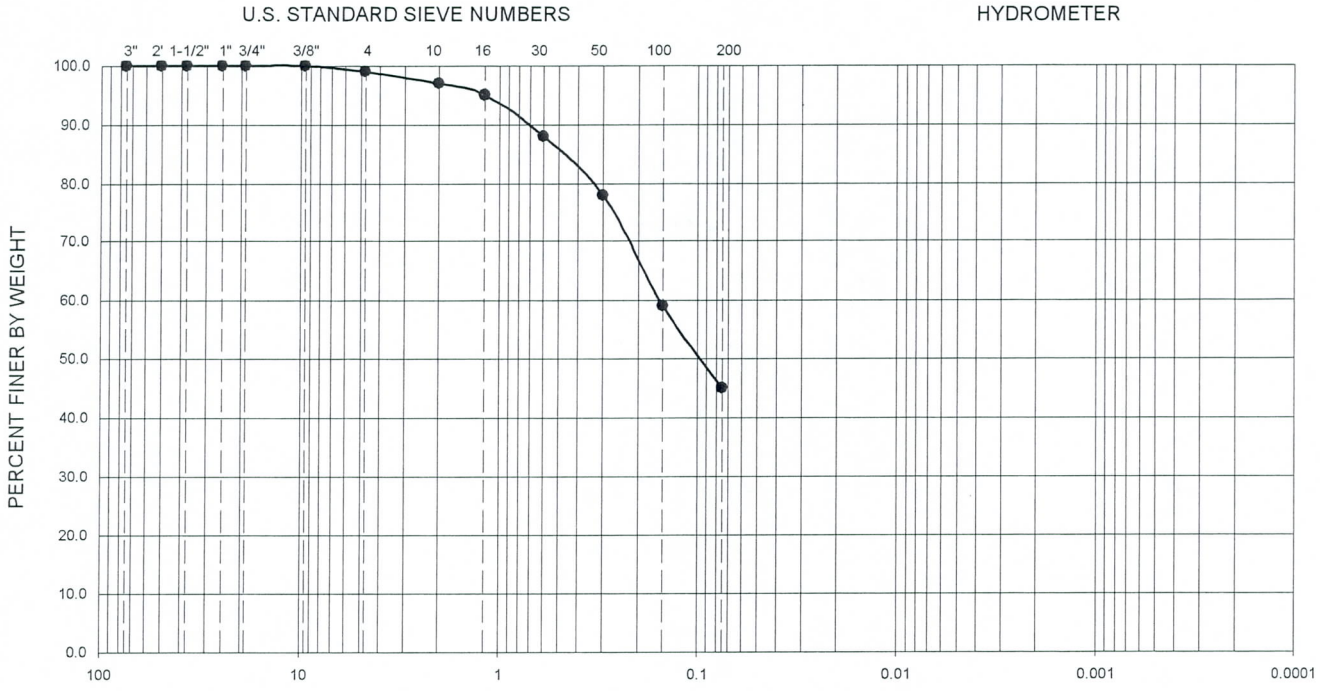
Consolidation (Response-to-Wetting)

Hydroconsolidation 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-15 through B-19.

Soil Corrosivity Tests

Soil pH and minimum resistivity tests were performed on representative samples in general accordance with Arizona Test 236b. Soluble sulfate and chloride content tests were also performed on these samples in general accordance with Arizona Test 733 and 736, respectively. The test results are presented on Figure B-20.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



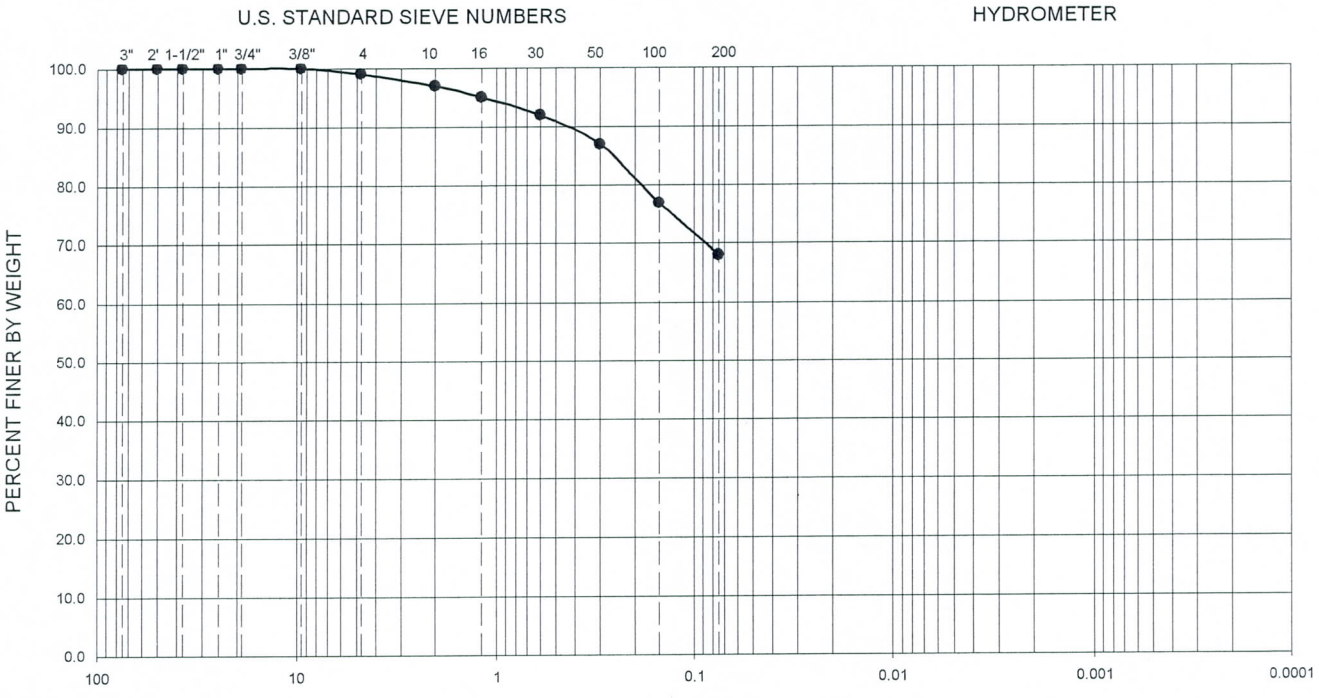
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-1	1-2.5	NP	NP	NP	--	--	--	--	--	45	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

NP - INDICATES NON-PLASTIC

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-1
602455001	10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

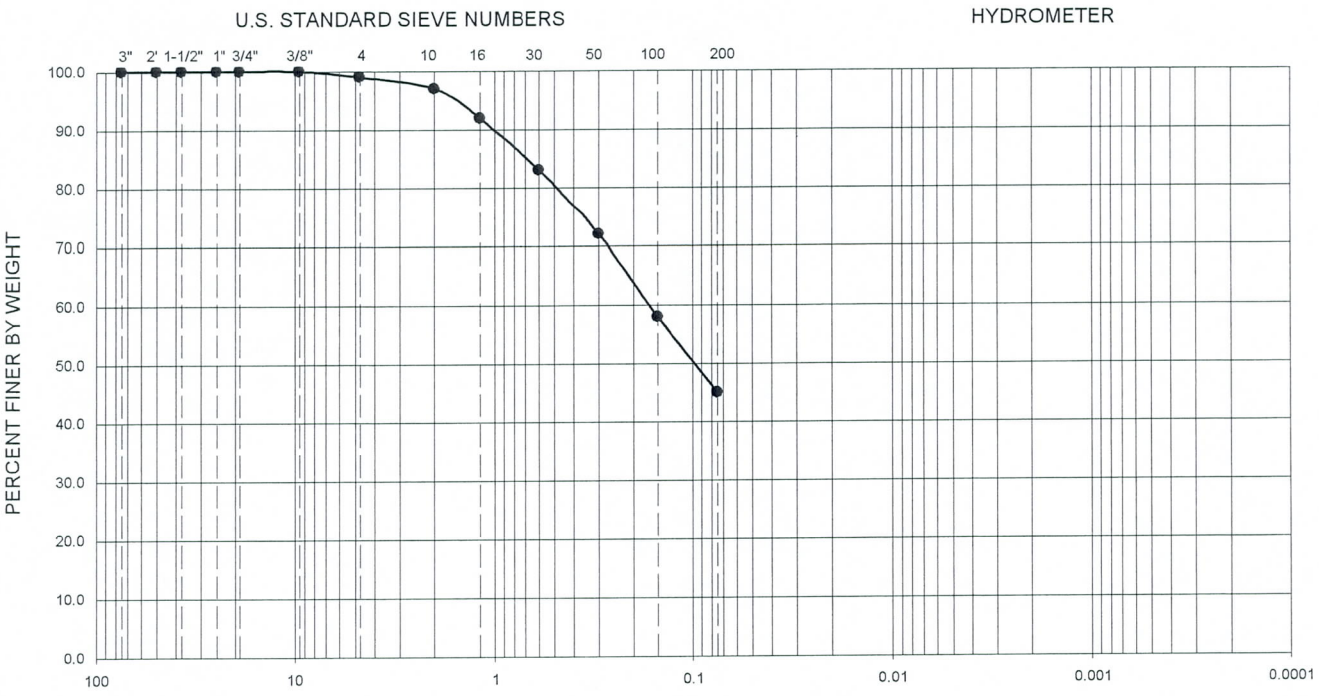


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-3	13.5-15	47	22	25	--	--	--	--	--	68	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-2
602455001	10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

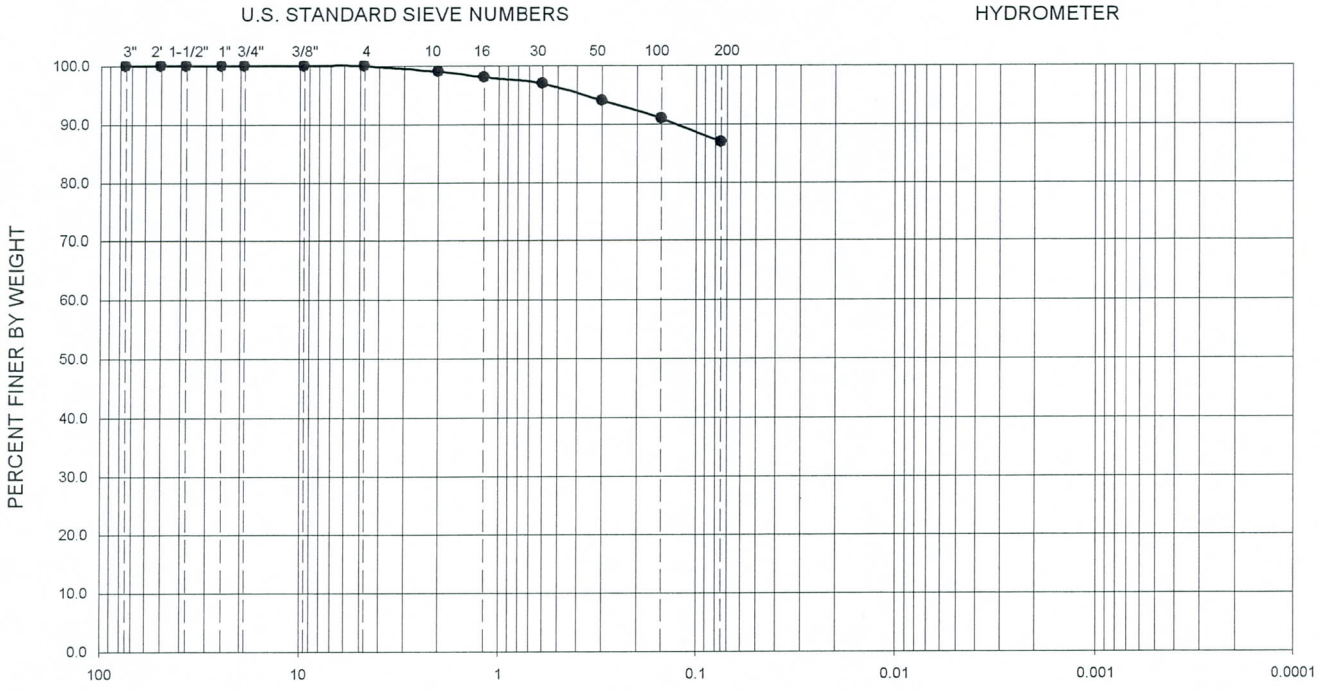


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-5	23.5-25	39	20	19	--	--	--	--	--	45	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-3
602455001 / 10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

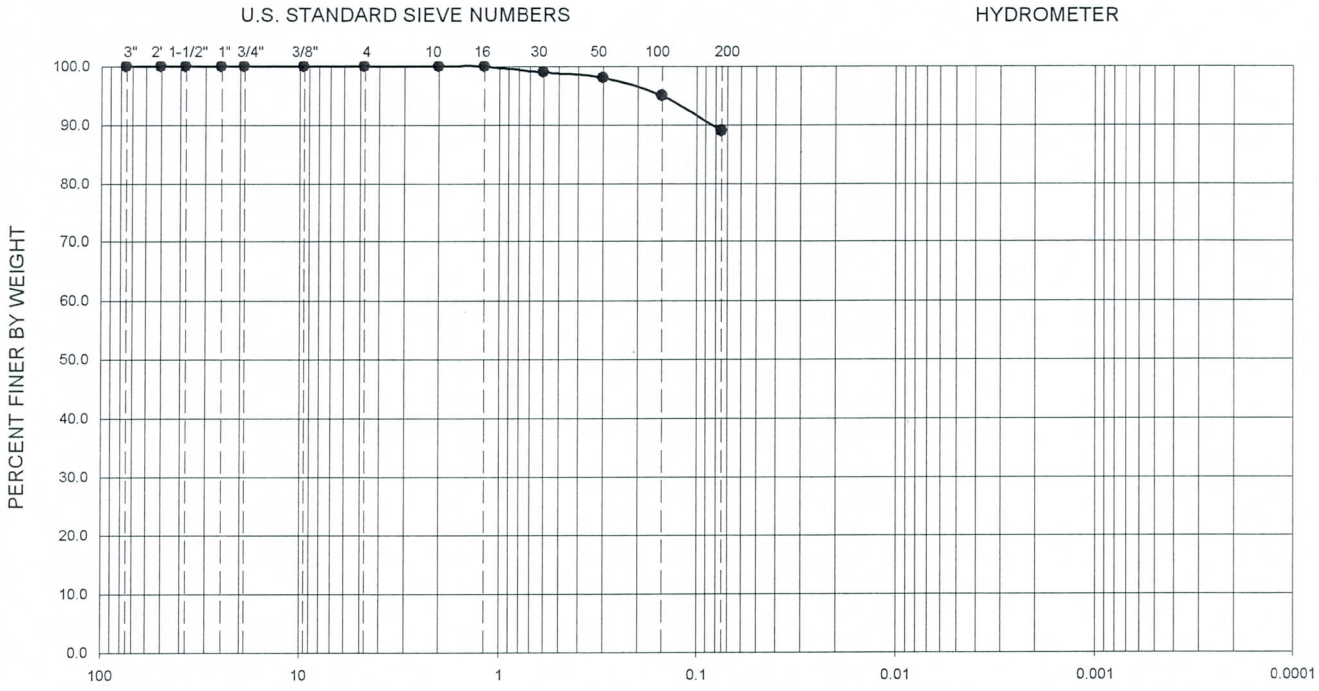


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-7	6-7.5	28	21	7	--	--	--	--	--	87	CL-ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-4
602455001 / 10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

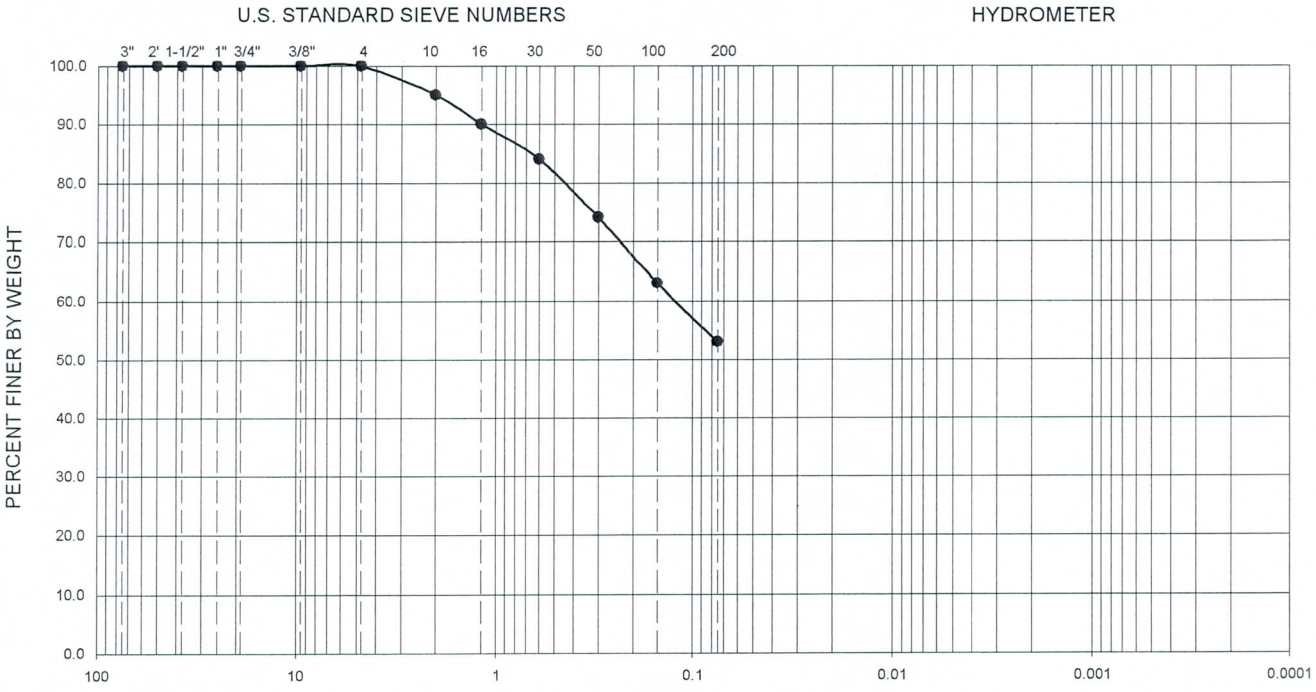


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-9	1-2.5	30	15	15	--	--	--	--	--	89	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

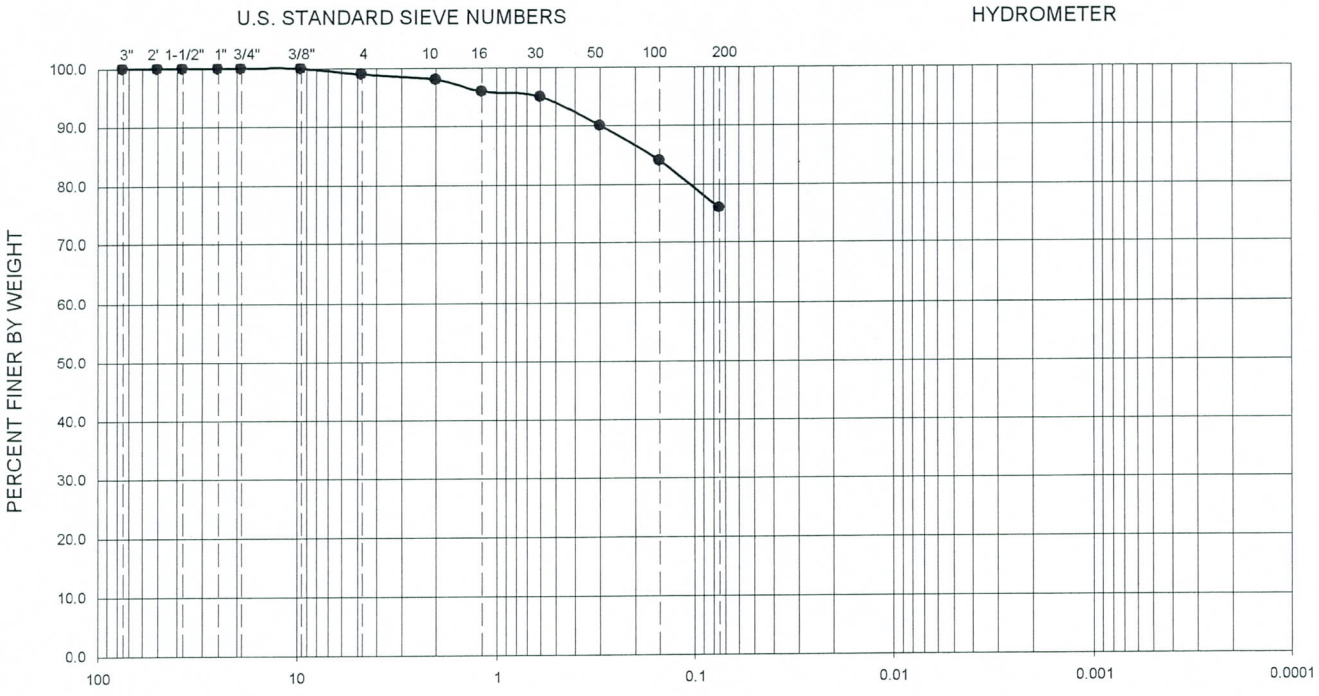


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-11	1-2.5	27	16	11	--	--	--	--	--	53	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-6
602455001	10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

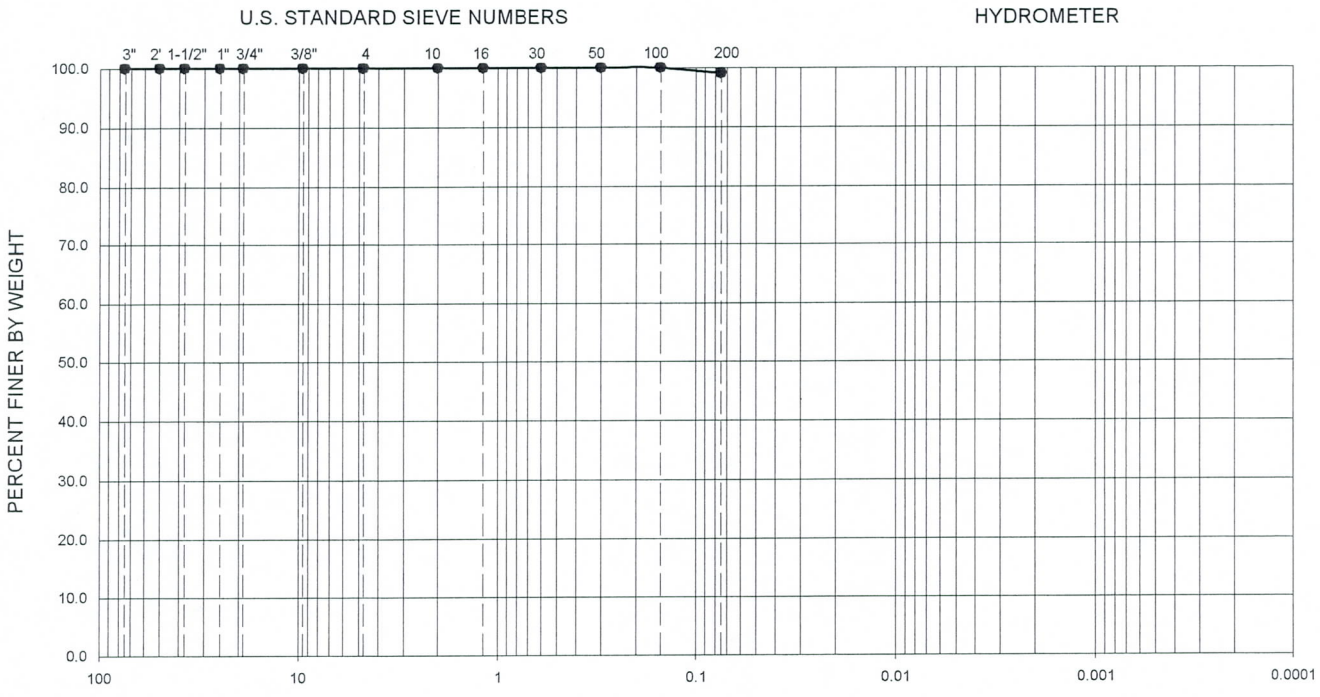


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-13	13.5-15	45	21	24	--	--	--	--	--	76	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-7
602455001	10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



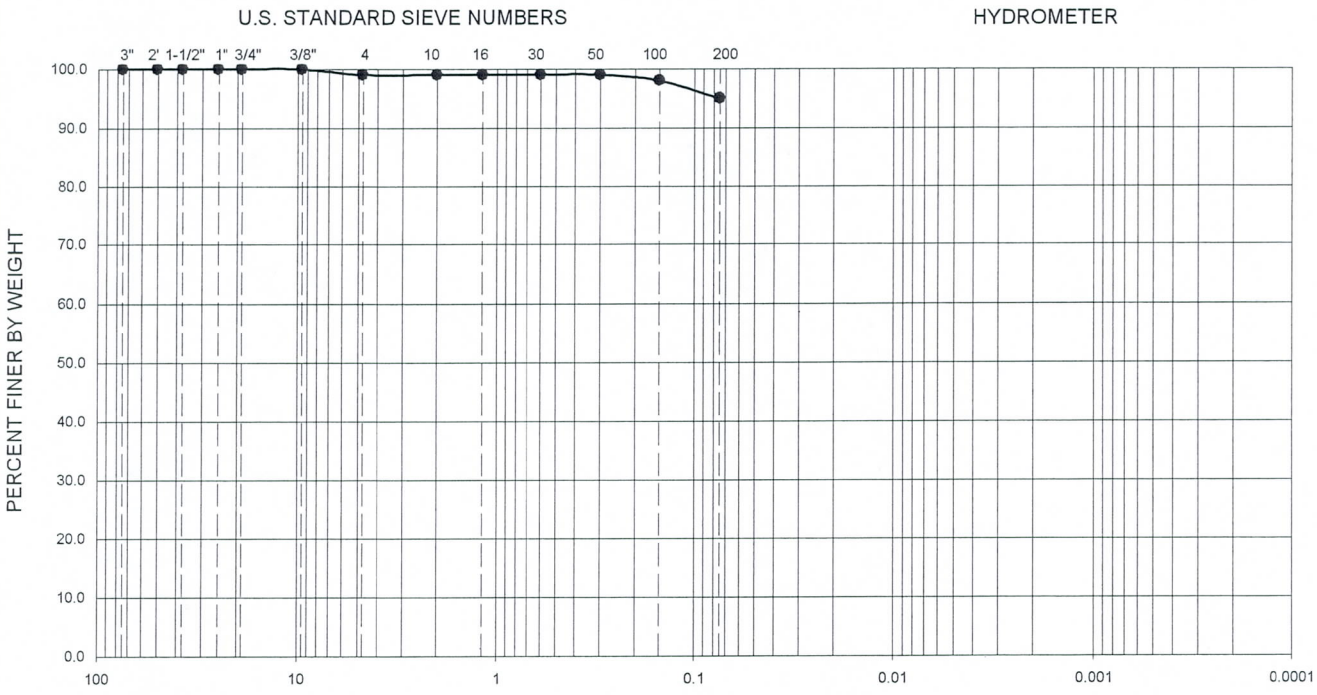
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-15	13.5-15	NP	NP	NP	--	--	--	--	--	99	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

NP - INDICATES NON-PLASTIC

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-8
602455001	10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



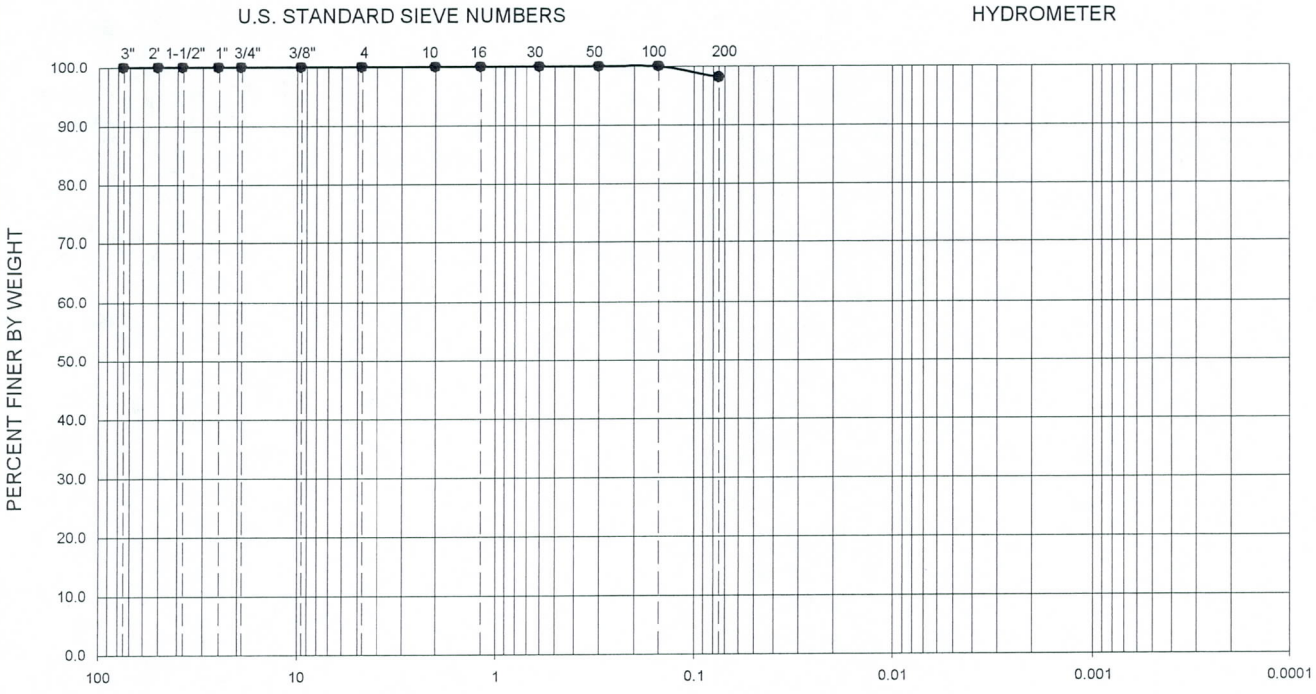
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-17	1-2.5	NP	NP	NP	--	--	--	--	--	95	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

NP - INDICATES NON-PLASTIC

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-9

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

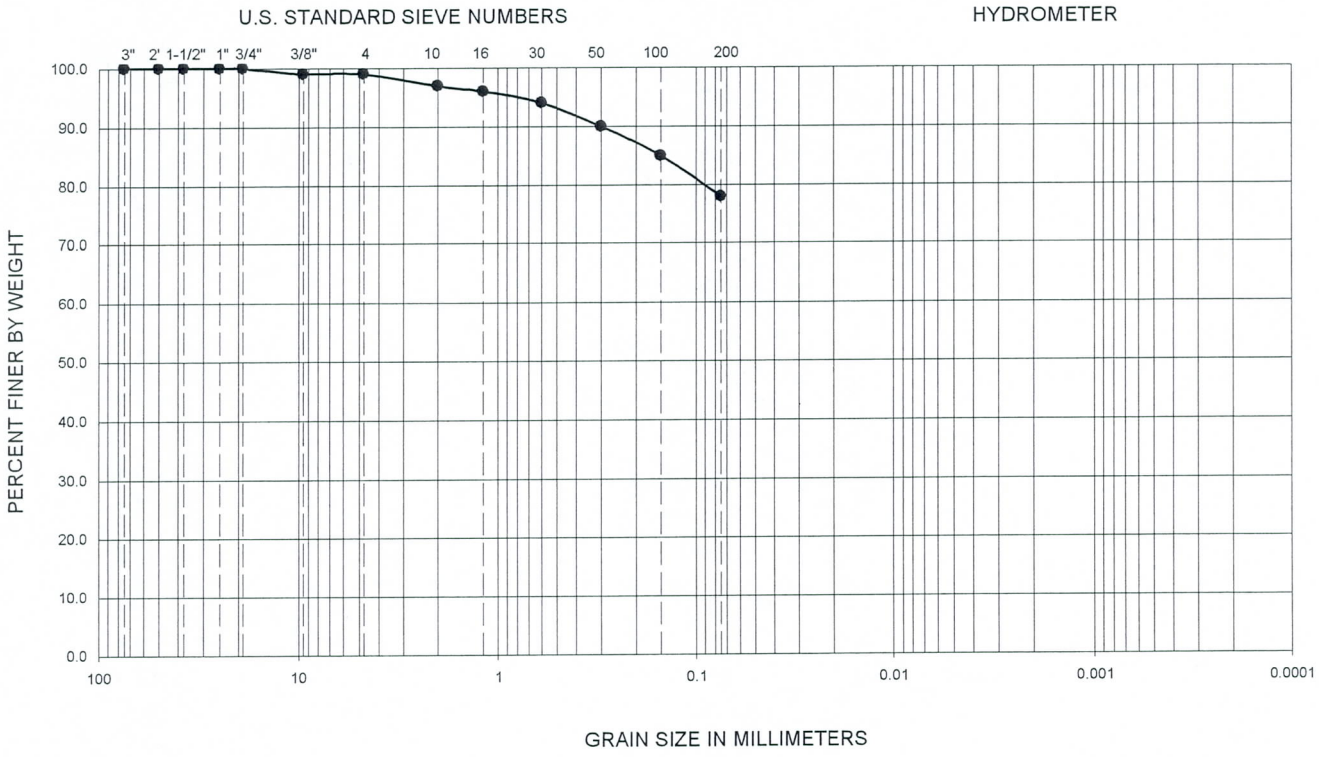


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-18	3.5-5	34	25	9	--	--	--	--	--	98	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-10
602455001 / 10/09		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

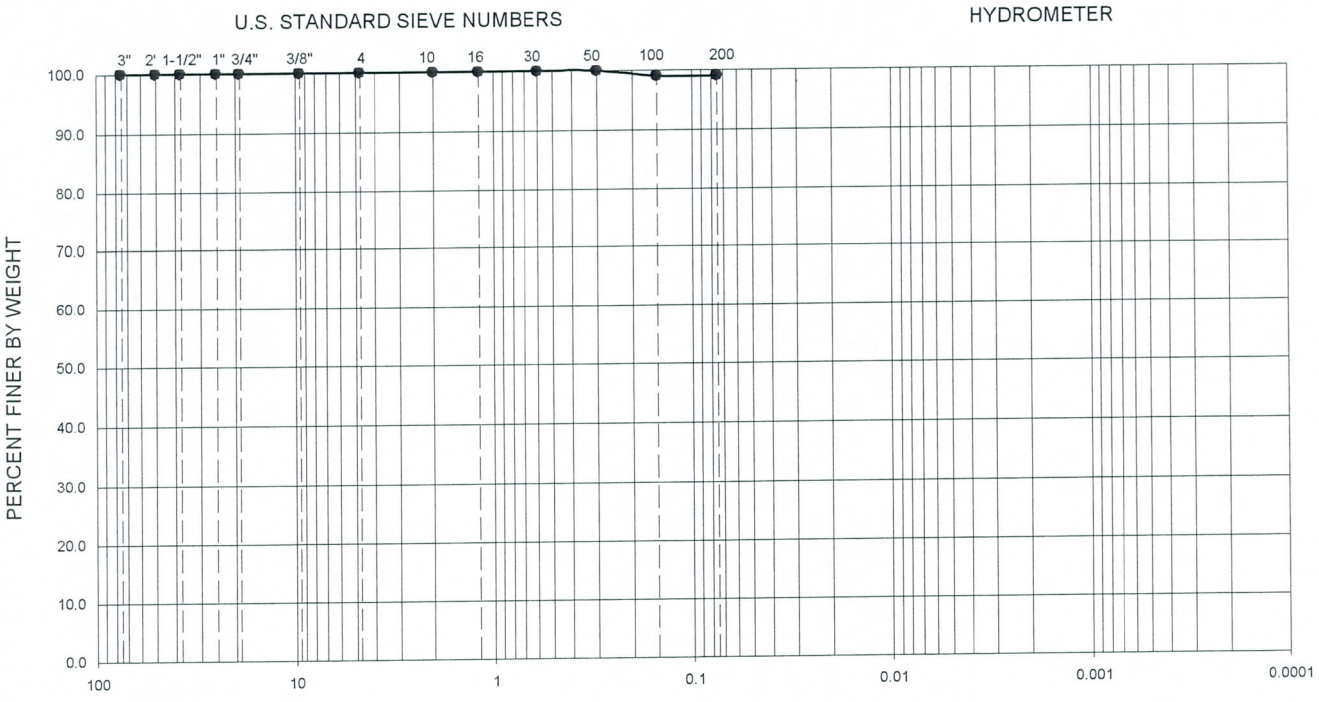


Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-19	13.5-15	30	22	8	--	--	--	--	--	78	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-11

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



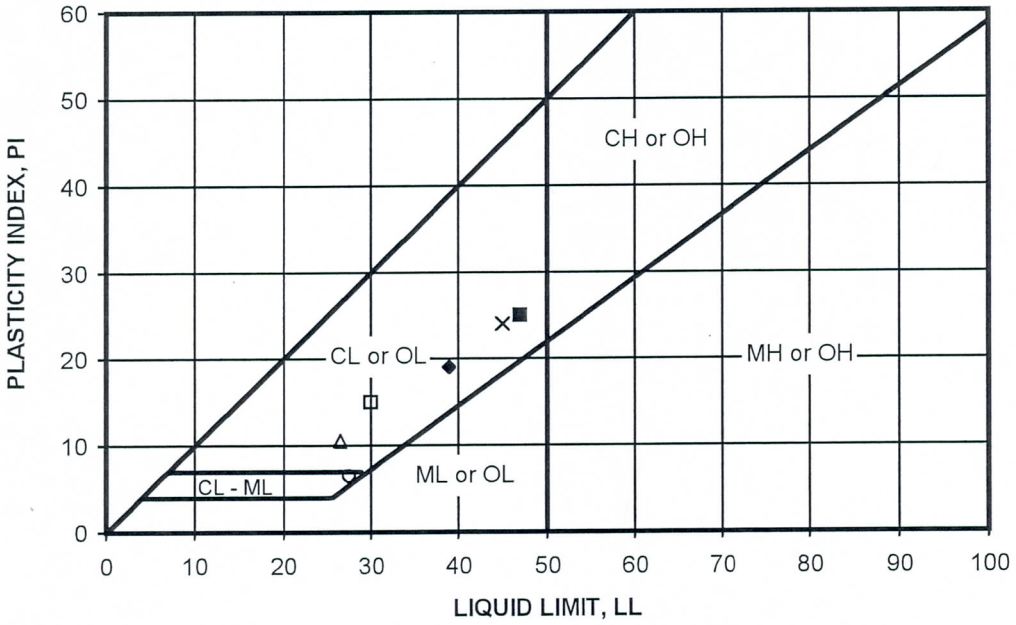
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-20	8.5-10	34	20	14	--	--	--	--	--	99	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63 (02)

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-12

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	1-2.5	NP	NP	NP	ML	SM
■	B-3	13.5-15	47	22	25	CL	CL
◆	B-5	23.5-25	39	20	19	CL	SC
○	B-7	6-7.5	28	21	7	CL-ML	CL-ML
□	B-9	1-2.5	30	15	15	CL	CL
△	B-11	1-2.5	27	16	11	CL	CL
X	B-13	13.5-15	45	21	24	CL	CL
+	B-15	13.5-15	NP	NP	NP	ML	ML

NP - INDICATES NON-PLASTIC

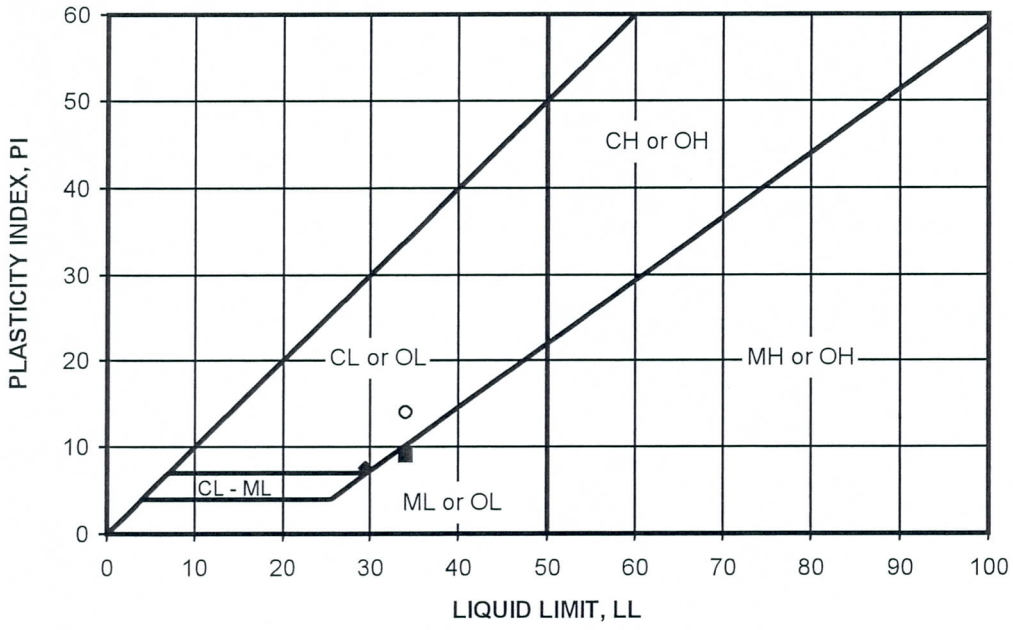


PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-05

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-13

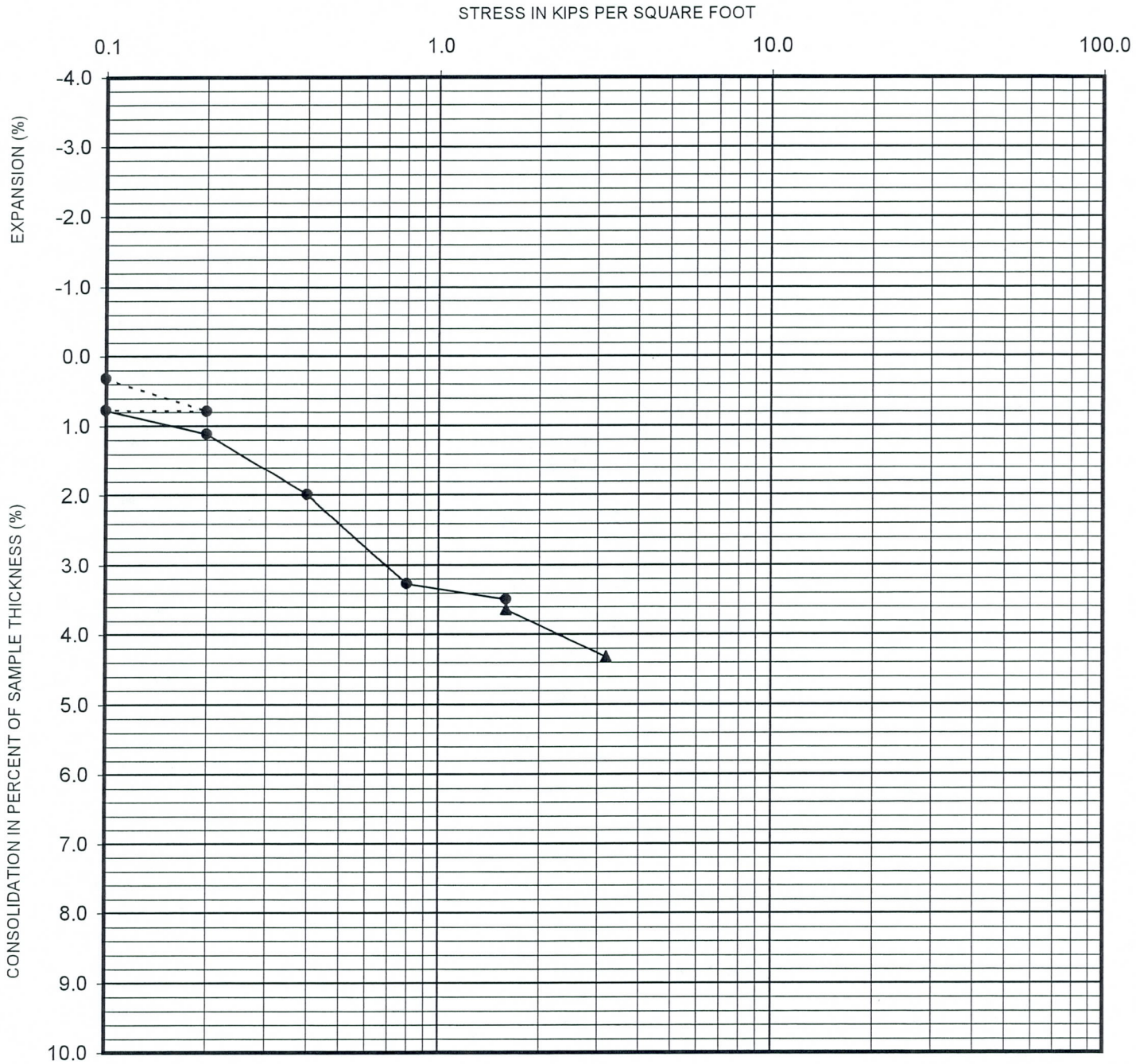
SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-17	1-2.5	NP	NP	NP	ML	ML
■	B-18	3.5-5	34	25	9	ML	ML
◆	B-19	13.5-15	30	22	8	CL	CL
○	B-20	8.5-10	34	20	14	CL	CL

NP - INDICATES NON-PLASTIC



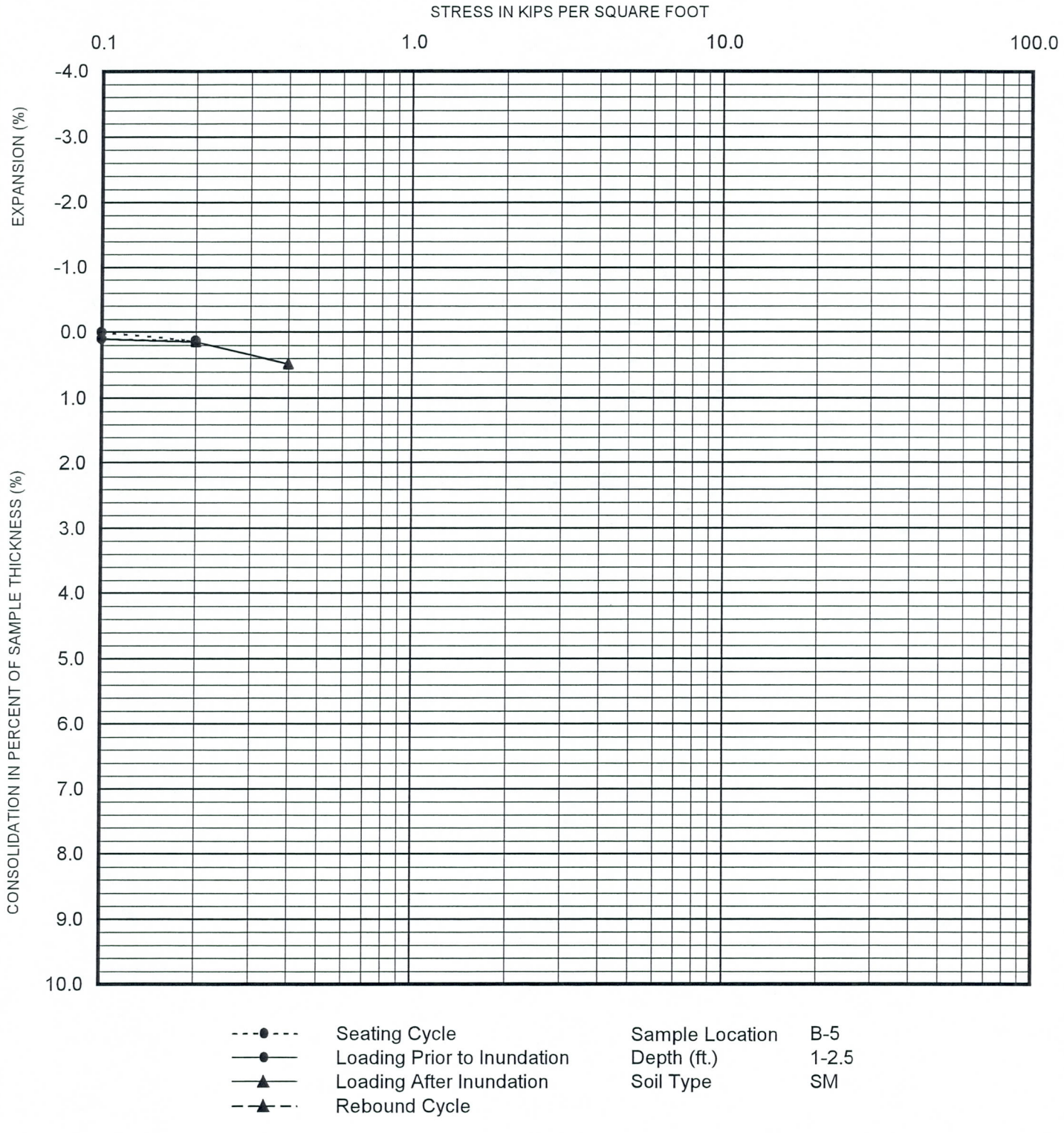
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-05

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-14



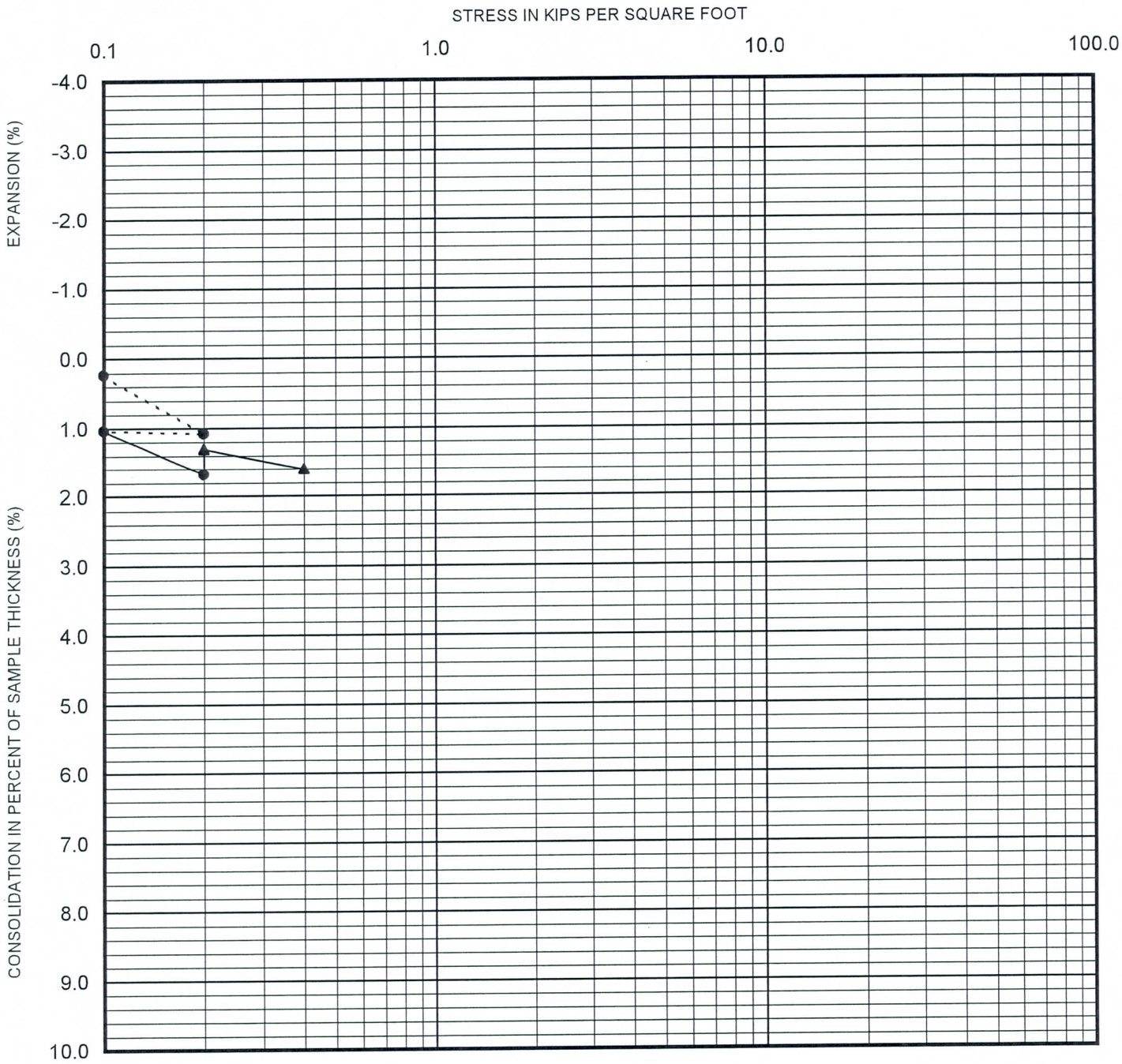
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-15



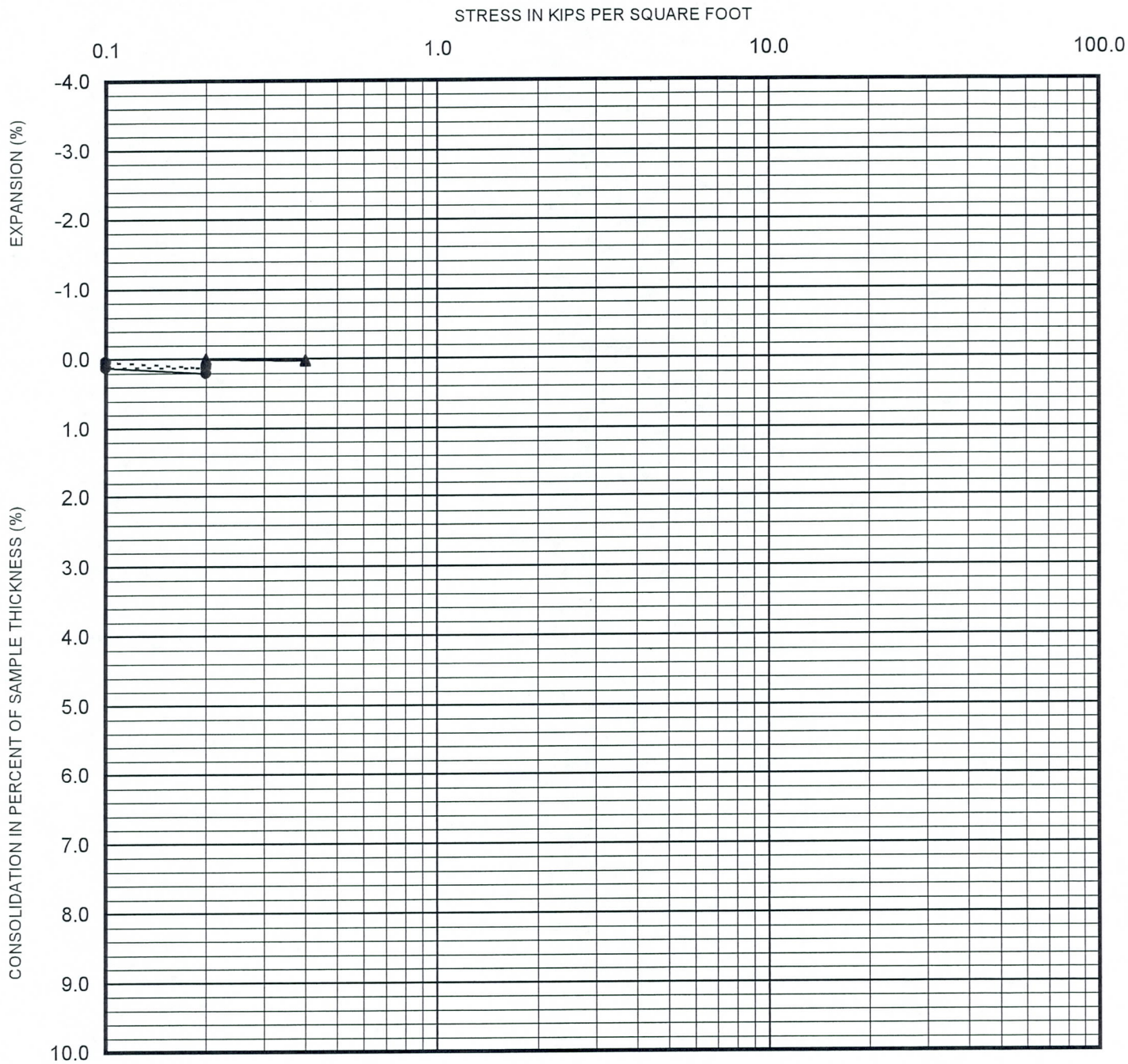
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-16



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-17

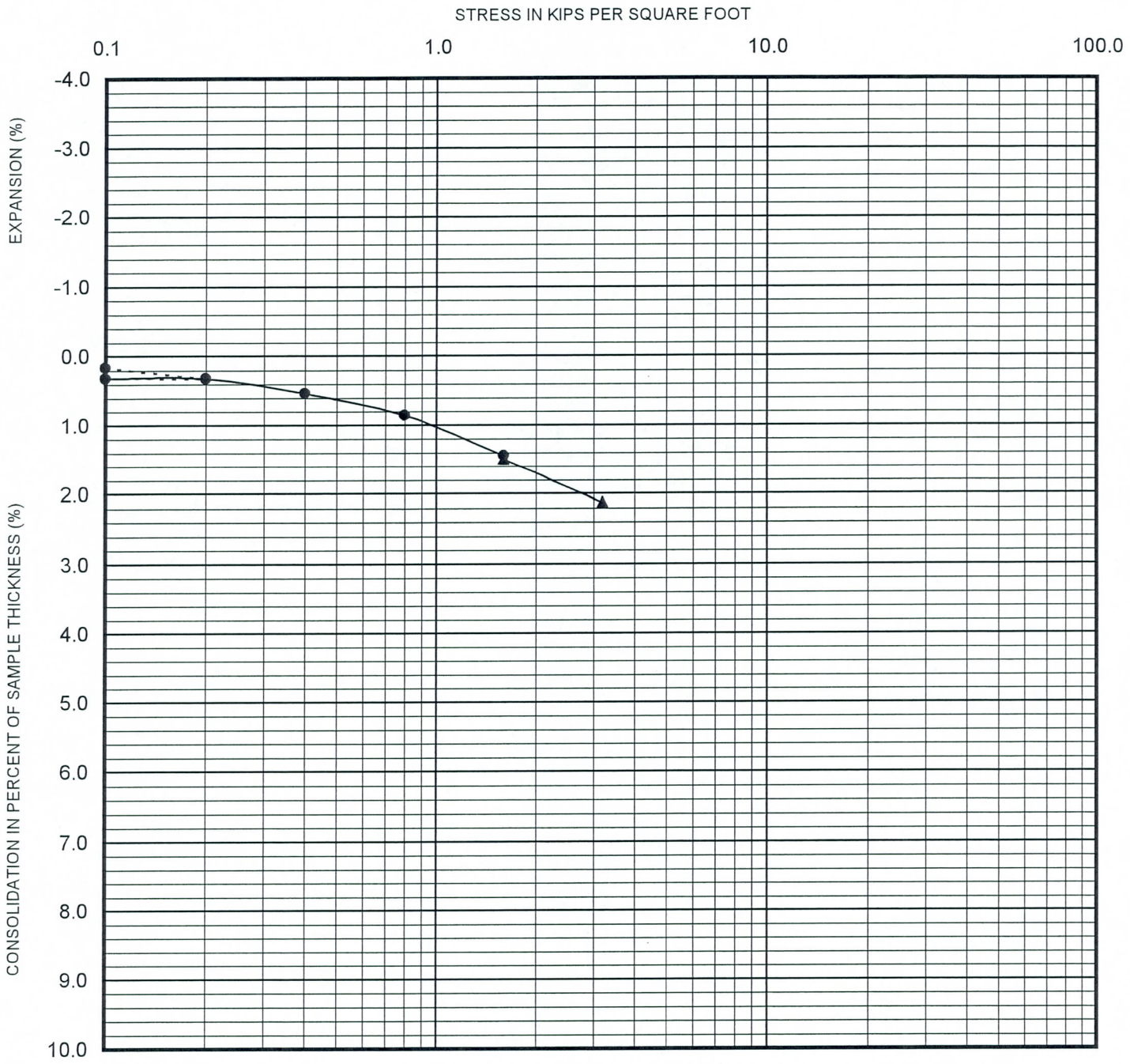


Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

Sample Location	B-15
Depth (ft.)	1-2.5
Soil Type	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-18
602455001 / 10/09		



Seating Cycle	
Loading Prior to Inundation	
Loading After Inundation	
Rebound Cycle	
Sample Location	B-19
Depth (ft.)	13.5-15
Soil Type	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-04

Ninyo & Moore	CONSOLIDATION TEST RESULTS	FIGURE
PROJECT NO. 602455001 / DATE 10/09	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-19

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH [1]	RESISTIVITY [1] (Ohm-cm)	SULFATE CONTENT [2]		CHLORIDE CONTENT [3] (ppm)
				(ppm)	(%)	
B-1	1-5	6.3	1,984	7	0.001	12
B-15	10-15	7.0	821	35	0.004	33
B-19	20-25	6.8	1,368	120	0.012	29

[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.	DATE	CAMELBACK ROAD STORM DRAIN 59TH AVENUE TO 75TH AVENUE GLENDALE, ARIZONA	B-20
602455001	10/09		

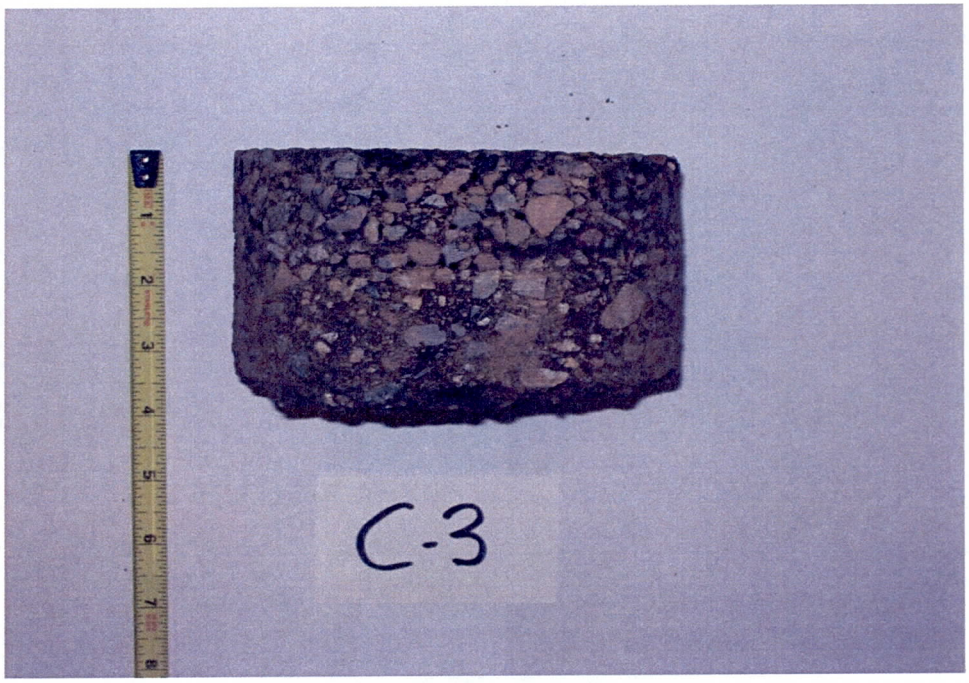
Ninyo & Moore

APPENDIX C

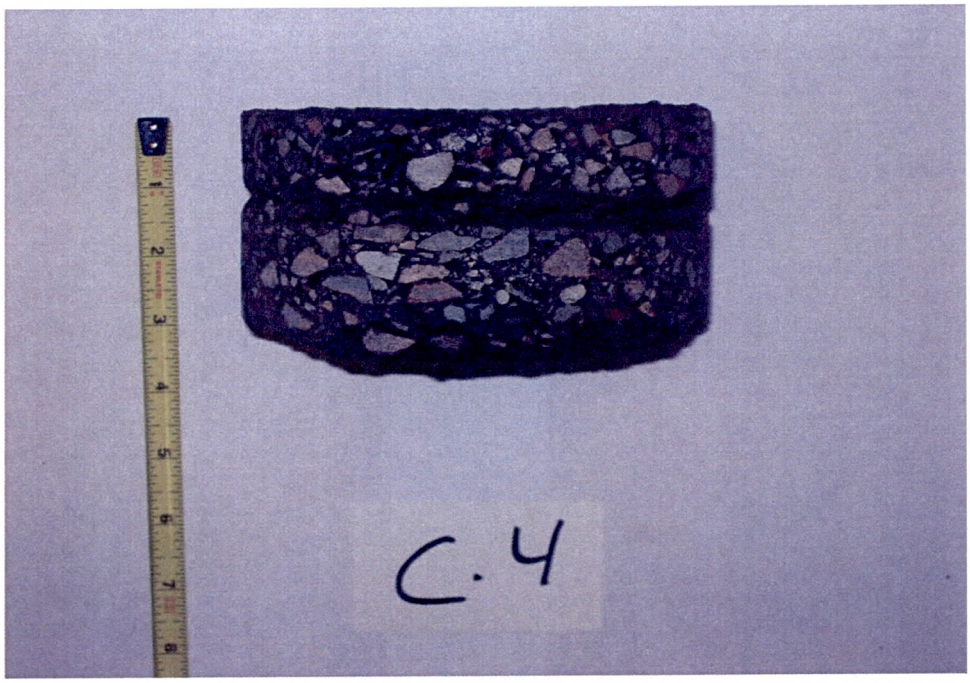
PHOTOGRAPHIC DOCUMENTATION OF PAVEMENT CORES

Photograph No. 1: **View of C-1 at location B-4.**

Photograph No. 2: **View of C-2 at location B-8.**



Photograph No. 3: **View of C-3 at location B-12.**



Photograph No. 4: **View of C-4 at location B-16.**