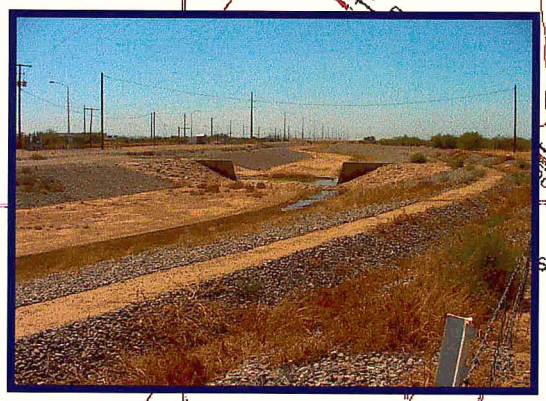
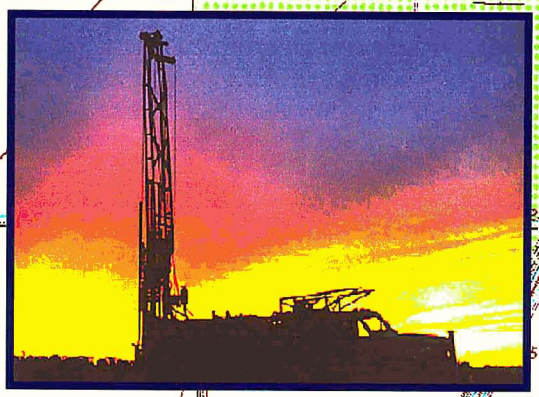
Geotechnical Evaluation

East Maricopa Floodway
Rittenhouse Detention Basin
Maricopa County, Arizona





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Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

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RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

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October 10, 2002
Project No. 600198002

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Mr. Barry Ling, P.E.
Kirkham Michael Consulting Engineers
9210 North 25th Avenue, Suite 195
Phoenix, Arizona 85021

Subject: Geotechnical Evaluation
East Maricopa Floodway
Rittenhouse Detention Basin
Maricopa County, Arizona

Dear Mr. Ling:

In accordance with our proposal dated January 28, 2002 and your authorization to proceed dated April 23, 2002, Ninyo & Moore has performed a geotechnical evaluation for the above-referenced site. The attached report represents our methodology, findings, conclusions, and recommendations regarding the geotechnical conditions at the project site.

We appreciate the opportunity to be of service to you during this phase of the project. If you have any questions or comments regarding this report, please call at your convenience.

Sincerely,
NINYO & MOORE

Steven D. Nowaczyk, P.E.
Senior Project Engineer

Registered Professional Engineer (Civil) CERTIFICATE NO. 34866 STEVEN D. NOWACZYK Date Signed 10-10-02 ARIZONA, U.S.A.

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1. INTRODUCTION

In accordance with our proposal dated January 28, 2002 and your authorization to proceed dated April 23, 2002, we have performed a geotechnical evaluation for the Rittenhouse Detention Basin project located in eastern Maricopa County, 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 the new basin. 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 the following:

- Reviewing readily available aerial photographs and published geologic literature, including maps and reports pertaining to the project site and vicinity.
- Marking-out the boring and test pit locations and notifying Arizona Blue Stake of these locations prior to our field work.
- Drilling, logging, and sampling 24 small-diameter exploratory borings to depths of about 16 to 26 feet below ground surface (bgs). The boring logs are presented in Appendix A.
- Excavating, logging, and sampling 11 test pit explorations to depths of about 8.5 to 12 feet bgs. The test pit logs are also presented in Appendix A.
- Performing four field infiltration tests at the anticipated bottom-of-basin level. The results are presented in Appendix C.
- Installing three piezometers in boreholes that were drilled along the East Maricopa Floodway (EMF).
- Performing laboratory tests on selected samples obtained from the borings and test pits to evaluate in-situ moisture content and dry density, grain size analysis, Atterberg limits, hydro-consolidation (swell/collapse) tests, maximum density/optimum moisture relationship, expansion index, agronomic testing (growability), permeability tests, unconsolidated undrained Triaxial Compression tests and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfates, and chlorides). The results of the laboratory testing are presented on the logs in Appendix A and/or the laboratory sheets present in Appendix B. The results from the agronomic testing are presented in Appendix D.
- Preparing this report that presents our findings, conclusions, and recommendations regarding the design and construction of the new basin.

3. SITE DESCRIPTION

Most of the project site is located in the southeast quarter of Section 36, Township 1 South, Range 6 East; however, a small portion of the site is located in the northeast quarter of Section 1, Township 2 South, Range 6 East. The project area encompasses about 160 acres of land and is situated in the Town of Gilbert, Arizona. The project area is bounded by Power Road to the east, Rittenhouse Channel to the southwest, and the EMF to the northwest, and is depicted on the Site Location Map (Figure 1).

At the time of our evaluation, the project site was vacant. Based on our research, farming occurred on the site in the past, particularly in the central and northern portions. Scattered trees, small brush, and weeds were observed during our site visits. Several unpaved roads crossed the site, including one that coincided with the alignment of Pecos Road in the southern portion of the project site. Some scattered piles of soil were observed. We understand that some spoils from the original construction of the EMF were spread out over the northern portion of this site.

According to the *Higley, Arizona 7.5-Minute USGS Topographic Quadrangle Map (1981),* the project area lies at an average elevation of roughly 1,325 feet relative to mean sea level (MSL). Based on the information from these quadrangle maps and the topographic information we obtained from your office, the project area slopes very gently from the southeast to the northwest, toward the EMF, with a vertical relief of about 13 feet.

Two aerial photographs were reviewed for this project. A 1967 photograph from the *USDA Soil Survey of Eastern Maricopa and Northern Pinal Counties, Arizona* shows row crops planted near the central portion of the site. In addition, some unidentifiable activity was observed near the southern tip of the project area. A series of 1999 aerial photographs from *Landiscor's Phoenix Real Estate Photo Book* show the project area similar to its current condition. Our evaluation of the aerial photographs and visual reconnaissance did not indicate any large disturbed areas that might be indicative of past development or filling.

4. PROPOSED CONSTRUCTION

The project generally includes the construction of a new detention basin along the southeast side of the EMF, from Power Road to the Rittenhouse Channel. The basin will collect stormwater during large storm events, retain the water for up to 36 hours, and then discharge it back into the EMF. The depth of the basin will be situated at about elevation 1,312 feet above MSL. Consequently, the excavation needed to create the basin area will extend to about 10 to 20 feet bgs.

An 800-foot long, concrete side weir will be constructed near the northwest corner of the basin. This weir will enable stormwater to enter the basin from the EMF. The weir crest elevation is tentatively planned to be at about elevation 1,315 feet above MSL. To allow the water to transfer back into the EMF, an outfall is planned beneath the southern-most portion of the side weir, about 1,700 feet southwest of the Power Road intersection with the EMF. This outfall is proposed to consist of multiple box culverts that will be incorporated structurally into the side weir. Based on our conversations with your office and the Flood Control District of Maricopa County, we understand that the basin is not considered to be a jurisdictional dam (as defined by the Arizona Department of Water Resources) because the water that is retained will be situated below the existing ground surface.

The steepest side slopes around the perimeter of the basin are proposed to be construction with a 4 vertical to 1 horizontal slope. The land use within the new basin is tentatively planned to be a golf course, with other recreational amenities. A portion of the site located on the south side of the Pecos Road alignment will not be excavated. This area may be used for future golf course operations.

5. FIELD EXPLORATION

5.1. Soil Borings

Ninyo & Moore conducted an initial soil boring subsurface evaluation at the site between July 5 and 16, 2001 and an additional subsurface evaluation on June 3, 2002 in order to evaluate the existing subsurface conditions and to collect soil samples for laboratory testing.

Specifically, our evaluation consisted of the excavating, logging, and sampling of 22 small-diameter borings. The borings were drilled using a CME-75 truck-mounted drill rig. Of these borings, nine were drilled along the EMF perimeter (denoted as RH-1 through RH-5 and RH-17B through RH-21), four were drilled along the Rittenhouse Channel perimeter (denoted as RH-7, RH-8, RH-22 and RH-23), five were drilled along the Power Road perimeter (denoted as RH-9 through RH-13), and five were drilled within the new basin area (denoted as RH-6 and RH-14 through RH-17). Bulk and relatively undisturbed soil samples were collected at selected intervals. Detailed descriptions of the soils encountered are presented in the logs in Appendix A.

The ground surface elevations and the lateral locations at each boring were measured by Consultant Engineering, Inc of Phoenix, Arizona after the drilling was finished. The elevations at each of the boring locations are provided on the logs. The general locations of the borings are denoted on the Boring and Test Pit Location Map (Figure 2).

5.2. Test Pits

In order to supplement the information obtained from the soil borings, Ninyo & Moore conducted an initial test pit subsurface evaluation on November 26 and 27, 2001 and an additional test pit evaluation on August 21 and 22, 2002. The test pits were excavated along the EMF and Rittenhouse Channel perimeter and within the basin using a Ford 555E backhoe. Detailed descriptions of the soils encountered are presented in the logs in Appendix A and the general locations of the test pits are denoted on Figure 2.

5.3. Piezometer Monitoring Wells

In order to monitor surface water seepage from the EMF after a large rain event, piezometer groundwater monitoring wells were installed in three of the boreholes after the boring was finished. Specifically, the piezometers were installed in borings RH-1, RH-3, and RH-5. In general, the bottom half of the wells consisted of screened PVC and the top half was solid. The annuli around the wells were backfilled with permeable sand and grouted near the surface. The tops of the wells were capped with an above-ground protective casing.

No substantial rainfall events occurred during our study period and therefore no meaningful readings were possible; however, the wells were left in-place. Consequently, if a heavy rain event occurs in the future, the piezometers may be read and the information could be useful. If this information is not needed, the piezometers should be removed during construction and backfilled with a cement/bentonite mixture.

5.4. Field Percolation Tests

In order to provide an estimate of the infiltration rate near the bottom of the proposed basin, Ninyo & Moore conducted four infiltration tests in general accordance with the City of Chandler Typical Detail No. C-109, which is commonly used for this purpose throughout metropolitan Phoenix. These tests were performed adjacent to borings RH-14, RH-15, RH-16, and RH-17. The procedures used consisted of the insertion of a 12-inch diameter Polyvinyl Chloride (PVC) casing into undisturbed soil, to a depth of about 15 to 17 feet bgs, followed by prewetting of the soil. The test continued after the prewetting period by refilling the casing and monitoring the drop in water level as a function of time until steady-state conditions were achieved. The results of this testing are provided in Appendix C.

5.5. Field Screening for Volatile Organic Compounds (VOCs)

In order to provide a preliminary screening of soil for the possible presence of VOCs, several collected samples were tested with a photoionization detector (PID). The Mini-Rae PID was calibrated at the beginning of each sampling day with 100 ppm isobutylene span gas. A zip-lock plastic bag was partially filled with a portion of each collected soil sample, sealed, and allowed to volatilize for 10 minutes. The tip of the PID was then inserted into the head-space of the plastic bag.

The highest PID reading was noted and recorded on the field boring logs and in the field notebook. No elevated VOC readings were observed during our field work.

6. LABORATORY TESTING

The soil samples collected from our field activities were transported to the Ninyo & Moore laboratory in Phoenix, Arizona for geotechnical laboratory analysis. The analysis included in-situ moisture content and dry density, grain size analysis, Atterberg limits, hydro-consolidation (swell/collapse) tests, maximum density/optimum moisture relationship, expansion index, agronomic testing (growability), permeability tests, unconsolidated undrained Triaxial Compression tests and corrosivity characteristics (including pH, minimum electrical resistivity, soluble sulfates, and chlorides). The results of the laboratory testing are presented on the logs in Appendix A and/or the laboratory sheets present in Appendix B.

Agronomic testing consisting of the testing of primary nutrients, secondary nutrients, micro nutrients, as well as other agricultural characteristics, was performed by Fruit Growers Laboratory, Inc. of Santa Paula, California. The results of these tests, which include planting recommendations, are presented in Appendix D.

7. GEOLOGY AND SUBSURFACE CONDITIONS

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

7.1. 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 13 million years ago during the mid- to late-Tertiary. Extensional tectonics resulted in the formation of horsts (mountains) and grabens (basins) with vertical displacement along high-angle normal faults. Intermittent volcanic activity also occurred during this time. The surrounding basins filled with alluvium from the erosion of the surrounding mountains as well as from deposition from

rivers. Coarser-grained alluvial material was deposited at the margins of the basins near the mountains. The surficial geology of the proposed canal is described as latest Quaternary age deposits (<10,000 years old) consisting of sand and silt, with local occurrences of fine gravels and coarse deposits that contain minimal soil development (Demsey, 1989).

7.2. Subsurface Conditions

Our knowledge of the subsurface conditions at the project site is based on our field exploration and laboratory testing, and our understanding of the general geology of the area. The following paragraphs provide a generalized description of the materials encountered. More detailed descriptions are presented on the boring logs in Appendix A.

Stratified desert alluvium was encountered at the surface of the borings and extended to the total depth explored. The alluvium consisted of clay (CL), silt (ML), and clayey/silty sand (SC/SM). Scattered caliche nodules, filaments, and stringers were present in many of the borings. Table 1 provides an estimated breakdown of the soil types encountered in our borings within the proposed basin excavation (e.g., from the ground surface to about 10 to 20 feet bgs):

Table 1 – Approximate Percentage of Soil Types Encountered from Ground Surface to Anticipated Bottom of Basin

GP/GC/GM	SP	SC/SM	ML	CL
0%	0%	21%	38%	41%

Table 2 provides a breakdown of the soil types encountered in our borings at the anticipated bottom of the basin excavation (e.g., about 10 to 20 feet bgs):

Table 2 – Approximate Percentage of Soil Types Encountered at the Anticipated Bottom of Basin Excavation

GP/GC/GM	SP	SC/SM	ML	CL
0%	0%	46%	29%	25%

The geological characteristics of the surface soils within the project site generally includes the presence of a Holocene "apron" overlying an older Late Pleistocene deposit. The Holocene deposits are typically of lower density and are relatively susceptible to collapse upon wetting. Consequently, the position of the contact between the Holocene and Late Pleistocene deposits is relevant. Based on our field work and laboratory testing, we estimate that this contact ranges from about elevation 1,300 to 1,320 feet MSL. Localized variations are largely attributable to erosion of the Late Pleistocene surface and subsequent alluvial deposition.

7.3. Groundwater

Groundwater was not encountered in our boring or test pit excavations. Based on well data from the Arizona Department of Water Resources (ADWR), the approximate depth to groundwater is in excess of about 180 or more feet bgs. 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; however, given the occurrence of relatively pervious zones, perched tailwater resulting from flood irrigation of cropland might be encountered.

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. Our summary of key geotechnical considerations includes the following:

- The on-site soils consist of stratified desert alluvium with a high degree of heterogeneity and anisotropy. The soils should generally be excavatable to planned depths with conventional earthmoving construction equipment in good working condition.

- A basin side slope angle of 4 horizontal to 1 vertical is feasible from a geotechnical standpoint. Our calculations show an acceptable factor of safety against appropriate failure modes.

- Of primary concern is the possibility of cracking, piping, and/or seepage through the natural levees. These concerns were addresses in the Failure Mode Analysis (FMA) performed for this project in December 2001. One of the major findings of the FMA was that a cut-off barrier (located within the levee between the basin and the EMF and Rittenhouse Channel) would reduce the risk associated with several of the potential failure modes discussed.

- We recommend that the weir be supported on a zone of engineered fill that extends through the Holocene alluvium soils and to older Pleistocene deposits. Based on our field work, laboratory testing and analysis we recommend that this zone of engineered fill extend to elevation 1,306 feet above MSL or deeper. An engineering geologist or geotechnical engineer should evaluate the exposed soil.

- Anti-seepage devices, like seepage collars, should be used for the installation of pipes or other penetrations that cross through or beneath the levees.

9. RECOMMENDATIONS

The following sections present our geotechnical recommendations for the proposed basin construction.

9.1. Earthwork

The following sections provide our earthwork recommendations. Other recommendations for grading and earthwork are included in our Earthwork Specifications Recommendations, Appendix E. If there are conflicting recommendations, those provided in this report supersede those in Appendix E.

9.1.1. Excavation Characteristics

Our evaluation of the excavation characteristics of the on-site materials is based on the results of 24 widely-spaced exploratory borings, 11 test pits excavations, our site observations, and our experience with similar materials. In our opinion, excavation of the on-site materials can generally be accomplished to the anticipated basin depth with conventional earthmoving equipment in good operating condition. However, scattered caliche nodules, filaments, and stringers were encountered in many of our excavations, which may be relatively time consuming to excavate. This cementation predominates in

the older Pleistocene deposits, which were encountered below roughly elevation 1,300 to 1,320 feet MSL.

We recommend that trenches and excavations associated with the project be designed and constructed in accordance with Occupational Safety and Health Administration (OSHA) regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet deep based on a description of the soil types encountered. Trenches greater than 20 feet deep should be designed by the Contractor's engineer based on site-specific geotechnical analyses. For planning purposes, we recommend that the OSHA soil classification for the encountered alluvial soil be considered as Type C.

9.1.2. Grading, Fill Placement, and Compaction

Vegetation and debris from the clearing operation should be removed from the site and disposed of at a legal dumpsite. Demolition debris should be removed from the site and disposed of at a legal dumpsite. Obstructions that extend below finish grade, if present, should be removed and the resulting holes filled with compacted soil.

The geotechnical consultant should carefully evaluate areas of soft or wet soils prior to placement of fill or other construction. Drying or overexcavation and replacement of such materials may be anticipated.

Imported soils and soils generated from on-site excavation activities that exhibit very low to low expansive potential, are generally suitable for reuse as engineered fill in structural areas. Very low to low expansive potential soils are defined as having an Expansion Index (by ASTM D 4829-95) of 50 or less.

We recommend that new fill be placed in horizontal lifts approximately 8 inches in loose thickness and compacted by appropriate mechanical methods, to 95 percent or more relative compaction, in accordance with ASTM D 698-00 at a moisture content within two percent of its above optimum.

Based on the laboratory tests we performed, an earthwork (shrinkage) factor of 10 to 25 percent is appropriate for the on-site soils within the basin area. This shrinkage factor range represents an average of the material tested. Potential bidders should consider this in preparing estimates and should review the available data to make their own conclusions regarding excavation conditions.

Although not apparent in our excavations and because much of this site was used for farming in the past, the top 6 to 12 inches may contain some organics. This layer may need to be segregated during construction and reused in non-structural area of the site.

9.1.3. Composition of On-Site Excavated Material

The composition of the soils that will likely be excavated for construction of the basin was outlined in Section 7.2. In addition to the index testing (grain size analysis and Atterberg limits) that was done to classify these soils, we also performed Expansion Index and corrosivity tests as a means to evaluate these soils for potential reuse. Table 3 outlines the results of these tests. Note that, given the very large volume of soil to be excavated and the heterogeneous nature of the natural soils, wider variations in soil characteristics than suggested by these results are likely.

Table 3 – Summary of Expansion Index and Corrosivity Test Results

Sample Location	Sample Depth (ft)	Expansion Index	pH	Resistivity (ohm-cm)	Water-Soluble Sulfate Content in Soil (%)	Chloride Content (ppm)
RH-6	0-2	18	--	--	--	--
RH-12	12-15	0	--	--	--	--
RH-14	0-5	6	7.8	726	0.002	55.6
RH-16	12-15	7	8.7	2,046	0.006	73.0

The Expansion Index test is used to evaluate the swell or expansion potential of a remolded soil sample that is inundated with water. Based on Uniform Building Code (UBC) Standard No. 18-2, an Expansion Index from 0 to 20 indicates a very low expansion potential, 21 to 50 indicates a low expansion potential, 51 to 90 indicates a medium

expansion potential, 91 to 130 indicates a high expansion potential, and 130 or above indicates a very high expansion potential. The soils that we tested exhibited a very low expansion potential.

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 Test 733 and 736, respectively. The soil pH values ranged from 7.8 to 8.7, which is considered to be alkaline. The minimum electrical resistivity measured in the laboratory varied from 726 to 2,046 ohm-cm, which is considered to be corrosive to ferrous materials. The chloride content of the sample tested ranged from about 56 to 73 ppm, which is also considered to be corrosive to ferrous materials.

Based on the UBC criteria, the potential for sulfate attack is negligible for water-soluble sulfate contents in soil ranging from 0.00 to 0.10 percent by weight (0 to 1,000 ppm), and moderate for water-soluble sulfate contents ranging from 0.10 to 0.20 percent by weight (1,000 to 2,000 ppm). The potential for sulfate attack is severe for water-soluble sulfate contents ranging from 0.20 to 2.00 percent by weight (2,000 to 20,000 ppm), and very severe for water-soluble sulfate contents over 2.00 percent by weight (20,000 ppm). The soluble sulfate content of the soil samples tested ranged from 0.002 to 0.006 percent, which represents a negligible sulfate exposure for concrete.

9.1.4. Imported Fill Material

Imported fill in contact with ferrous materials or concrete, if utilized, should consist of clean, granular material with a very low or low expansion potential. Import material that is in contact with buried ferrous materials or concrete should also have low corrosion potential (minimum resistivity greater than 2,000 ohm-cm or chloride content less than 25 parts per million [ppm], and soluble sulfate content of less than 0.1 percent). The geotechnical consultant should evaluate such materials and details of their placement prior to importation.

9.2. Levee Stability and Seepage

The excavation of the new basin will, in effect create a natural levee along the perimeter of the basin, specifically along the EMF and the Rittenhouse Channel. Levees are usually constructed with select materials that are placed over a prepared foundation in an engineered manner and compacted to a specified density. For seepage and piping considerations, constructed levees will ordinarily be zoned and may contain internal drainage, and the embankment foundations are prepared with cut-offs extending below the embankment.

Due to the infrequent and transient nature of water storage and flow in the abutting channels, the embankment soils, constructed as proposed, will remain dry and (in some cases) brittle until a wetting front passes through during flood events. Given the short impoundment time, seepage through embankments is not expected to reach steady-state conditions.

The composition of these natural levees will be highly heterogeneous and anisotropic, and could be subject to differential settlements, cracking, piping and/or seepage concerns. Although not disclosed in our sampling program, the natural levees and their foundations may contain defects such as desiccation cracks, open graded channels, etc. The following sections of the report address construction considerations with regards to the natural levees that will be constructed for this project and also address the basin infiltration that may be expected.

9.2.1. Side Slope Stability

Based on our conversations with your office and the 60 percent plans we were given, we understand that the design of the side slopes around the perimeter of the basin calls for a 4 (horizontal) to 1 (vertical) slope or shallower. We performed slope stability analyses on a typical embankment section with this slope. The stability analyses were done using the computer program (PCSTABL6H), which is a static and pseudostatic stability program using Bishop's modified circular failure surfaces. Based on the results of this analysis, we have calculated a factor of safety against failure in excess of 2.0. In determining this factor of safety, we assumed very conservative embankment soil parameters and employed a total stress analysis. Because saturated conditions are not

anticipated (except for the faces of the levees), rapid drawdown stability scenarios have been ruled out as highly unlikely.

On the basis of these analyses, we believe that the proposed 4:1 slope is feasible and stable from a geotechnical standpoint. A graphical representation of this slope stability analysis is given in Figure 3.

9.2.2. Cut-Off Barrier

Because these natural levees will be constructed of native soils that are highly heterogeneous and not placed in an engineered manner, differential settlements, desiccation cracking, piping and seepage from the basin to the EMF and Rittenhouse Channel (or vice versa) are major design considerations. To better understand these and other potential risks associated with this type of construction, a failure mode assessment (FMA) was conducted for this project in December 2001.

The outcome of this FMA was summarized in a Failure Mode Report, which was prepared by Kirkham Michael Consulting Engineers. One of the major findings revealed in this process was that a cut-off barrier (located within the levee between the basin and the EMF and Rittenhouse Channel) would reduce the risk associated with several of the potential failure modes discussed, particularly those associated with differential settlement, cracking, piping and seepage. The following paragraphs outline our recommendation for construction of this cut-off wall.

We recommend that the cut-off barrier be 12 or more inches wide and extend to depths of 13 or more feet below the ground surface. A sketch that schematically represents our recommendations for the proposed barrier is attached to this report (Figure 4). The trench used for the barrier can likely be excavated with a backhoe or trencher. We anticipate that the trench sidewalls will generally stand near vertical for short periods of time; however, the trench should not be left open overnight. The barrier should be located in embankment areas between the basin and the EMF or Rittenhouse Channel

where the top of the embankment is 55 feet wide or less. It is our opinion that the barrier does not have to extend under the weir structure.

The geotextile used in the cut-off barrier should consist of a Contech C-80NW, Mirafi, Inc. 180N, or equivalent. Specifically, the following material properties should be utilized in selecting a geotextile:

Grad Tensile Strength (tested by ASTM D 4632)	200 or more pounds
Grade Elongation (tested by ASTM D 4632)	50 or more percent
Puncture Strength (tested by ASTM D 4833)	100 or more pounds
Mullen Burst (tested by ASTM D 3486)	350 or more psi
Trapezoidal Tear (tested by ASTM D 4533)	75 or more pounds

The geotextile material should be anchored at the surface with anchor pins spaces every 25 lineal feet, in accordance with the manufacture's specifications. The manufacture's representative should provide deign support and construction observations and should provide written assurance of installation procedures.

Native soils excavated from the trench could be reused as engineered fill after the trench is excavated and the geotextile is placed and anchored, provided they meet the criteria mentioned above. Some of the excavated soils may be cemented. As such, soil clods may be present. Therefore, mechanical processing may be needed to such that no particle or soil clod is greater than 1.5 inches in its greatest dimension. No specific moisture-compaction specification for the trench backfill soils is recommended. However, the contractor should place the backfill in a manner that will inhibit bridging or the creation of voids within the backfill matrix. In addition, the backfill material should be placed in a manner that does not damage to the geotextile material.

The top segment of the cut-off barrier trench (extended from the ground surface to a depth of 12 or more inches) should be capped with a low permeability soil, as shown on the sketch. Settlement of the backfill soils should be expected. As such, occasional maintenance, consisting of the backfilling of depressions, should be anticipated. Based

on our conversations with local contractors, we understand that the cost to construct a cut-off barrier as described above ranges for about $15 to $20 per lineal foot

9.2.3. Basin Base Infiltration

As mentioned earlier, four field percolation tests were performed for this basin. The tests were located within the central portion of the proposed basin area and extended 15 to 17 feet bgs. Table 4 summarizes these results of these percolation tests.

Table 4 – Summary of Percolation Tests Within Rittenhouse Basin

Approximate Test Location	Test Depth (ft)	Average Percolation Rate ($ft^3/hr/ft^2$)	Soil Type at Test Depth
RH-14	15	0.08	SC
RH-15	15	2.09	SC
RH-16	15	0.88	CL
RH-17	17	1.31	SM

The measured values should be viewed as highly approximate since soil permeability is among the more variable quantities used in soil mechanics. A conservative approach to seepage rates is recommended. This approach may include an equation similar to this:

Estimated Value = Average Value +/- 3 x Standard Deviation

We estimate the average percolation rate for this basin to be 1.09 $ft^3/hr/ft^2$ and a standard deviation of 0.84.

9.3. Side Weir and Outlet Works

As mentioned earlier, we understand that an 800-foot long side weir will be constructed near the northwest corner of the basin. This weir will enable stormwater to enter the basin from the EMF after it reaches about elevation 1,315 feet above MSL. To allow the water to transfer back into the EMF, an outfall is planned near the southern-most end of the side weir,

about 1,700 feet southwest of the Power Road intersection with the EMF. This outfall is proposed to consist of multiple box culverts that will be incorporated structurally into the side weir.

In addition, we understand the weir will be concrete lined on both sides. The EMF side will be slightly battered toward the basin, and the basin side will be stepped. The drawings that we received also show two cut-off walls, located on either side of the weir and extending about 6 to 7 feet deep. We understand that the primary function of these walls is to discourage undermining, erosion and/or scouring of the side weir by water flow.

9.3.1. Foundation Preparation

As part of our scope of work, the characteristics of the foundation soils supporting the new levees were evaluated. Particularly, the extent of a Holocene "apron" overlying the older Late Pleistocene deposits was considered. The Holocene deposits are typically of lower density and are relatively susceptible to collapse upon wetting. Consequently, the depth of the contact between the Holocene and Late Pleistocene deposits is relevant.

In our evaluation of the Holocene/Late Pleistocene contact, the qualitative description of cementation stage proposed by Machette (1985) was used in conjunction with that proposed by Beckwith and Hanson (1982). The various stages of cementation are denoted on the logs in Appendix A. Based on our field work and laboratory testing, we estimate that this contact is situation at about elevation 1,300 to 1,320 feet MSL. Localized variations are largely attributable to erosion of the Late Pleistocene surface.

Specifically, we recommend that the weir be supported on a zone of engineered fill that generally extends through the Holocene alluvium soils and to older Pleistocene deposits. Based on our field work, laboratory testing and analysis we recommend that this zone of engineered fill extend to elevation 1,306 feet above MSL or deeper. The exposed soil should be carefully evaluated by an engineering geologist or geotechnical engineer.

Engineered fill should be placed in horizontal lifts approximately 8 inches in loose thickness and compacted by appropriate mechanical methods, to 95 percent or more relative compaction, in accordance with ASTM D 698-00 at a moisture content within two percent of its optimum moisture content. Selected low permeability, on-site soils could be reused for this purpose.

9.3.2. Pipe Penetrations

An embankment breach can result from inadequately designed or constructed pipelines, utility conduits, or culverts (hereafter referred to as pipes) located beneath or within levees. During high water, seepage tends to concentrate along the outer surface of pipes resulting in piping (potential washing out) of fill or foundation material. Seepage may also occur because of leakage from the pipe. Consequently, we recommend that anti-seepage devices be employed to mitigate piping or erosion along the outside wall of the pipe. The term "anti-seepage device" usually refers to metal diaphragms or concrete collars that extend from the pipe into the backfill material. The diaphragms and collars are often referred to as "seepage rings". To reduce increased piping potential, great care should be taken when selecting and compacting backfill around these seepage rings.

In addition, the pipe should have adequate strength to withstand the applied earth loads. Consideration should also be given to live loads imposed from equipment during construction and the loads from traffic and maintenance equipment after the levee construction.

The pipe joints should be selected to accommodate movements resulting from foundation or fill settlement. In addition, the pipe joints, as well as the pipe itself, should be watertight.

9.3.3. Concrete

As mentioned previously, the results of the sulfate content laboratory tests indicate the site soils present a negligible sulfate exposure to concrete. In accordance with Table 19-A-3 of the 1994 UBC, we believe that Type II cement can be used for the construction

of concrete structures at this site. However, due to potential uncertainties as to the use of reclaimed irrigation water, or topsoil that may contain higher sulfate contents, sulfate-resistant cement, pozzalon, or admixtures may be considered.

The concrete should have a water-cement ratio no greater than 0.5 by weight for normal weight aggregate concrete. From a quality standpoint, a 28-day compressive strength of 4,000 psi or higher is desirable because it will improve concrete durability.

9.4. Pre-Construction Conference

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

9.5. 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, including the extent and depth of overexcavation if loose soils are encountered during construction, to evaluate the suitability of proposed borrow materials for use as fill, and to observe placement and test compaction of fill soils. We recommend that the design geotechnical consultant should be retained for construction services. However, 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 and may not provide sufficient data to prepare an accurate bid by some 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 ac-

tion 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. SELECTED REFERENCES

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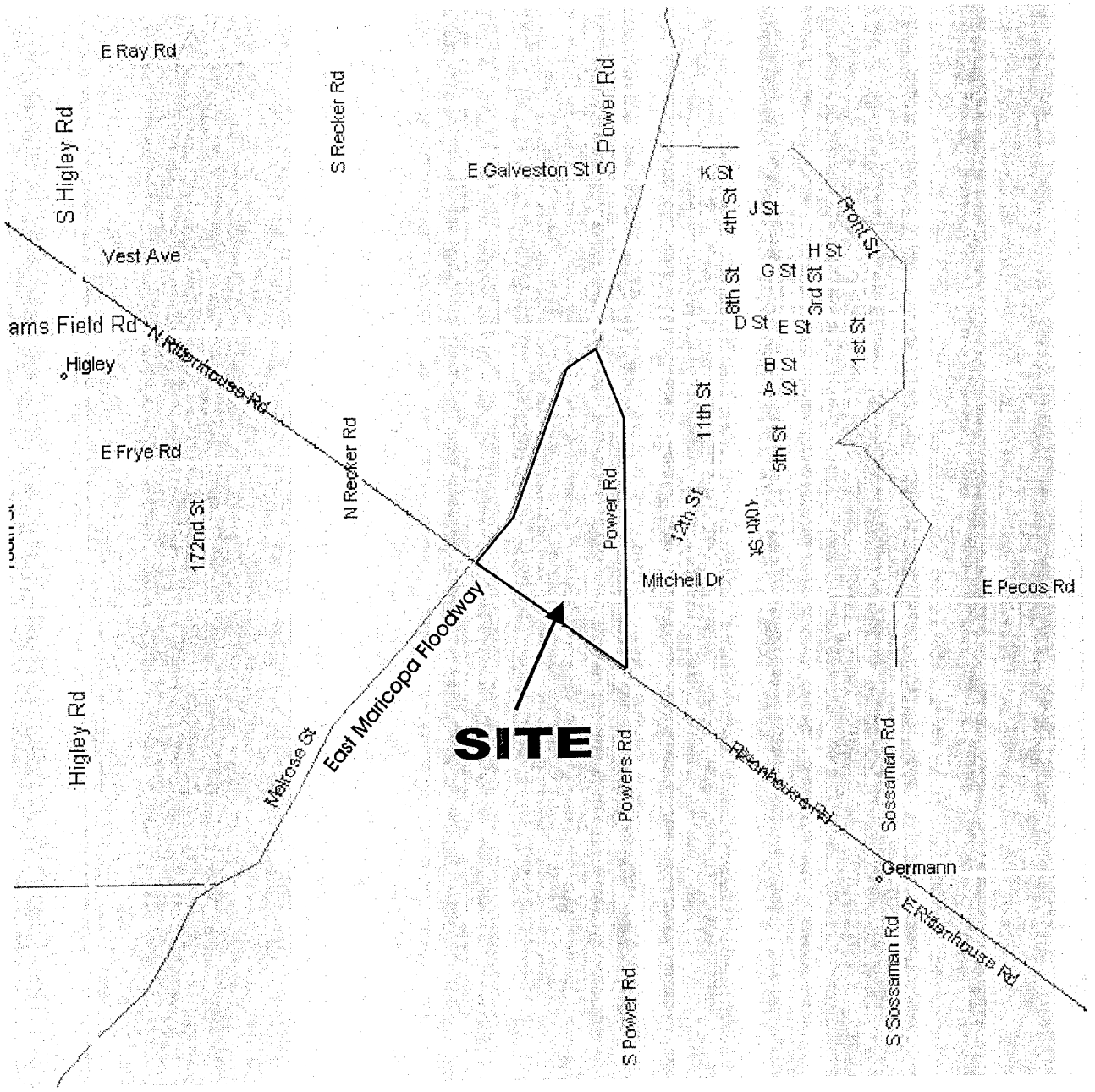

Reference: Microsoft Streets98, 1998.

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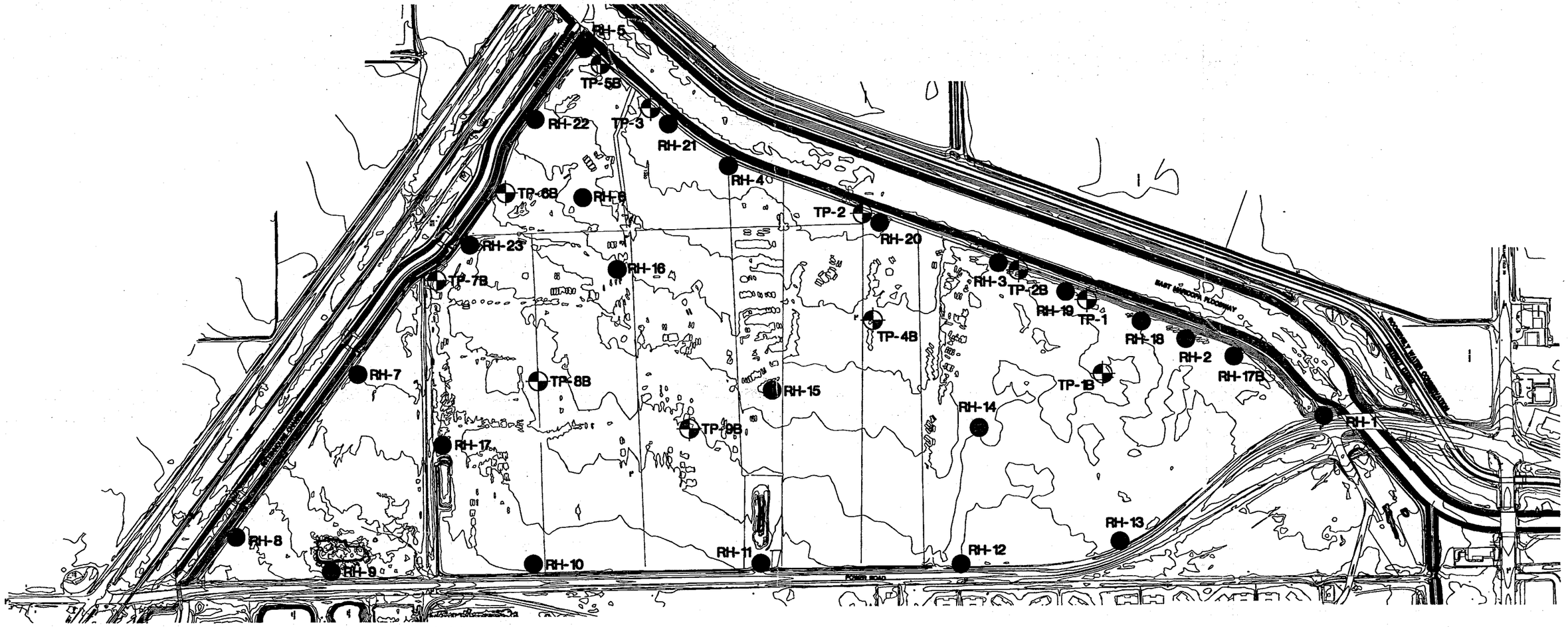
SITE LOCATION MAP

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	1



LEGEND

TP-8B Approximate location of exploratory test pit.

RH-10 Approximate location of exploratory boring.

NOTE: All dimensions and directions are approximate.

N

0 500

APPROXIMATE SCALE IN FEET

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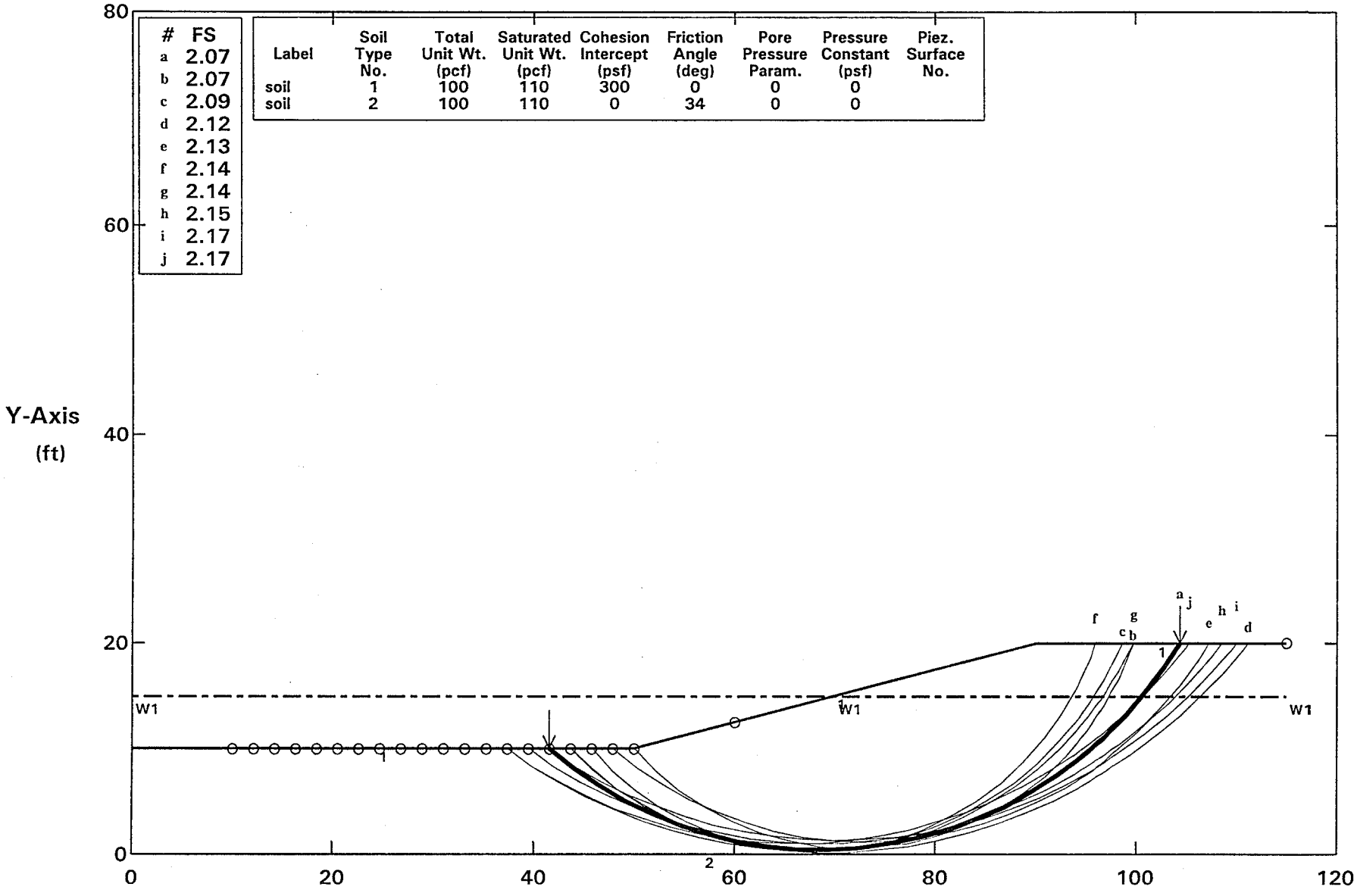
BORING AND TEST PIT LOCATION MAP

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	2

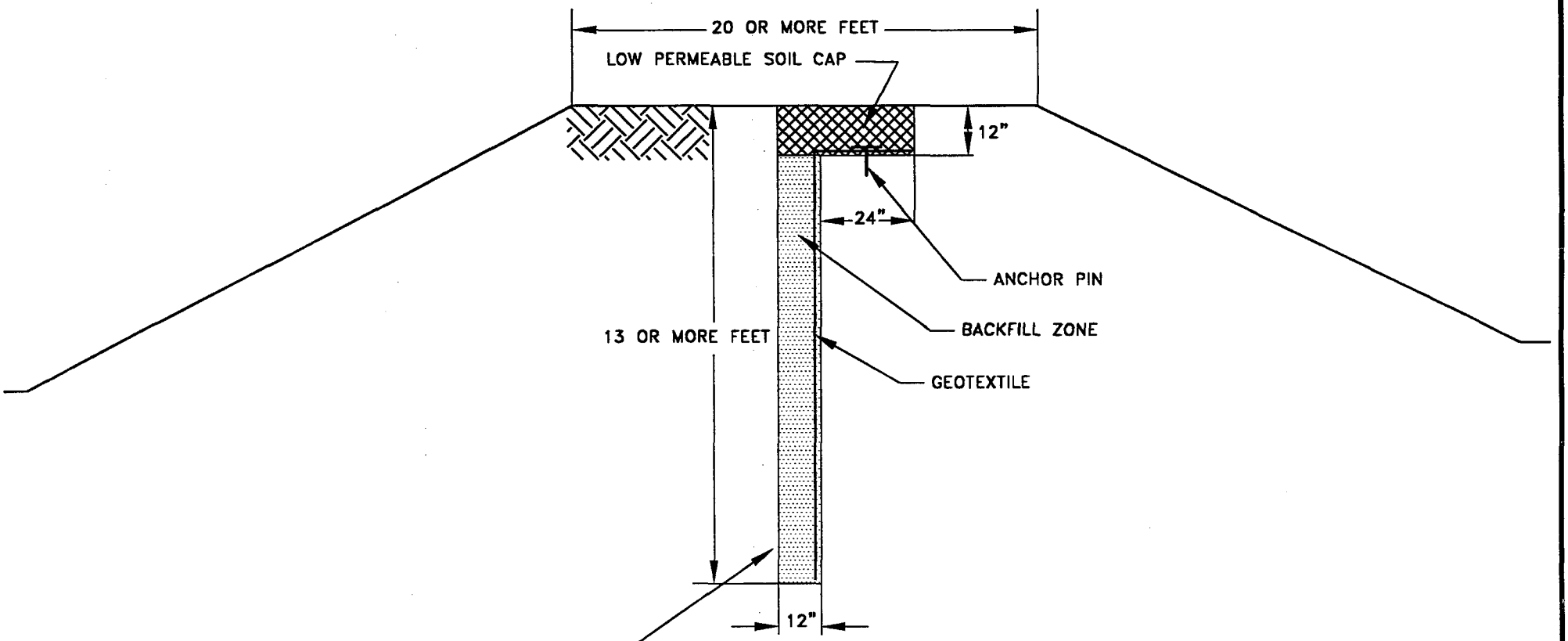
Figure 3: Slope Stability Analysis of Typical Embankment

Ten Most Critical. C:EMF-TYP.PLT By: Curt 09-28-01 3:52pm



STABL6H FSmin = 2.07 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method



CUT-OFF BARRIER

NOT TO SCALE

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CONCEPTUAL FIGURE
CUT-OFF BARRIER

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	4

APPENDIX A

BORING/TEST PIT 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 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 up to 18 inches into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586-84. 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 method.

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 a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586-84. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

DATE DRILLED 7/16/01 BORING NO. RH-1

GROUND ELEVATION 1324'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown to brown (7.5 YR 6/4 to 7.5 YR 5/4), dry, hard, silty CLAY. Stage I cementation, weakly cemented by sparse calcium carbonate filaments and grain coatings.
		49	8.3	114.9			
5		44					
		9	3.8				Stiff.
						SC	Brown (7.5 YR 5/4), dry, medium dense to dense, clayey fine to coarse SAND. Stage I cementation, weakly cemented by sparse calcium carbonate and grain coatings.
10		30	6.9	99.4			
		43					Very dense.
15		85/11"	5.2				
		44					
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-1

DATE DRILLED 7/16/01 BORING NO. RH-1

GROUND ELEVATION 1324'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		67	4.5	112.2		SC	ALLUVIUM: (continued) Brown (7.5 YR 5/4), damp, dense, clayey fine to coarse SAND; few silty sand layers.
		55	3.8			SM	Pale brown (10 YR 6/3), dry, very dense, silty SAND.
25		50/3"					Total Depth =25.3' Groundwater not encountered. Piezometer installed on 7/16/01.
30							
35							
0							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-2

DATE DRILLED 7/9/01 BORING NO. RH-2

GROUND ELEVATION 1320'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage I cementation, weakly cemented by sparse calcium carbonate filaments.
		34	7.4				
5		41					
		76/10"	11.6	100.0			Scattered fine gravel.
						SC-SM	Reddish brown (5 YR 5/4), damp, dense, silty, clayey SAND.
10		26	11.9				
		75/11"					Very dense. Stage II cementation, moderate cementation by calcium carbonate nodules less than 1/4" in diameter.
15		29	12.4				Dense.
						ML	Brown (7.5 YR 5/4), damp, very dense, sandy SILT.
		90/10"	9.8	103.6			Stage II cementation.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-3

DATE DRILLED 7/9/01 BORING NO. RH-2

GROUND ELEVATION 1320'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			69				ML	ALLUVIUM: (continued) Brown (7.5 YR 5/4), damp, very dense, sandy SILT.
								Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/9/01.
25								
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-4

DATE DRILLED 7/16/01 BORING NO. RH-3

GROUND ELEVATION 1320'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	ALLUVIUM: Light brown to brown (7.5 YR 6/4 to 7.5 YR 5/4), dry to damp, silty, medium dense SAND; few fine gravel. Stage I cementation, weakly cemented and scattered filaments.
		31	8.3	89.9			
5		74/10"	9.9	93.8			Very dense.
		47	6.0				
						ML	Very pale brown (10 YR 7/4), dry, hard, clayey SILT. Stage II cementation with scattered caliche nodules less than 1/4" in diameter.
10		64					
		54					
15		90/10"	8.4	86.0			
		81	6.2				
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-5

DATE DRILLED 7/16/01 BORING NO. RH-3

GROUND ELEVATION 1320'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		82	12.7	100.9		CL	ALLUVIUM: (continued) Very pale brown (10 YR 7/4), dry, hard, silty CLAY.
							Total Depth = 21.5' Groundwater not encountered. Piezometer installed on 7/16/01.
25							
30							
35							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-6

DATE DRILLED 7/9/011 BORING NO. RH-4

GROUND ELEVATION 1319'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), dry, very stiff, silty CLAY. Stage I cementation, weakly cemented scattered calcium carbonate filaments.
		24					
5		22	8.0	98.3			
		91/11"	7.7				Very pale brown (10 YR 7/4), dry, hard, sandy CLAY. Stage II cementation, trace to sparse caliche nodules less than 1/2" in diameter, moderately cemented.
10		66/11"	9.0	91.4			
		46	6.6				
15		47	7.3	98.3		SC	Reddish brown (5 YR 5/4), dry to damp, dense, clayey SAND; trace fine gravel. Stage II cementation, moderately cemented, few to some calcium carbonate nodules less than 1/2" in diameter.
		33	4.8				Color change to very pale brown at 18.5'.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-7

DATE DRILLED 7/9/011 BORING NO. RH-4

GROUND ELEVATION 1319'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	64/11"			▨	SC	ALLUVIUM: (continued) Reddish brown (5 YR 5/4), damp, dense, clayey SAND; trace fine gravel.
								Total Depth = 20.9' Groundwater not encountered. Backfilled on 7/9/01.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-8

DATE DRILLED 7/16/01 BORING NO. RH-5

GROUND ELEVATION 1320'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry, hard, silty CLAY. Stage I cementation, weakly cemented and scattered filaments.
		29					
5		93/9"	6.5				
		50/6"	8.4				
10		48	8.0	97.1			
		64					
15		91/9"					Sparse fine sand, cementation. Stage II cementation, moderately cemented and scattered calcium carbonate nodules up to 1/4" in diameter.
		77	1.8			SC	Pale brown, dry, very dense, clayey SAND; sparse fine gravel.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-9

DATE DRILLED 7/16/01 BORING NO. RH-5

GROUND ELEVATION 1320'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	74			▨	SC	ALLUVIUM: (continued) Pale brown (10YR 6/3), dry, very dense, clayey SAND; sparse fine gravel. Stage II cementation, moderately cemented.
								Total Depth = 21.0' Groundwater not encountered. Piezometer installed on 7/16/01.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-10

DATE DRILLED 7/9/01 BORING NO. RH-6

GROUND ELEVATION 1322'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry, hard, silty CLAY; few fine sand. Stage I cementation, scattered caliche filaments.
		51	5.4	100.2			
5		50/5"	6.1				
		68/11"					Brown (7.5 YR 5/4).
10		31	10.6	79.3			
		42	10.1				
15		52	7.0	106.3			Light to pale brown (7.5 YR 6/4 to 10 YR 6/3).
		29	6.8			SM	Light brown (7.5 YR 6/3), dry, dense, silty SAND. Stage II cementation, scattered caliche coatings.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-11

DATE DRILLED 7/9/01 BORING NO. RH-6

GROUND ELEVATION 1322'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		44				ML	ALLUVIUM: (continued) Light brown to brown (7.5 YR 6/3 to 7.5 YR 5/3), damp, hard, clayey SILT. Stage II cementation, scattered caliche nodules.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/9/01.
25							
30							
35							
40							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-12

DATE DRILLED 7/10/01 BORING NO. RH-7

GROUND ELEVATION 1325'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Pale brown (10 YR 6/3), dry, hard, silty CLAY. Stage I cementation, weakly cemented.
			♀				
		35	7.1	89.6			
5		60	6.9				
		90/9"					
10		34	13.9				
		53	13.3	91.6			Few fine sand.
							Reddish brown (5 YR 5/4), damp.
15		40	10.6				
		71	13.2	81.9			
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-13

DATE DRILLED 7/10/01 BORING NO. RH-7

GROUND ELEVATION 1325'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	50/5"				ML	ALLUVIUM: (continued) Reddish brown (5 YR 5/4), damp, hard, clayey SILT; few sand. Stage I cementation, weakly cemented.
								Total Depth = 20.4' Groundwater not encountered. Backfilled on 7/10/01.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-14

DATE DRILLED 7/5/01 BORING NO. RH-8

GROUND ELEVATION 1329'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/3), dry, hard, silty CLAY; few fine to medium sand; scattered caliche filaments.
		41	8.0	93.5			
5		97/10"	8.7				
		89/11"	10.7				
10		37				ML	Light brown (7.5 YR 6/3), dry, hard, clayey SILT; few fine sand. Stage II cementation, scattered caliche nodules less than 1/4" in diameter.
		54	10.5	84.7			
15		55				SM	Brown (7.5 YR 5/4), damp, very dense, silty SAND; few fine subrounded gravel. Stage II cementation.
		95/11"	11.3			CL	Light brown (7.5 YR 6/3), dry, hard, silty CLAY; few fine sand. Stage II cementation, scattered caliche nodules less than 1/4" in diameter.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-15

DATE DRILLED 7/5/01 BORING NO. RH-8

GROUND ELEVATION 1329'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20						CL	ALLUVIUM: (continued) Light brown (7.5 YR 6/3), dry, hard, silty CLAY; few fine sand, scattered caliche nodules less than 1/2", scattered caliche stringers. Stage II cementation with scattered caliche nodules less than 1/2" in diameter.
		76					
		63/11"	10.8	102.6			
25		64					
							Total Depth = 26.5' Groundwater not encountered. Backfilled on 7/9/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-16

DATE DRILLED 7/10/01 BORING NO. RH-9

GROUND ELEVATION 1329'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Pale brown (10 YR 6/3), dry to damp, hard, clayey SILT. Stage I cementation, weakly cemented.
	Driven	82					
5	Driven	55	7.9	109.0		CL	Pale brown (10 YR 6/3), dry to damp, hard, silty CLAY. Stage I cementation, weakly cemented.
	Driven	48	9.4				
10	Driven	84					
	Driven	34	18.8				
15	Driven	32	18.2	103.3			
	Driven	18	12.4			SM	Brown to pale brown (7.5 YR 5/4 to 10 Yr 6/3), damp, medium dense, silty SAND; trace fine, subrounded gravel. Stage II cementation, gravel has thin coatings.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-17

DATE DRILLED 7/10/01 BORING NO. RH-9

GROUND ELEVATION 1329'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		40	7.3	107.8		SC	ALLUVIUM: (continued) Brown (7.5 YR 5/4), damp, medium dense, clayey fine to coarse SAND; trace subangular fine gravel. Stage II cementation, gravel has thin coatings.
		33					Dense to very dense.
25		90/11"					Very dense.
							Total Depth = 27.8' Groundwater not encountered. Backfilled on 7/10/01.
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-18

DATE DRILLED 7/9/011 BORING NO. RH-10

GROUND ELEVATION 1327'(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry, hard, silty CLAY. Stage I cementation, weakly cemented with scattered caliche filaments.
		31					
5		53					
		94/10"	12.3				
10		62	7.3			ML	Pale brown (10 YR 6/3), dry, hard, clayey SILT. Stage II cementation, scattered nodules.
		66	10.5	86.9			
15		59	7.1				
							Total Depth = 16.5 Groundwater not encountered. Backfilled on 7/9/01.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-19

DATE DRILLED 7/10/01 BORING NO. RH-11

GROUND ELEVATION 1325'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Pale brown (10 YR 6/3), dry, hard, silty CLAY. Stage I cementation, weakly cemented with scattered filaments.
		71	7.5	10.9			
5		85	9.3				
		21	14.4				
10		30	13.8	98.2			
		33					
15		23	16.6				Few sand.
		32				SC	Light brown to very pale brown (7.5 YR 6/3 to 10 YR 7/4), damp, medium dense, clayey SAND. Stage II cementation below 17' bgs.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-20

DATE DRILLED 7/10/01 BORING NO. RH-11

GROUND ELEVATION 1325'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		36	9.3	104.8		SC	ALLUVIUM: (continued) Light brown (7.5 YR 6/3), damp, medium dense, clayey SAND.
							Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/10/01.
25							
30							
35							
40							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-21

DATE DRILLED 7/9/01 BORING NO. RH-12

GROUND ELEVATION 1322'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Pale brown (10 YR 6/3), dry to damp, hard, clayey SILT. Stage I cementation, scattered filaments.
		46	6.7	97.5			
5		50/6"	6.7	91.6			
		36	3.8			SM	Pale brown (10 YR 6/3), dry to damp, very dense, silty SAND; trace fine gravel. Stage I cementation, scattered filaments.
10		76/11"				ML	Pale brown (10 YR 6/3), dry to damp, very hard, SILT.
		50/5"	5.2			SM	Pale brown (10 YR 6/3), dry to damp, very dense, silty SAND; scattered caliche filaments.
15		50/5"	7.5	84.1		CL	Pale brown (10 YR 6/3), dry to damp, hard, silty CLAY; trace fine gravel. Stage II cementation below 15' bgs.
		40					
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-22

DATE DRILLED 7/9/01 BORING NO. RH-12

GROUND ELEVATION 1322'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			65				SM	ALLUVIUM: (continued) Reddish brown (5 YR 5/4), dry, dense, silty SAND; trace fine gravel.
								Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/9/01.
25								
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-23

DATE DRILLED 7/10/01 BORING NO. RH-13

GROUND ELEVATION 1324'(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light to dark brown (7.5 YR 6/4 to 7.5 YR 3/4), damp, very stiff, silty CLAY. Stage I cementation, scattered filaments.
		24	8.7	89.3			
5		30	12.0				Hard.
		21	11.2				
10		50	13.7	101.3			
		31	9.9				Scattered subrounded fine gravel.
15		86/11"					
		56	9.1				
20						ML	Reddish brown (5 YR 5/4), damp to dry, hard, clayey SILT.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-24

DATE DRILLED 7/10/01 BORING NO. RH-13

GROUND ELEVATION 1324'(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY LLG

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20							ML	Stage II cementation, weakly cemented, scattered nodules.
		■	60	8.4	97.6			ALLUVIUM: (continued) Reddish brown (5 YR 5/4), damp to dry, hard, clayey SILT.
								Total Depth = 21.5' Groundwater not encountered. Backfilled on 7/10/01.
25								
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-25

DATE DRILLED 7/5/01 BORING NO. RH-14

GROUND ELEVATION 1323'(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY EMS LOGGED BY EMS REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (7.5 YR 6/4), dry, hard, silty CLAY; trace sand. Stage I cementation, weakly cemented.
		38	7.6	94.9			
							Little fine to coarse sand.
5		39	6.8				
		50/4"	4.5	103.9			Few gravel.
						ML	Light brown (7.5 YR 6/4), dry, very dense, fine sandy SILT.
10		47	5.1				
						SC	Light brown (7.5 YR 6/4), damp, very dense, clayey fine to coarse SAND. Stage I cementation, scattered filaments.
15		83/9"	7.5	99.7			
							Total Depth = 15.8' Groundwater not encountered. Backfilled on 7/5/01.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-26

DATE DRILLED 7/5/01 BORING NO. RH-15

GROUND ELEVATION 1322'(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY EMS LOGGED BY EMS REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Brown (7.5 YR 5/4), damp, hard, clayey SILT; few fine sand. Stage I cementation, scattered filaments.
		44	9.6	86.7			
5		70/11"	10.4	96.5			Weakly to moderately cemented by caliche.
		22	15.5				
10		45	15.4	101.7		CL	Brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage II cementation, scattered caliche filaments and nodules.
						SC	Brown (7.5 YR 5/4), damp, medium dense to dense, clayey fine to medium SAND. Stage II cementation, scattered nodules.
15		20	5.7				
							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/5/01.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-27

DATE DRILLED 7/5/01 BORING NO. RH-16

GROUND ELEVATION 1322'(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY EMS LOGGED BY EMS REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Brown (7.5 YR 5/4), damp, hard, silty CLAY; little fine to medium sand. Stage I cementation, scattered filaments.
		51	7.2	92.7			
5		79	12.5				
		93/9"	20.5	94.5		SM	Brown (7.5 YR 5/4), damp, very dense, silty fine to medium SAND. Stage II cementation, scattered to numerous caliche filaments and nodules.
10		16	18.1			CL	Brown (7.5 YR 5/2), moist, very stiff, silty CLAY. Stage II cementation, scattered caliche nodules.
15		32	17.1	108.3			Hard.
							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/5/01.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-28

DATE DRILLED 7/5/01 BORING NO. RH-17

GROUND ELEVATION 1327'(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75, 8" Diameter Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Auto) DROP 30"

SAMPLED BY EMS LOGGED BY EMS REVIEWED BY LLG

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	ALLUVIUM: Brown (7.5 YR 5/4), damp, medium dense, clayey fine to coarse SAND; few gravel. Stage I cementation, weakly cemented.
		17	4.3	100.7			
5		27	4.7	106.4			
		73/10"	5.8			SM	Brown (7.5 YR 5/4), damp, very dense, silty fine to coarse SAND; few gravel; trace clay. Stage I cementation, weak cementation with scattered caliche filaments.
10		72					
15		85	7.2				
							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/5/01.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-29

DATE DRILLED 6/3/02 BORING NO. RH-17B

GROUND ELEVATION 1320' (MSL) SHEET 1 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SC	ALLUVIUM: Light brown (7.5YR 6/4), dry to damp, medium dense, clayey SAND; weakly cemented by sparse to few calcium carbonate filaments.
		28					
5		30	11.1	105.0			
						SM	Reddish brown (5YR 6/4), dry to damp, medium dense, silty SAND.
		75/10"				ML	Reddish brown, dry to damp, hard, clayey SILT; sparse calcium carbonate stringers; weakly cemented.
10		67/11"	11.4	105.7			
		69				SC	Reddish brown (5YR 6/4), dry to damp, dense, clayey fine to coarse SAND; weakly to moderately cemented by sparse stringers of calcium carbonate. Stage II cementation below 14' bgs.
15		38	12.7	105.6			Medium dense.
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-30

DATE DRILLED 6/3/02 BORING NO. RH-17B

GROUND ELEVATION 1320' (MSL) SHEET 2 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		77/11"				ML	ALLUVIUM: (continued) Pale brown (10YR 6/3), dry to damp, hard, clayey SILT; weakly cemented by calcium carbonate.
25		34					Total Depth = 26.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
30							
35							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-31

DATE DRILLED 6/3/02 BORING NO. RH-18

GROUND ELEVATION 1320' (MSL) SHEET 1 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	ALLUVIUM: Light brown (735YR 6/4), dry to damp, hard, sandy CLAY; trace gravel; trace caliche stringers.
		51					Stage I cementation.
5		74	7.5	102.7			
		100/10"					
10		76	8.8	71.3			Light yellowish brown (10YR 6/4), moderate cementation by calcium carbonate. Stage II cementation below 11' bgs.
		57/11"				SM	Reddish brown (5YR 5/4), dry to damp, medium dense, silty SAND; trace fine gravel; moderately cemented by calcium carbonate.
15		50/6"	9.4	95.2		SC	Reddish brown (5YR 5/4), dry to damp, dense, clayey fine to medium SAND; moderately cemented by calcium carbonate.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-32

DATE DRILLED 6/3/02 BORING NO. RH-18

GROUND ELEVATION 1320' (MSL) SHEET 2 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			50/1"				SC	ALLUVIUM: (continued) Reddish brown (5YR 5/4), dry to damp, very dense, clayey SAND; moderately cemented by calcium carbonate.
25			59					Total Depth = 26.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
30								
35								
40								

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-33

DATE DRILLED 6/3/02 BORING NO. RH-19

GROUND ELEVATION 1320' (MSL) SHEET 1 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, hard, clayey SILT; trace of weak cementation by calcium carbonate.
		45					
5		79/11"	17.4	108.4			Trace calcium carbonate nodules less than 1/4" in diameter.
		43					Moderately well cemented by calcium carbonate; trace sand. Stage II cementation below 8.5' bgs.
						CL	Light yellowish brown (10YR 6/4), dry to damp, hard, silty CLAY; some fine to medium sand; moderately well cemented by calcium carbonate.
10		36	22.0	84.2			
		57					Scattered calcium carbonate nodules less than 1/4" in diameter.
15							
		40	8.0	108.2		SC	Brown (10YR 4/3), dry to damp, medium dense, clayey fine to coarse SAND; trace gravel.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-34

DATE DRILLED 6/3/02 BORING NO. RH-19

GROUND ELEVATION 1320' (MSL) SHEET 2 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		77				SM	ALLUVIUM: (continued) Brown (10YR 4/3), dry to damp, medium dense, silty SAND.
						ML	Light yellowish brown (10YR 6/4), dry to damp, hard, clayey SILT; trace fine sand.
25		77/9"					
							Total Depth = 26.2 feet. Groundwater not encountered. Backfilled on 6/3/02.
30							
35							
40							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-35

DATE DRILLED 6/3/02 BORING NO. RH-20

GROUND ELEVATION 1320' (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Light brown (7.5YR 6/4), dry to damp, stiff to very stiff, clayey SILT; weakly cemented by scattered calcium carbonate filaments.
		15					
5		32	9.1	100.9			Very stiff; Stage I cementation.
	N	50/1"					Hard; cobbles or caliche.
						SM	Light yellowish brown (10YR 6/4), dry to damp, medium dense, silty fine to medium SAND; few caliche nodules less than 1/4" in diameter.
10		54	6.3	89.6			Stage II cementation below 11' bgs.
15		70					Very dense. Moderately well cemented by caliche.
							Total Depth = 16.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-36

DATE DRILLED 6/3/02 BORING NO. RH-21

GROUND ELEVATION 1319' (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						ML	ALLUVIUM: Light brown (7.5YR 6/4), dry to damp, stiff, clayey SILT.
		12					Stage I cementation.
5		16	7.7	100.3			Sandy.
		50/4"					Brown (7.5YR 5/4); hard; silty; trace caliche.
10		92/4"					
15		30					Pale brown (10YR 6/3); caliche nodules less than 1/4" in diameter; Stage II cementation.
							Total Depth = 16.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-37

DATE DRILLED 6/3/02 BORING NO. RH-22

GROUND ELEVATION 1321' (MSL) SHEET 1 OF 1

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CH	ALLUVIUM: Light brown (7.5YR 6/3), dry to damp, hard, silty CLAY; trace fine gravel.
		41					Stage I cementation.
5		70	11.8	88.7			Some fine to medium sand.
						ML	Light brown (7.5YR 6/3), dry to damp, hard, clayey SILT; trace fine gravel.
		80					Trace caliche at 8.3' - 8.5' bgs. Trace caliche nodules less than 0.5" in diameter at 8.5' bgs.
10		48	9.4	101.1			Stage II cementation below 10.5' bgs. Color change to 10YR 7/3; very pale brown.
15		31					Trace fine sand.
							Total Depth = 16.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-38

DATE DRILLED 6/3/02 BORING NO. RH-23

GROUND ELEVATION 1323' (MSL) SHEET 1 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	ALLUVIUM: Light brown (7.5YR 6/4), dry to damp, medium dense; silty fine to coarse SAND; few gravel; trace caliche.
		13					
5		28	3.5	112.8			
						ML	Light brown (7.5YR 6/4), dry to damp, hard, clayey SILT with fine gravel; trace caliche.
		75					Increase in caliche at 8.5' bgs.
10		50/6"					
		57	7.5	95.3			Caliche stringers up to 1/2" long.
						SM	Pale brown (10YR 6/3), dry to damp, medium dense, silty SAND.
15		17					
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-39

DATE DRILLED 6/3/02 BORING NO. RH-23

GROUND ELEVATION 1323' (MSL) SHEET 2 OF 2

METHOD OF DRILLING CME-55, 8" Hollow-Stem Auger

DRIVE WEIGHT 140 lbs. (Cathead) DROP 30"

SAMPLED BY MDE LOGGED BY MDE REVIEWED BY SDN

TH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	58	7.6	110.3	▒	SM	ALLUVIUM: (continued) Pale brown (10YR 6/3) to brown (7.5YR 5/4), dry to damp, medium dense, silty SAND; trace gravel.
								Total Depth = 21.5 feet. Groundwater not encountered. Backfilled on 6/3/02.
25								
30								
35								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198002	10/02	A-40

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

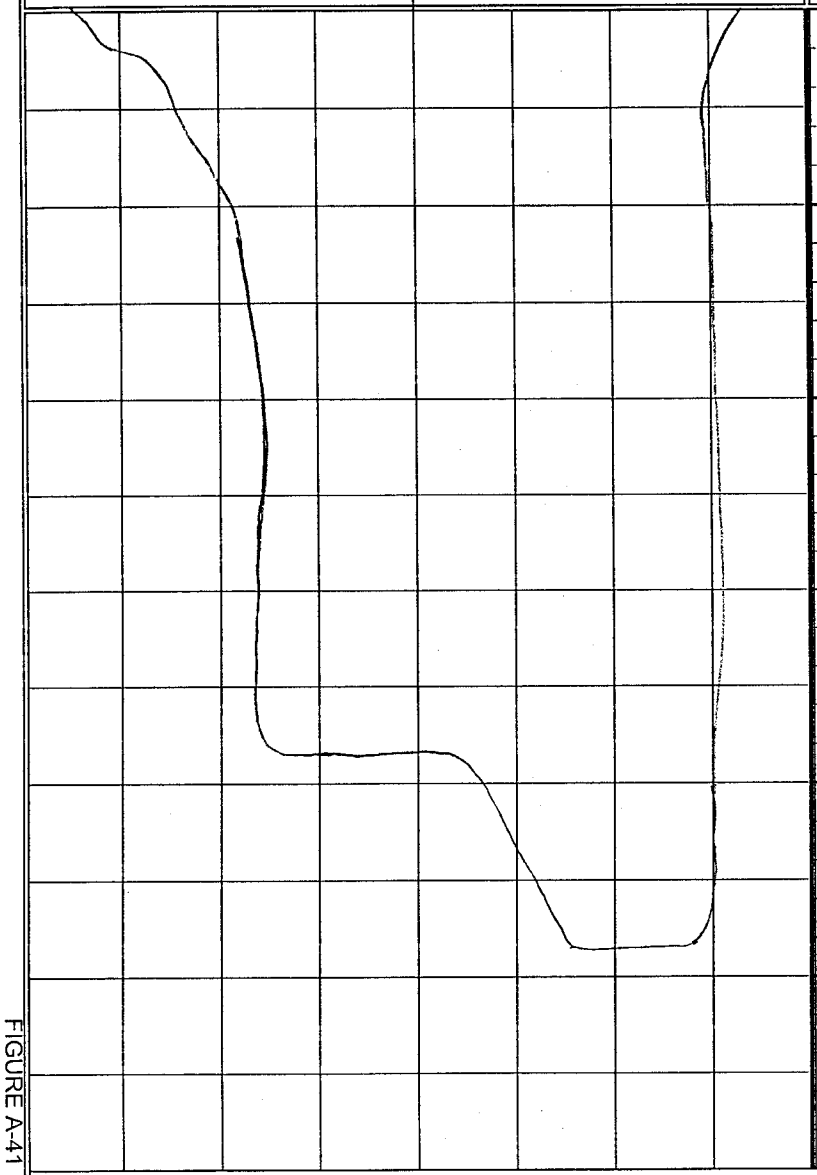
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 11/26/01 TEST PIT NO. TP-1

GROUND ELEVATION -- LOGGED BY MDE

METHOD OF EXCAVATION Backhoe - Ford 555 E

LOCATION 0.4 Mi. N/NE of TP-3, E Side of EMF Rd. at Fenceline



CLASSIFICATION U.S.C.S.	DESCRIPTION
SM	FILL: Brown (7.5 YR 5/4), dry to damp, loose, silty fine to medium sand, scattered fine GRAVEL.
CL	ALLUVIUM: Brown, damp, very stiff, CLAY. @ 2-2.5 feet, scattered calcium carbonate filaments less than 1/4" long, scattered rootlets, scattered caliche nodules less than 1/2" in diameter at 2.0 to 2.5 feet, weakly cemented (Class 1).
ML	Strong brown (7.5 YR 4/6), loose to medium dense, damp, SILT. Stage I cementation, weakly cemented. @ 4 feet bgs, becomes loose, dry to damp. @ 6 feet bgs, becomes dense, with increased calcium carbonate cementation in abundant stringers less than 1" long and scattered rootlet casts, color lightens to brown (7.5 YR 4/4). @ 7 feet, becomes reddish brown (5 Y/R 4/4), with trace to few fine sand, higher observed porosity, strongly reactive with HCL, open pinhole porosity coated with calcium carbonate in-fill. @ 8 feet, pervasive calcium carbonate stringers, degree of cementation increases, color hue lightens to reddish brown (5 YR 5/4), dense. @ 10.5 to 12 feet, medium dense, damp, sparse fine SAND, (7.5 YR 4/6), strong brown, strong reaction with HCL. Stage I cementation decreases. Strong reaction with HCL.
	Total Depth = 12 feet. Groundwater not encountered during drilling. Backfilled on 11/26/01. Excavation Bearing: 201°

SCALE = 1 in./2.5 ft.

FIGURE A-41

Rinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

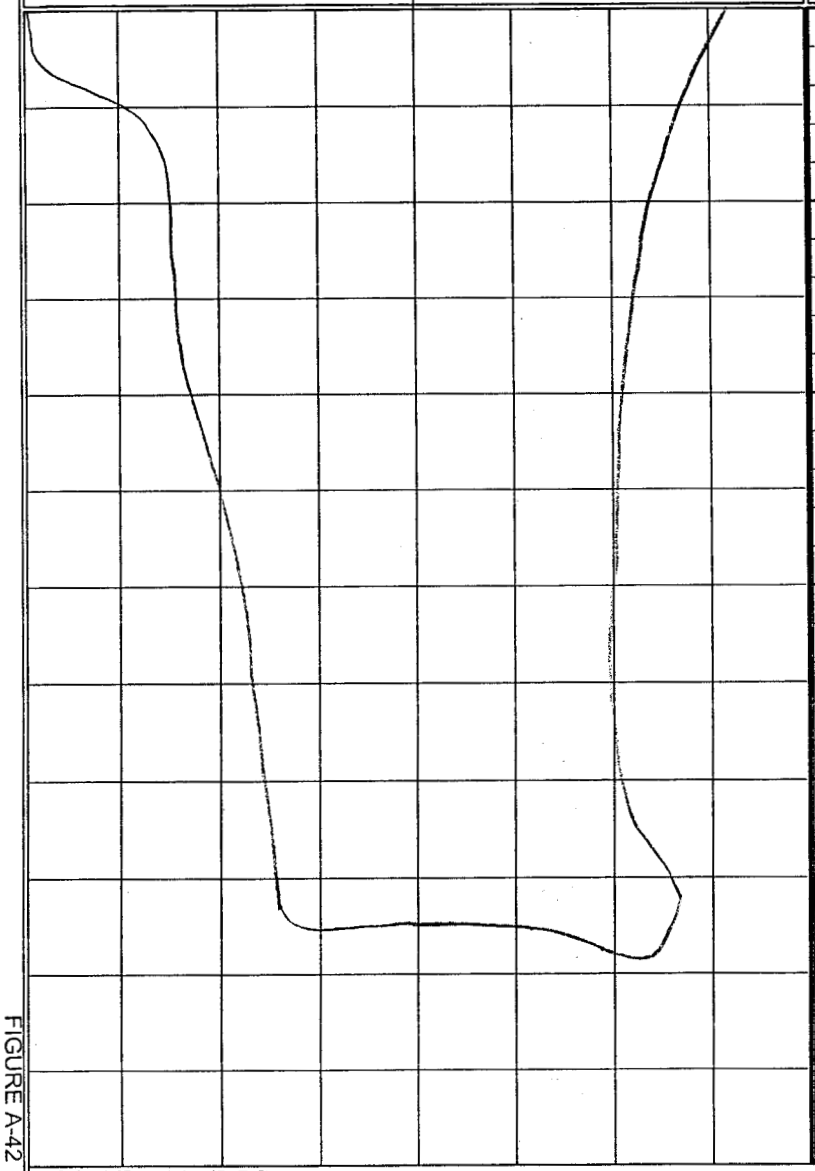
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 11/27/01 TEST PIT NO. TP-2

GROUND ELEVATION -- LOGGED BY MDE

METHOD OF EXCAVATION Backhoe - Ford 555 E

LOCATION 0.2 Mi. S of TP-1, E Side of EMF Rd., E of Road 8'.



CLASSIFICATION U.S.C.S.	DESCRIPTION
CL	ALLUVIUM: Strong brown (7.5 YR 4/6), stiff, damp, silty CLAY; scattered rootlets, scattered pinhole porosity, trace fine sand, trace fine gravel, weak reaction with HCL. Stage I cementation, weakly to non-cemented.
ML	Brown (7.5 YR 5/4), loose to medium dense, dry to damp SILT, trace fine sand, trace fine gravel, scattered rootlets, scattered pinhole porosity, scattered root casts up to 1/8" in diameter. Stage I cementation, scattered filaments less than 1/4" long. @ 4 feet bgs, becomes dense with higher degree of calcium carbonate cementation, silt color lightens to light brown (7.5 YR 6/4), moderate reaction with HCL. @ 7 feet, Stage I cementation with abundant calcium carbonate filaments, very dense pockets of calcium carbonate cementation within sandy silt up to 6" in diameter by 2" thick, surrounding silt is weakly cemented and weakly reactive with HCL.
SM	Strong brown (7.5 YR 5/6), dry to damp, silty SAND; scattered fine gravel, abundant pinhole porosity. Stage II cementation, moderately cemented, scattered to sparse pockets less than 6" in diameter of strong cementation.
ML	Brown (7.5 YR 4/4), damp, medium dense, sandy SILT.
	Total Depth = 12 feet. Groundwater not encountered during drilling. Backfilled on 11/27/01. Excavation Bearing: 200°

SCALE = 1 in./2.5 ft.

FIGURE A-42

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

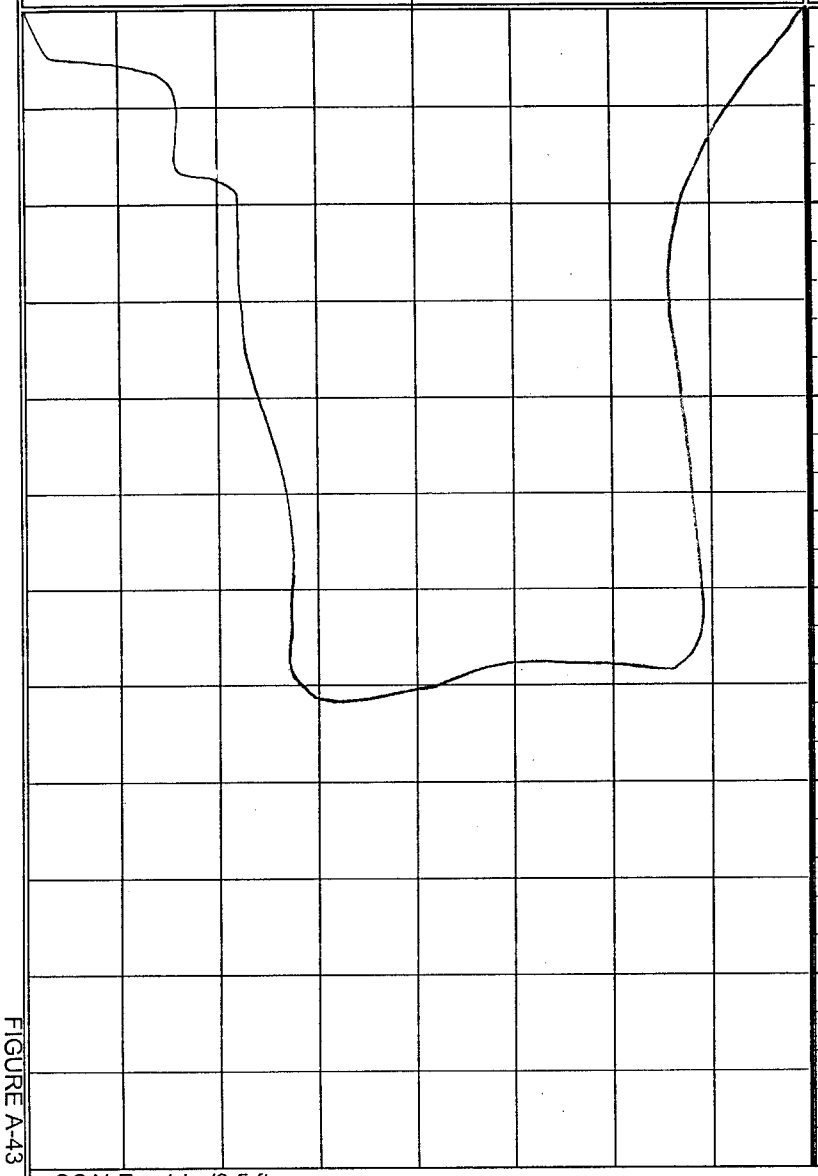
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 11/26/01 TEST PIT NO. TP-3

GROUND ELEVATION -- LOGGED BY MDE/HV

METHOD OF EXCAVATION Backhoe - Ford 555 E

LOCATION E Side of EMF, approx. 500'N of RH-5, E of Road 8'.



CLASSIFICATION U.S.C.S.	DESCRIPTION
SM	FILL: Brown (7.5 YR 5/4), dry to damp, loose, silty fine -to medium SAND; scattered fine gravel.
CL	ALLUVIUM: Dark brown (7.5 YR 3/3), damp, stiff to very stiff, silty CLAY; scattered rootlets. Stage I cementation, weakly to non-cemented.
ML	Strong brown (7.5 YR 4/6), loose to medium dense, damp, SILT; trace fine sand and clay, scattered pinhole porosity, scattered rootlets and roots. Stage I cementation, scattered filaments less than 1/2" long. @ 4 feet bgs, becomes loose. @ 6 feet bgs, becomes hard with higher degree of cementation. @ 7 feet bgs, (10 YR 6/6), changes to fine sandy scattered pockets of silt, higher porosity. Stage I cementation, abundant filaments.
SM	Strong brown (7.5 YR 5/6), dense to medium dense, dry, silty SAND; scattered fine gravel, scattered pinhole porosity. Stage II cementation, moderately cemented, increased calicum carbonate coatings on root casts and open pore space. Refusal on strongly cemented, Stage II material with 555 backhoe.
	Total Depth = 8.5 feet. Groundwater not encountered during drilling. Backfilled on 11/26/01. Excavation Bearing: 215°

SCALE = 1 in./2.5 ft.

FIGURE A-43

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

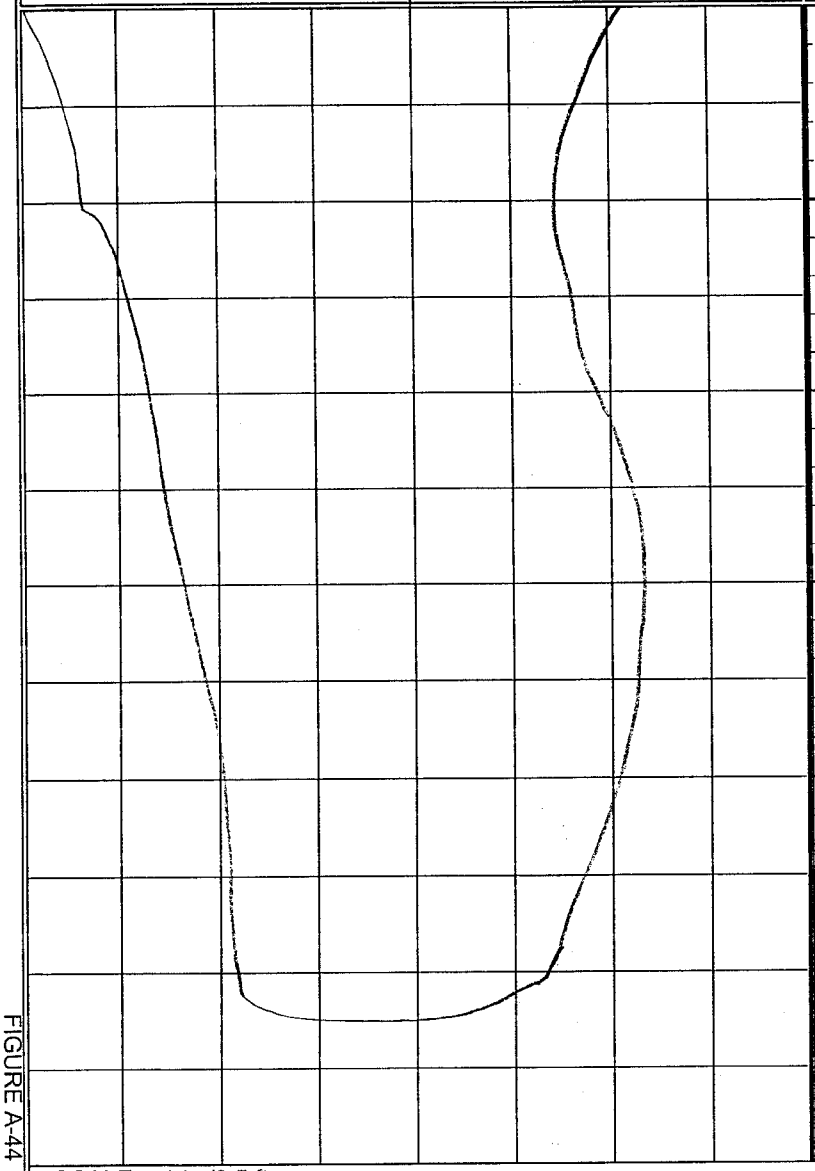
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/22/02 TEST PIT NO. TP-1B

GROUND ELEVATION 1323' (MSL) LOGGED BY TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



CLASSIFICATION U.S.C.S.	DESCRIPTION
CL	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, silty CLAY; few fine gravel; trace caliche nodules less than 1/4" in diameter from 1.5' - 2.5'. @ 1.5' - 2.5': Stiff to very stiff. Strong brown (7.5YR 5/6); stiff to very stiff; less caliche nodules and few caliche filaments; weakly cemented; scattered pinhole voids from 2.5' to 5.0'. Strong reaction with HCl. . Increased cementation; increase in caliche filaments. Soil breaks into lens shapes. Moderate to weak cementation by caliche.
SM	Light brown (7.5YR 6/4), dry to damp, loose, silty SAND; few fine gravel. Few to some fine gravel; numerous caliche nodules and filaments; increased cementation by caliche. Moderately to well cemented (Stage II soil).
	Total Depth = 13.0 feet. Groundwater not encountered. Backfilled on 8/22/02.

SCALE = 1 in./2.5 ft.

FIGURE A-44

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

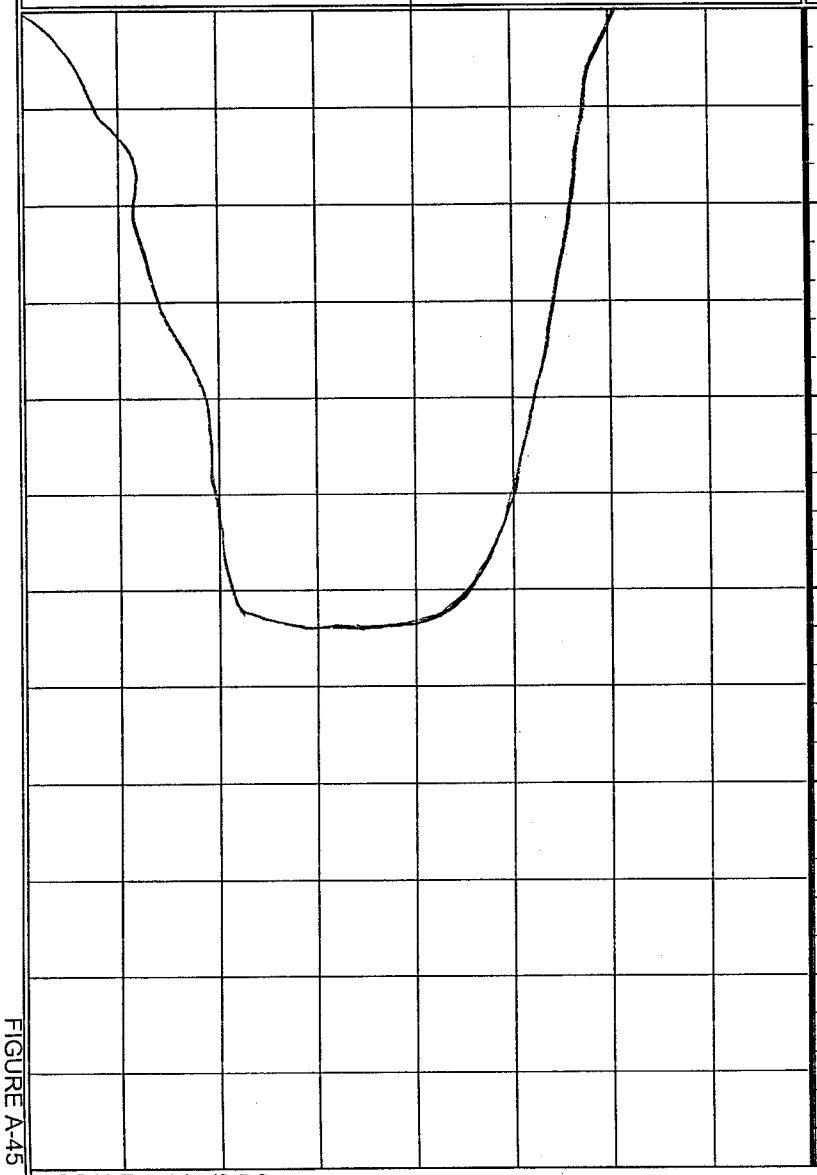
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-2B

GROUND ELEVATION 1320' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



CLASSIFICATION U.S.C.S.	DESCRIPTION
CL	ALLUVIUM: Brown (7.5YR 4/4), dry to damp, soft, silty CLAY; scattered pinhole voids; trace caliche filaments less than 1/4" long; trace rootlets and root casts less than 1/8" in diameter.
ML	Light brown (7.5YR 6/4), dry to damp, soft to stiff, clayey SILT; scattered caliche nodules less than 1/4" in diameter; scattered pinhole voids. Strong reaction with HCl (Stage I soil). Increase in cementation by caliche to moderately cemented. Abundant caliche filaments and intergranular cementation. Few to little caliche nodules less than 1/2" in diameter. Scattered to sparse pockets less than 6" in diameter of strong cementation (Stage II cementation).
	Total Depth = 8.0 feet. Groundwater not encountered. Backfilled on 8/21/02.

SCALE = 1 in./2.5 ft.

FIGURE A-45

Rinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

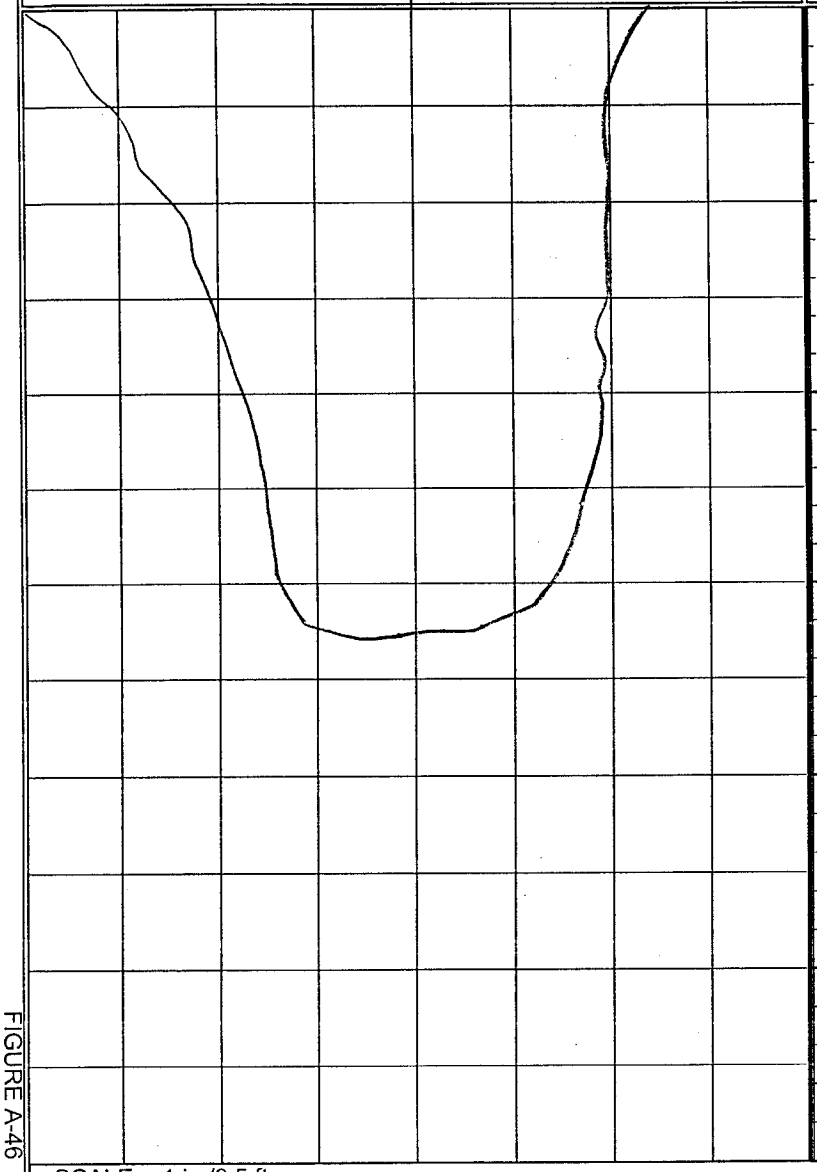
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-3B

GROUND ELEVATION 1320' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



DESCRIPTION	CLASSIFICATION U.S.C.S.
ALLUVIUM: Brown (7.5YR 5/4), dry to damp, soft to stiff, silty CLAY; trace to little caliche filaments; trace rootlets; moderate reaction with HCl.	CL
Trace caliche nodules less than 1/4" in diameter; slight increase in silt content; trace fine sand (Stage I cementation).	
Degree of cementation increases from weak to moderate from 5.0' - 8.0'.	
Trace coarse sand. Soil breaks into coarse gravel to cobble-size, moderately well cemented fragments (Stage II material).	
Total Depth = 8.0 feet. Groundwater not encountered. Backfilled on 8/21/02.	

SCALE = 1 in./2.5 ft.

FIGURE A-46

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

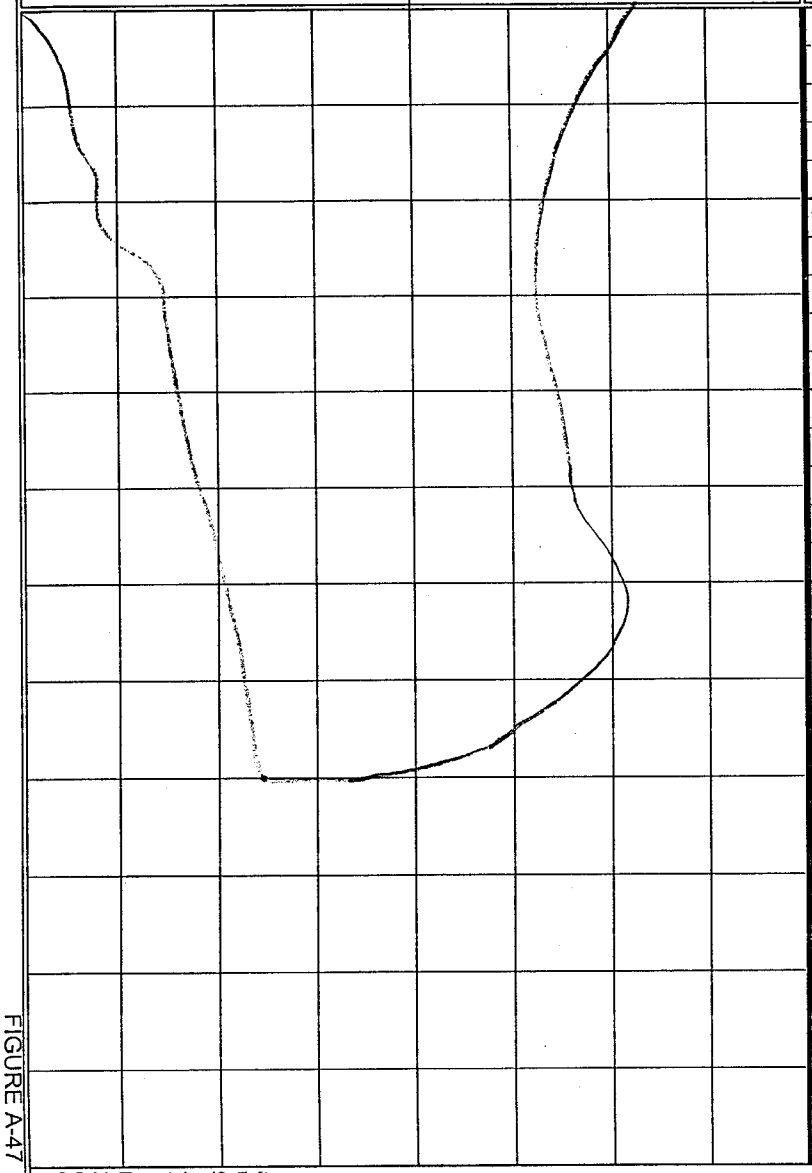
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-4B

GROUND ELEVATION 1308' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



SCALE = 1 in./2.5 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, stiff, silty CLAY; trace caliche filaments; trace fine sand; trace rootlets; non-cemented; strong reaction with HCl.
2.5							Density changes to soft at 2.0'.
5							Brown (7.5YR 4/4); increase in caliche nodules less than 1/2" in diameter; weakly cemented (Stage I soil); strong reaction with HCl.
7.5							Few fine sand (Stage I).
10							Increased cementation by caliche. Color changes to mottled (Stage II soil).
12.5							Trace fine gravel; numerous caliche filaments; moderate to strong cementation by caliche at 10.0'.
15							Total Depth = 10.0 feet. Groundwater not encountered. Backfilled on 8/21/02.

FIGURE A-47

Rinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

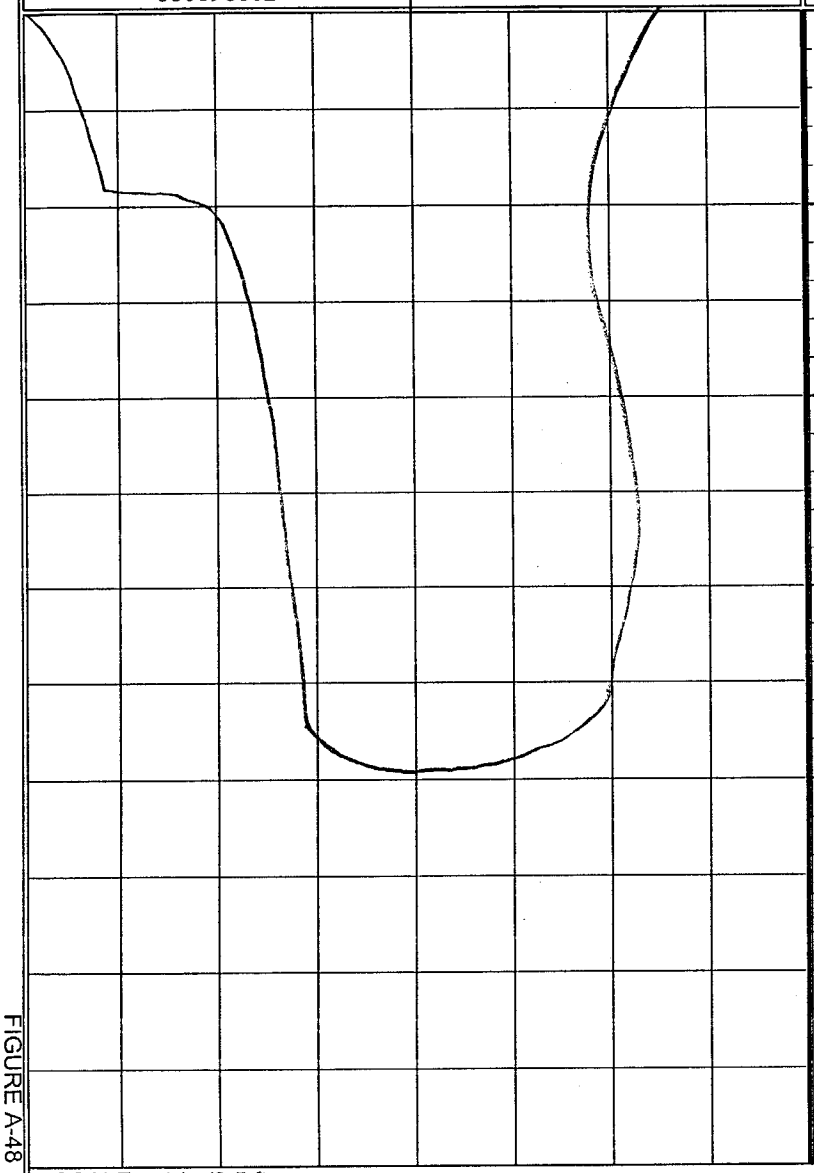
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-5B

GROUND ELEVATION 1320' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Strong brown (7.5YR 5/6), dry to damp, soft to stiff, silty CLAY; scattered rootlets from 0' - 3.0'. Scattered caliche filaments from 0' - 2.0'.
2.5							Stiff; numerous caliche filaments at 2.0'.
5							Brown (7.5YR 4/4); weak reaction with HCl (Stage I soil).
7.5							@ 9.0': Trace coarse sand; abundant caliche filaments. Increased cementation to moderate; moderate to strong reaction with HCl (Stage II cementation).
10							Total Depth = 9.0 feet. Groundwater not encountered. Backfilled on 8/21/02.
12.5							
15							

SCALE = 1 in./2.5 ft.

FIGURE A-48

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

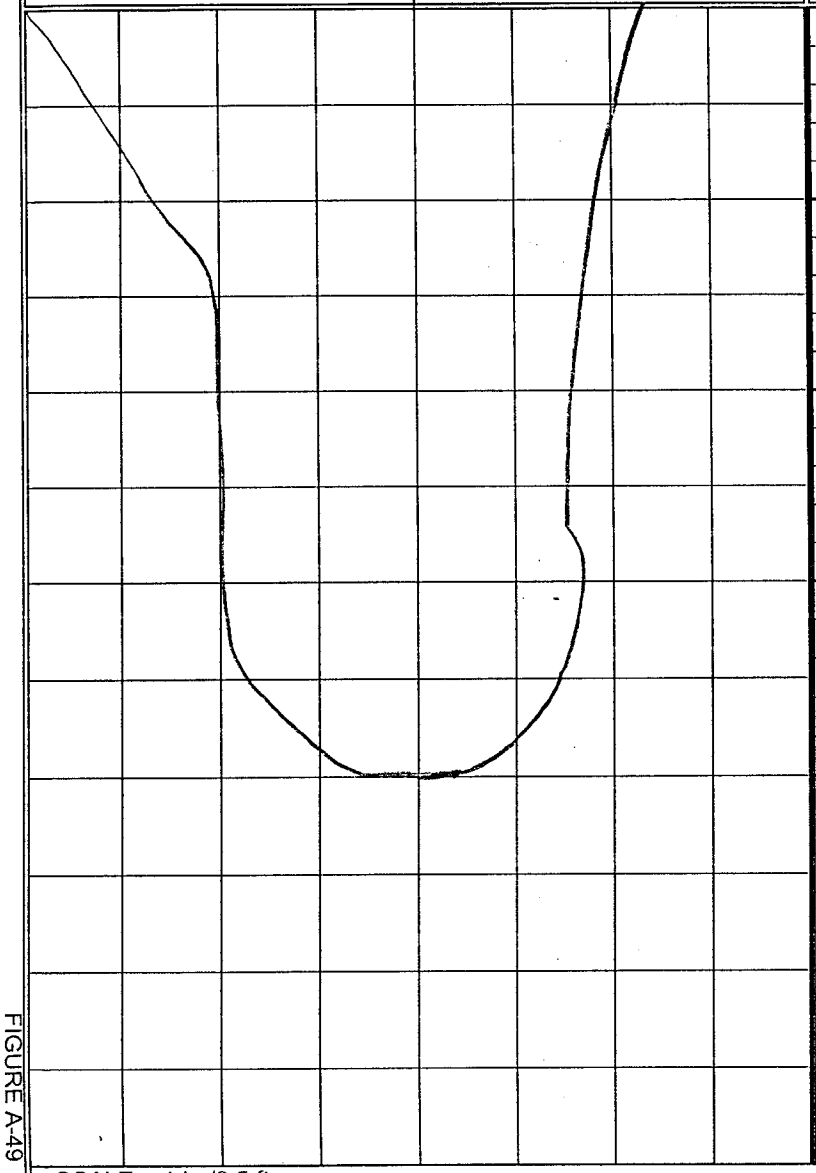
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-6B

GROUND ELEVATION 1322' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



SCALE = 1 in./2.5 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Light brown (7.5YR 6/4), dry to damp, soft to stiff, silty CLAY; scattered fine gravel and coarse sand; scattered caliche filaments less than 1/4" long; scattered caliche nodules less than 1/4" in diameter; scattered pinhole to 1/8" diameter voids. Moderate to strong reaction with HCl (Stage I soil).
2.5							
5							Increased caliche filaments; moderately cemented by caliche; excavated soil breaks into gravel to cobble-size fragments cemented by caliche. Grades into Stage II cementation between 6.5' and 8.0'. Moderately to strongly cemented (Stage II soil) at 8.0'.
7.5							
10							Total Depth = 10.0 feet. Groundwater not encountered. Backfilled on 8/21/02.
12.5							
15							

FIGURE A-49

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-7B

GROUND ELEVATION 1325' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, stiff, silty CLAY; scattered caliche filaments and rootlets; weakly cemented (Stage I soil).
2.5							Few to little fine gravel; few fine sand; soft to stiff; weak reaction with HCl between 3.0' and 4.0'.
5							Scattered to few pinhole to 1/8" voids; scattered rootlets.
7.5							Mottled (brown 7.5YR 5/4) and (dark brown 7.5YR 3/4); slight increase in amount of caliche filaments; slight increase in soil cementation; (Stage I cementation). Numerous caliche filaments; little to some caliche nodules less than 1/2" in diameter; moderately cemented; strong reaction with HCl at 8.0' (Stage II soil).
10							Total Depth = 10.0 feet. Groundwater not encountered. Backfilled on 8/21/02.
12.5							
15							

SCALE = 1 in./2.5 ft.

FIGURE A-50

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

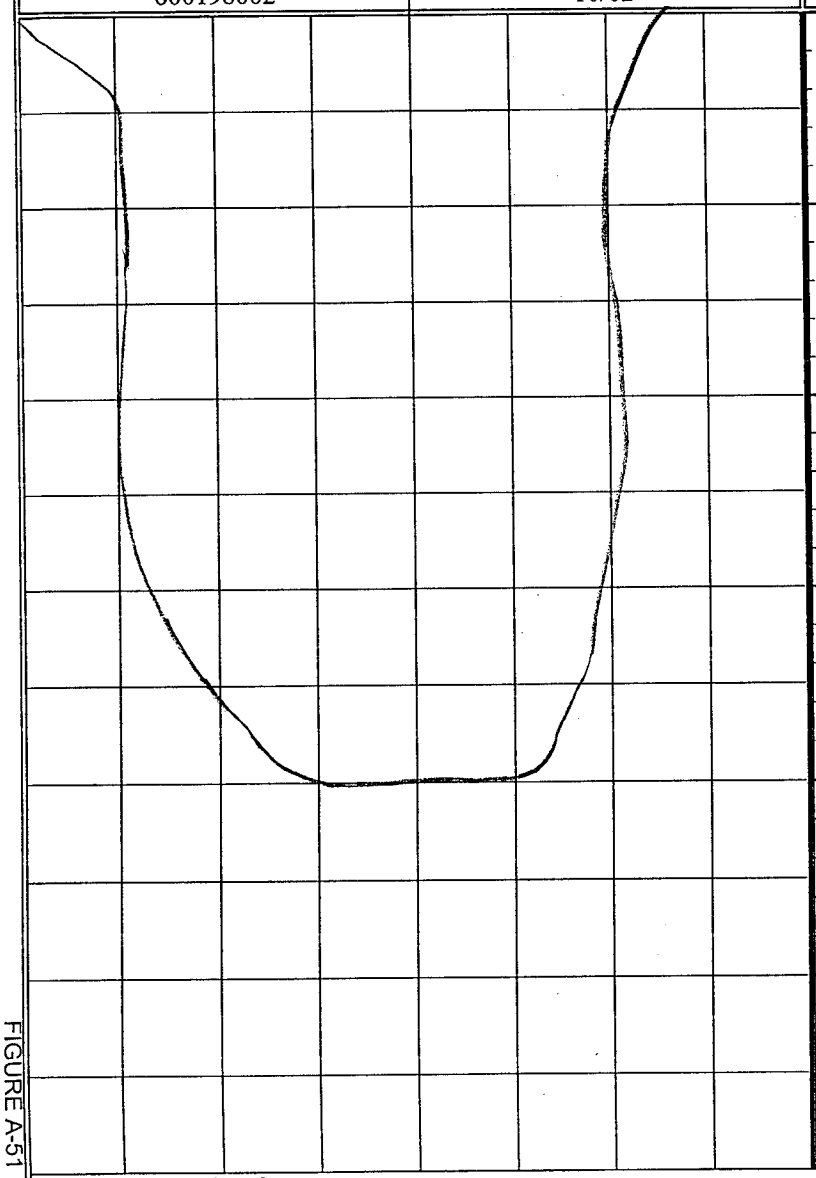
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-8B

GROUND ELEVATION 1309' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, soft to stiff, silty CLAY; trace fine sand; scattered caliche filaments; scattered rootlets; scattered pinhole voids; weakly cemented.
2.5							Soft; non-cemented (Stage I soil).
5							
7.5							
10							Mottled brown (7.5YR 5/4) and dark brown (7.5YR 3/4); increase in cementation to moderately cemented. Numerous caliche filaments and numerous nodules less than 1/2" in diameter (Stage II cementation).
12.5							Total Depth = 10.0 feet. Groundwater not encountered. Backfilled on 8/21/02.
15							

SCALE = 1 in./2.5 ft.

FIGURE A-51

Kinyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

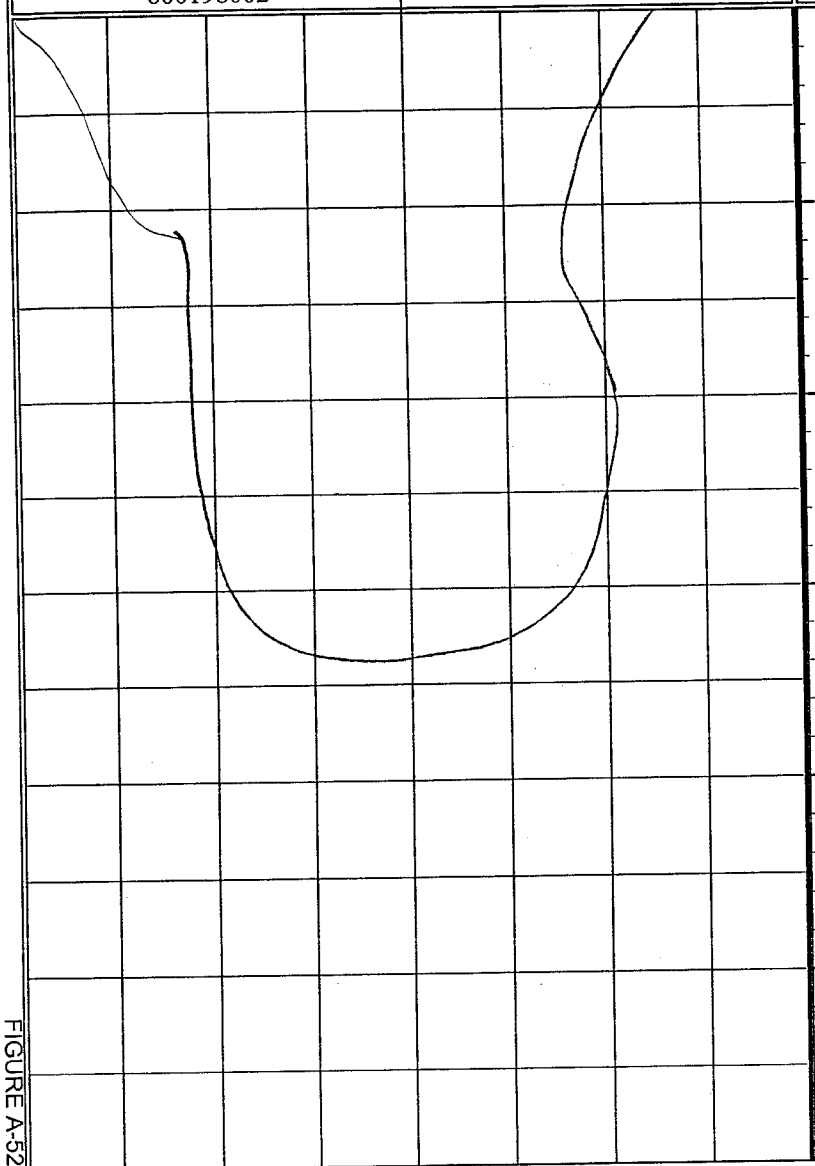
PROJECT NO.	DATE
600198002	10/02

DATE EXCAVATED 8/21/02 TEST PIT NO. TP-9B

GROUND ELEVATION 1312' (MSL) LOGGED BY MDE/TLC

METHOD OF EXCAVATION Backhoe 555E

LOCATION See Location Map



SCALE = 1 in./2.5 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0						CL	ALLUVIUM: Brown (7.5YR 5/4), dry to damp, soft, sandy CLAY; non-cemented; scattered roots and rootlets.
							Stiff; scattered to few caliche filaments; weakly cemented; trace caliche nodules less than 1/4" in diameter at 1.5'. Weak reaction with HCl.
2.5							Dark brown (7.5YR 4/ 4) at 2.5'.
							Very stiff; few caliche nodules less than 1/2" in diameter at 4.5'. Moderate reaction with HCl.
5							Trace fine to coarse sand at 6.5'.
							Scattered to numerous caliche filaments; scattered caliche nodules at 8.0' (Stage I soil).
7.5							Strongly cemented (Stage II soil) at 8.0'.
10							Total Depth = 8.0 feet. Groundwater not encountered. Backfilled on 8/21/02.
12.5							
15							

FIGURE A-52

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 2488-93. Soil classifications are indicated on the logs of the exploratory excavations in Appendix A.

Moisture Content

The moisture content of samples obtained from the exploratory excavations was evaluated in accordance with ASTM D 2216-92. The test results are presented on the logs of the exploratory excavations in Appendix A.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory excavations were evaluated in general accordance with ASTM D 2937-94. The test results are presented on the logs of the exploratory excavations in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422-63. The grain-size distribution curves are shown on Figures B-1 through B-44. 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 4318-00. 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-45 through B-50.

Consolidation Tests

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435-96. 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-51 through B-62.

Maximum Dry Density and Optimum Moisture Content Tests

The maximum dry density and optimum moisture content of selected representative soil samples were evaluated in general accordance with ASTM D 698-00. The results of these tests are summarized on Figures B-63 through B-65.

Expansion Index Tests

The expansion index of selected materials was evaluated in general accordance with U.B.C. Standard No. 18-2. Specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 1 percent). The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of these tests are presented on Figure B-66.

Soil Corrosivity Tests

Soil pH and minimum resistivity tests were performed on representative samples in general accordance with Arizona Test 236b. The chloride content of selected samples was evaluated in general accordance with Arizona Test 736. The sulfate content of selected samples was evaluated in general accordance with Arizona Test 733. The test results are presented on Figure B-67.

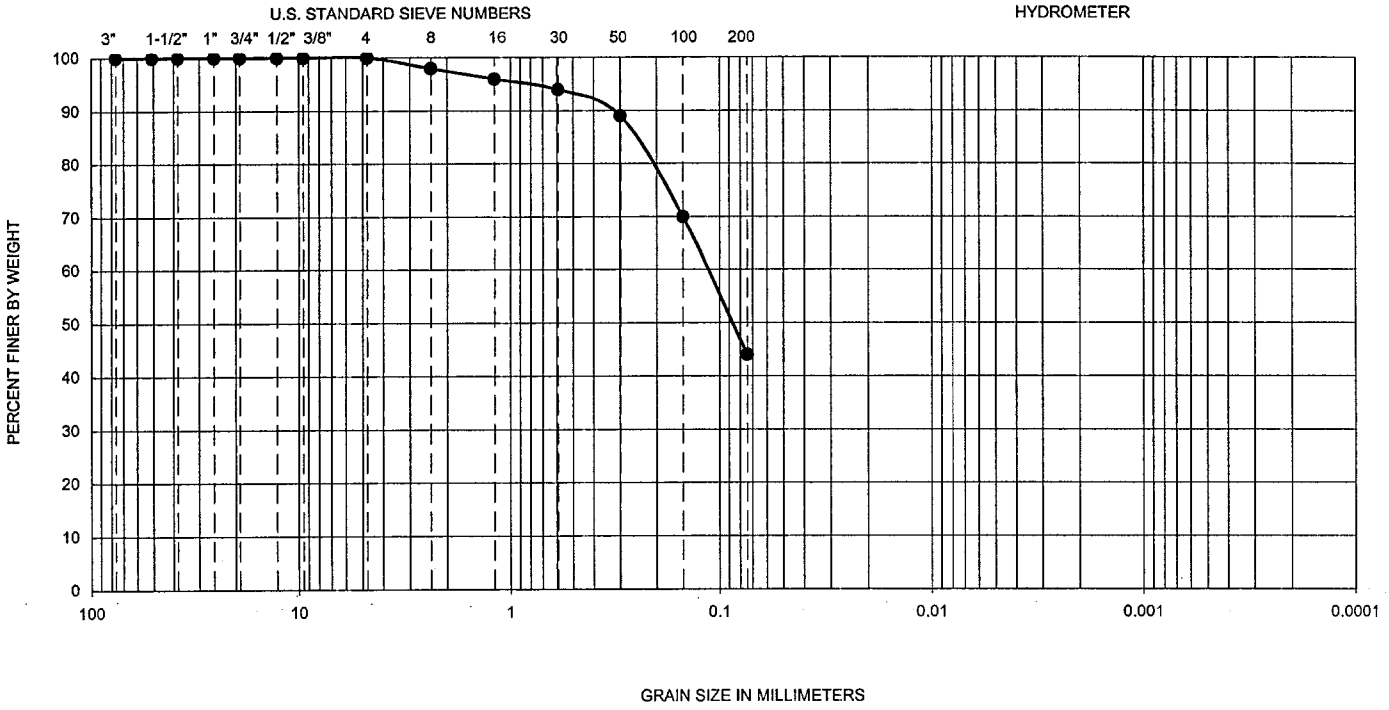
Permeability Tests

Constant head permeability tests were performed on selected remolded soil samples in general accordance with ASTM D 2434-68. The samples were placed in the apparatus and saturated. Water flow through the soil was sustained using a pneumatically induced head at specified pressures. The quantity of flow, the elapsed time, and the hydraulic gradient were recorded. The permeability was then calculated using Darcy's equation. The results of the tests are presented on Figure B-68.

Unconsolidated Undrained Triaxial Compression Tests

Triaxial compression tests were performed on selected remolded and undisturbed samples in general accordance with ASTM D 2850-95. The test results are shown on Figures B-69 and B-70.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-1	10-11.5	--	--	NP	--	--	--	--	--	44	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

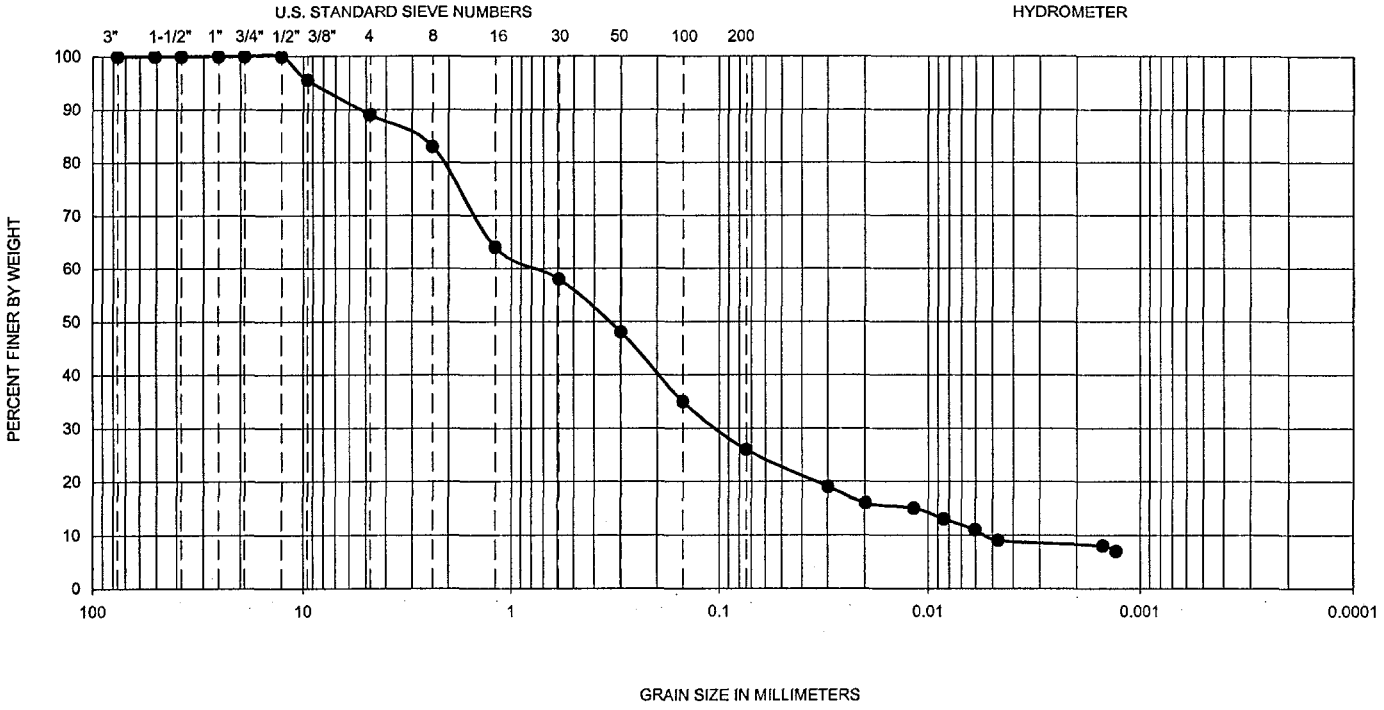
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-1

SIEVE RH-01@10

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-1	25.0-26.5	--	18	--	0.01	0.11	0.84	167.2	2.8	26	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

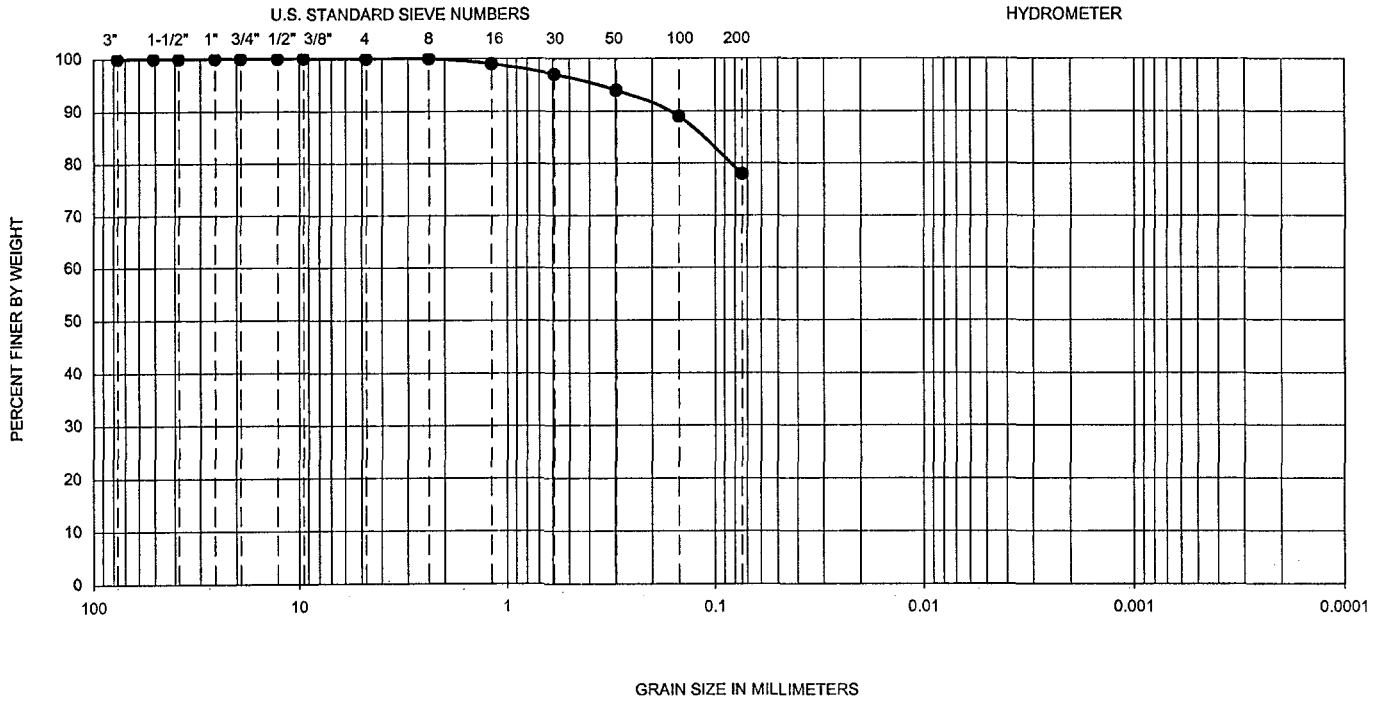
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-2

RH-1 25 TO 26.5 SIEVE+HYDRO1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-2	2.5-4	34	8	26	--	--	--	--	--	78	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

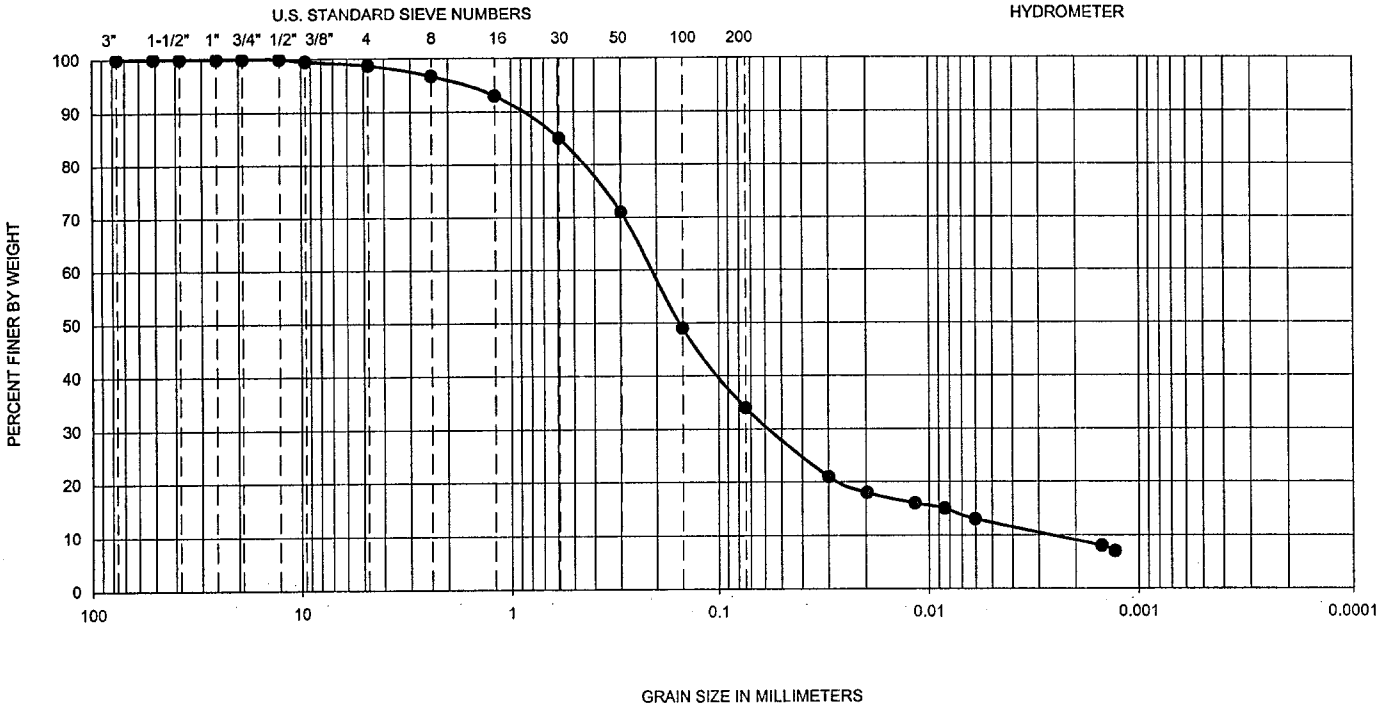
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-3

SIEVE RH-02@2

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-2	12.5-14.0	23	17	6	0.004	0.07	0.22	56.0	4.7	34	SC-SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

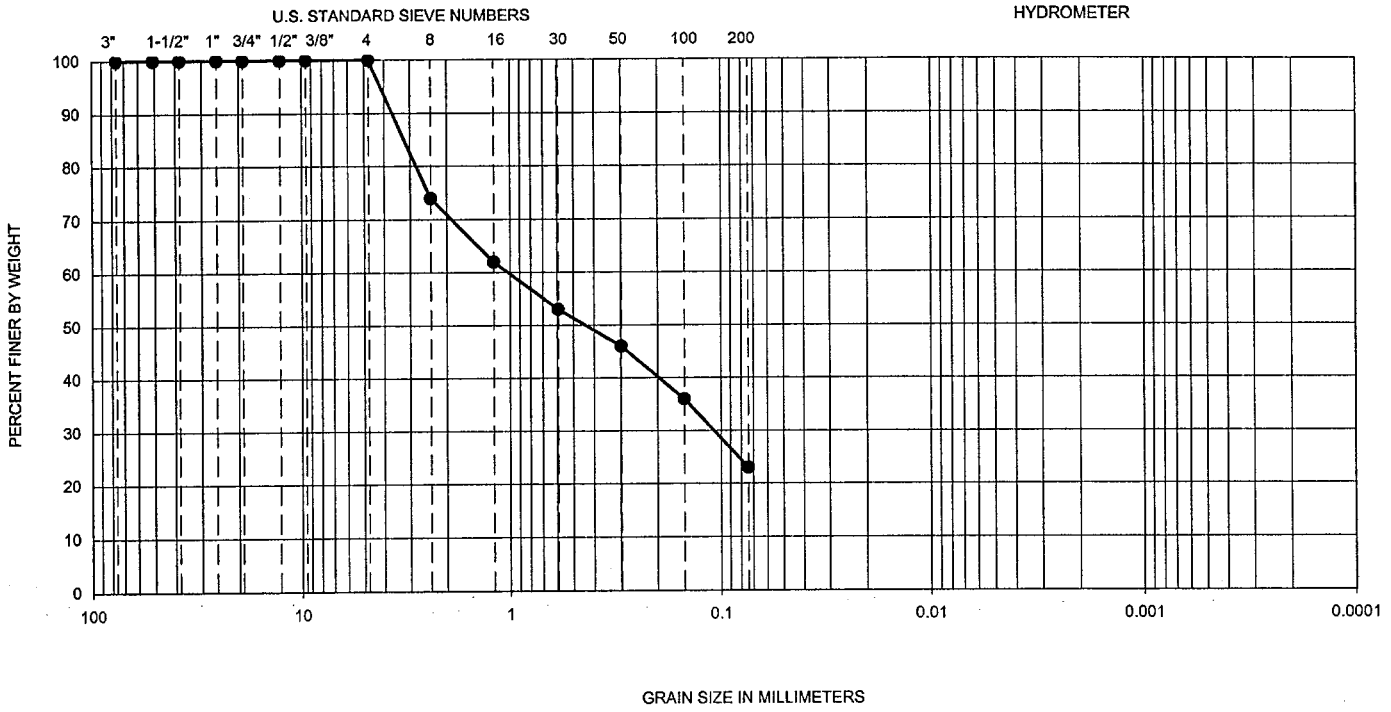
Ninyo & Moore

GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-4

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-3	5-6.5	28	24	4	--	--	--	--	--	23	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

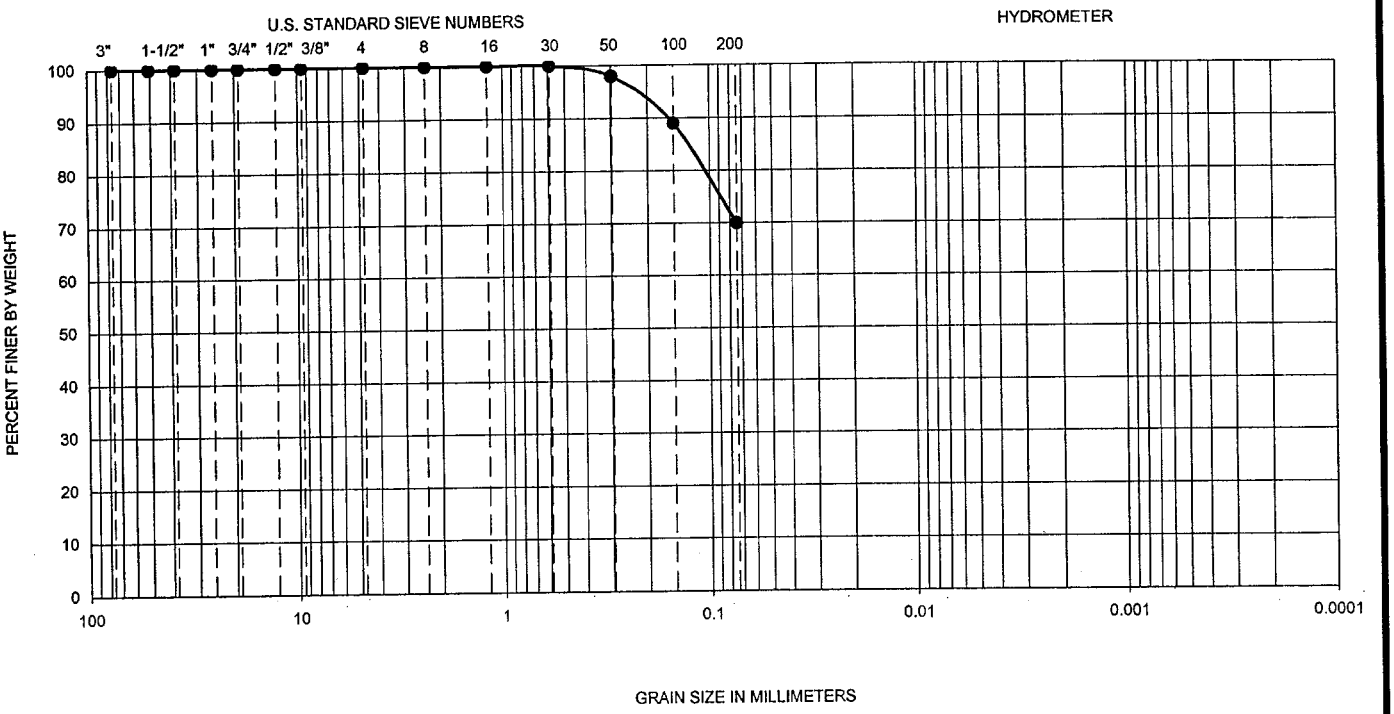
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-5

SIEVE RH-03@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-4	5-6.5	27	15	12	--	--	--	--	--	70	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

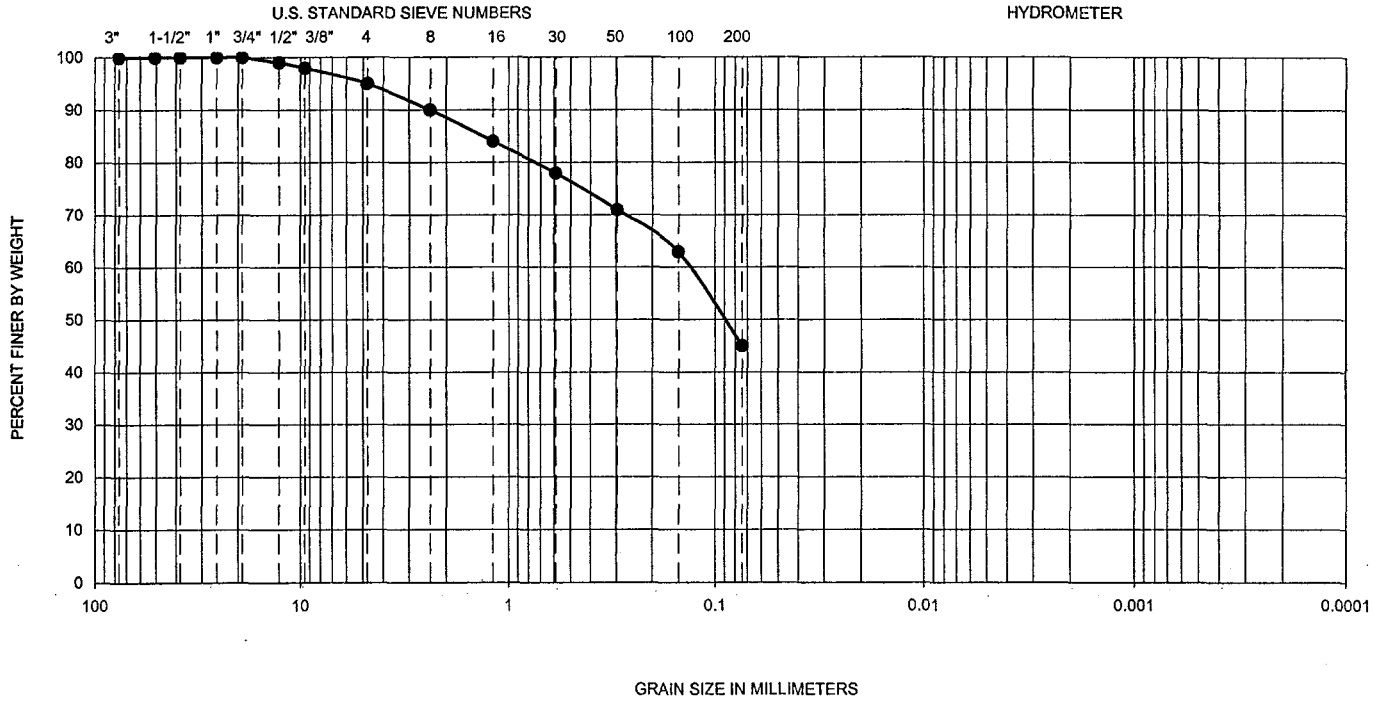
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-6

SIEVE RH-04@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-4	15-16.5	29	16	13	--	--	--	--	--	45	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

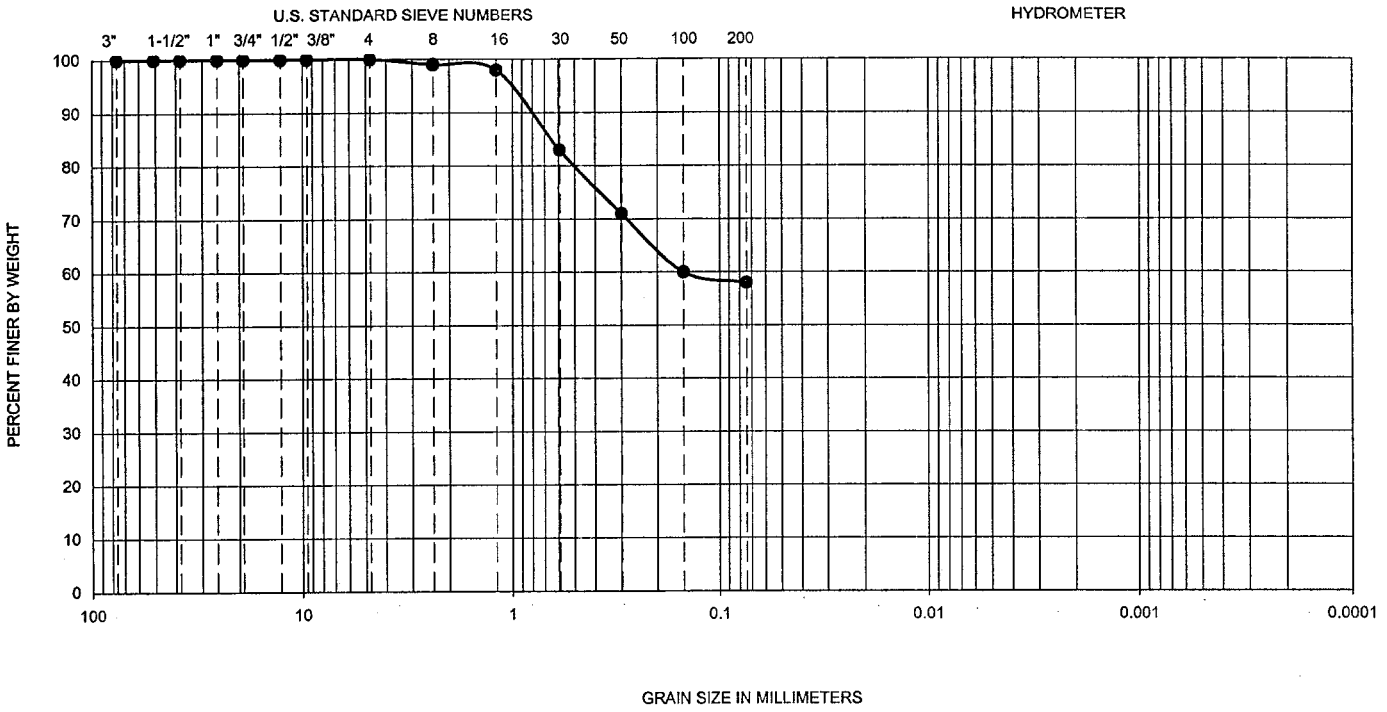
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-7

SIEVE RH-04@15

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-5	5-6.5	25	20	5	--	--	--	--	--	58	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

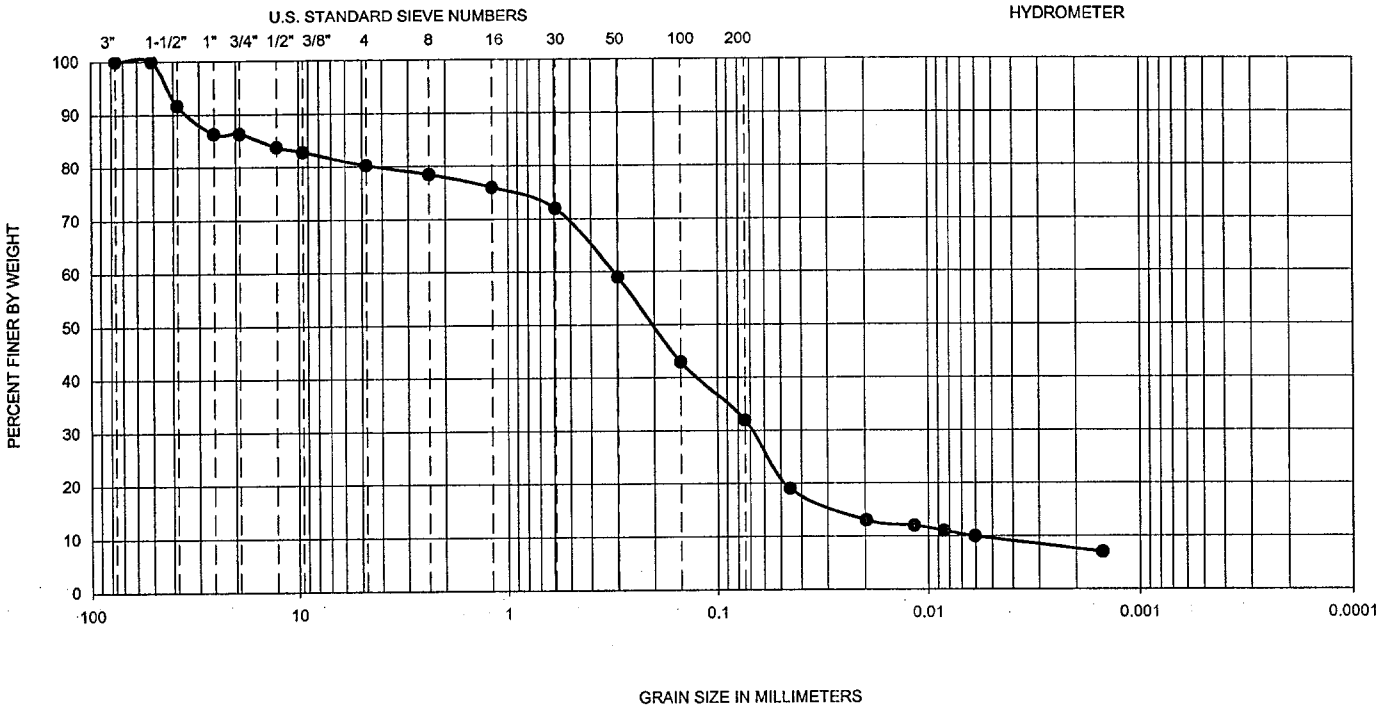
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-8

SIEVE RH-05@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-5	20.0-21.5	27	19	8	0.006	0.07	0.32	53.5	2.6	32	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

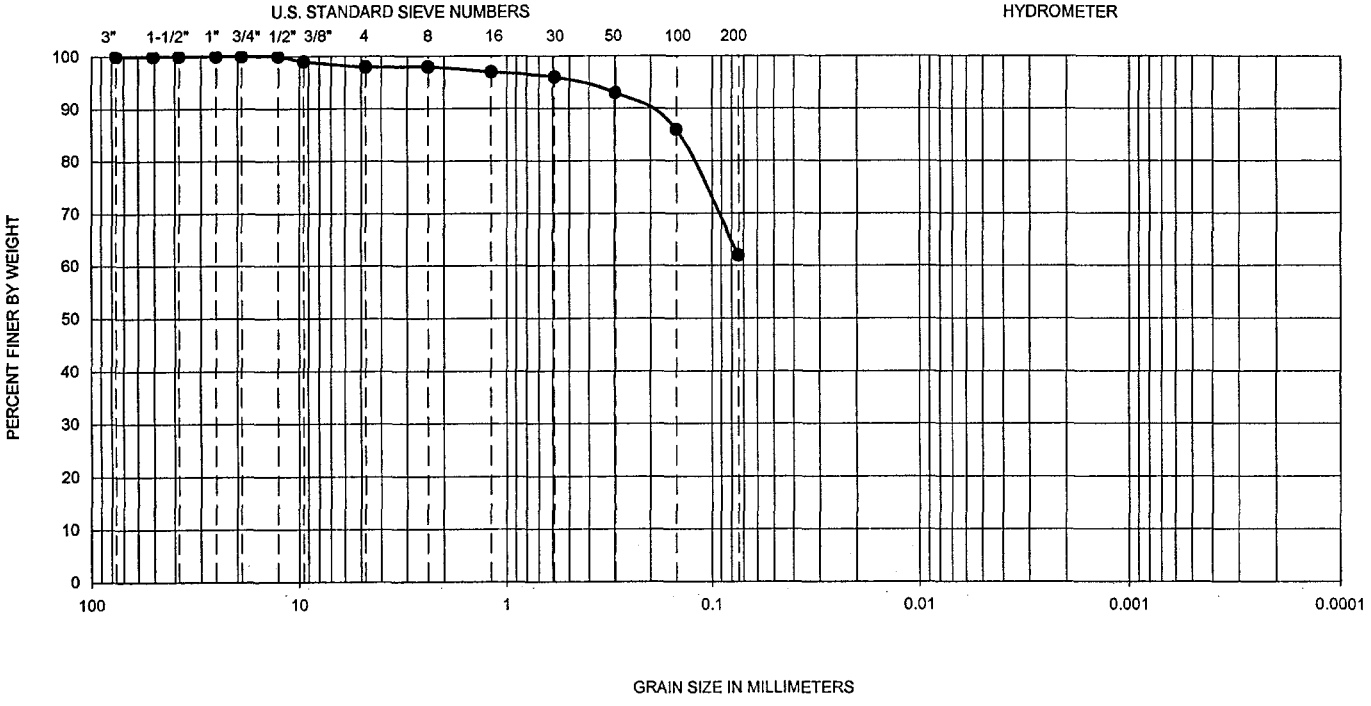
Ninyo & Moore

GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-9

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-6	10-11.5	28	19	9	--	--	--	--	--	62	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

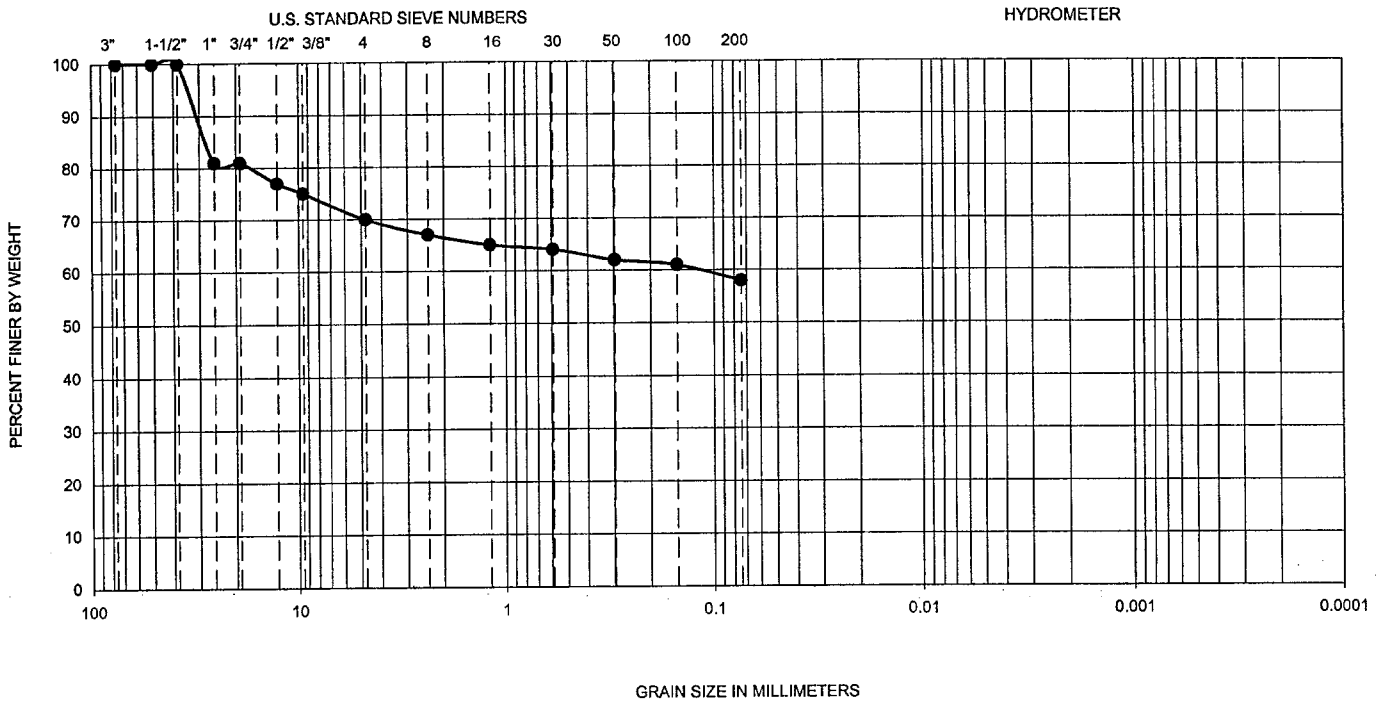
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-10

SIEVE RH-06@10

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-6	15-16.5	32	19	13	--	--	--	--	--	58	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

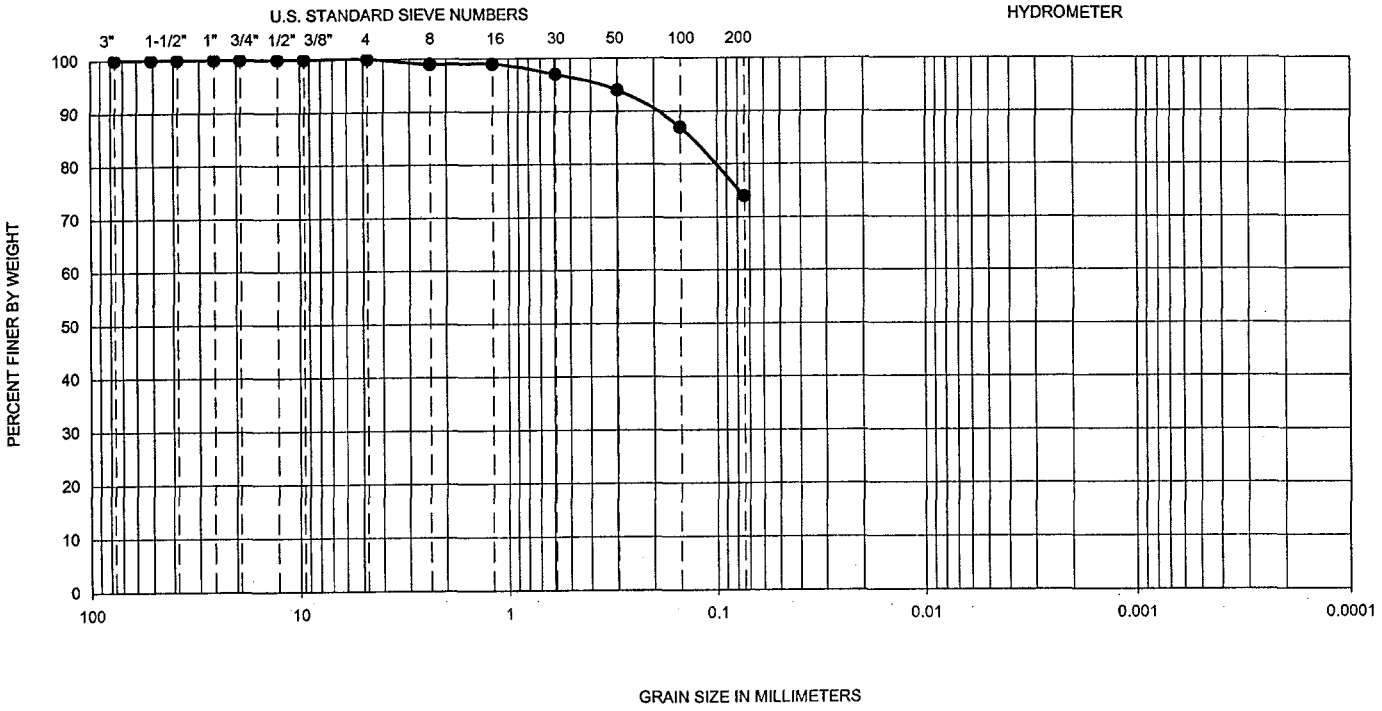
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-11

SIEVE RH-06@15

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-7	2.5-4	30	16	14	--	--	--	--	--	74	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

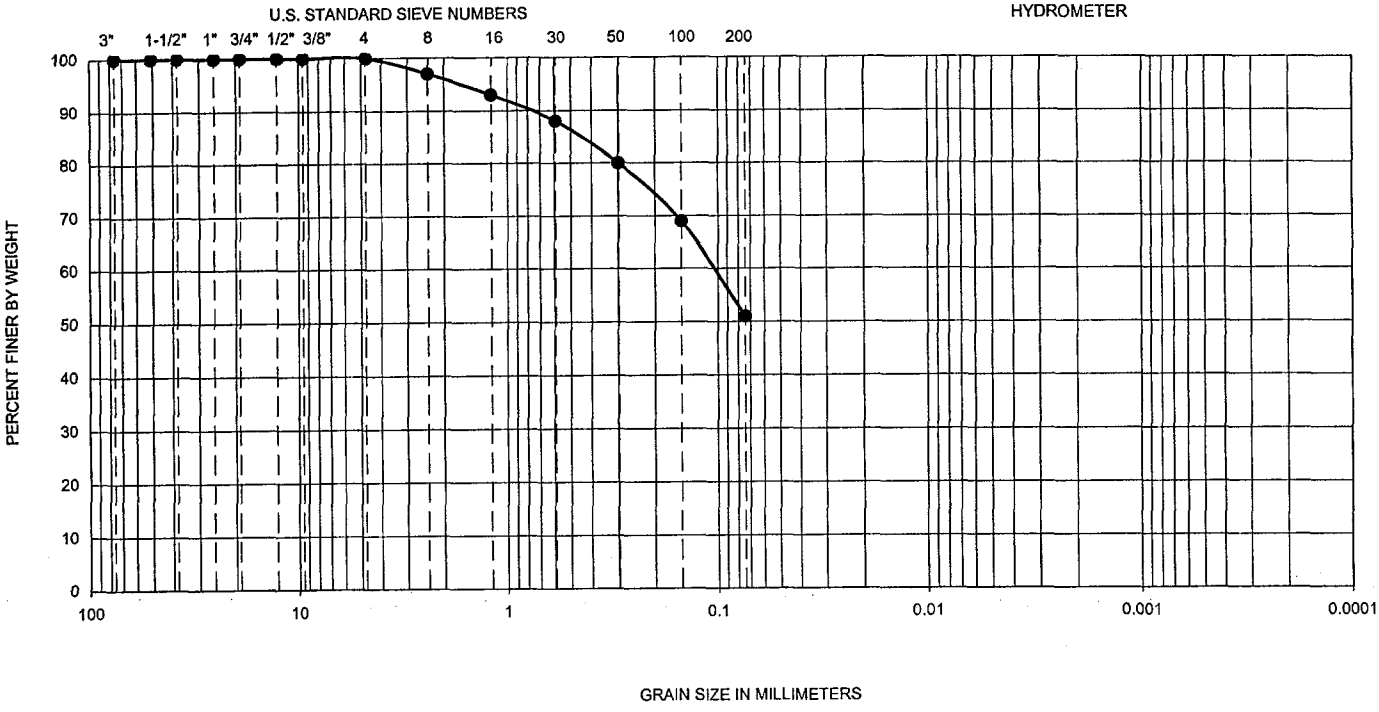
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-12

SIEVE RH-07@2

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-7	17.5-18.5	32	19	13	--	--	--	--	--	51	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

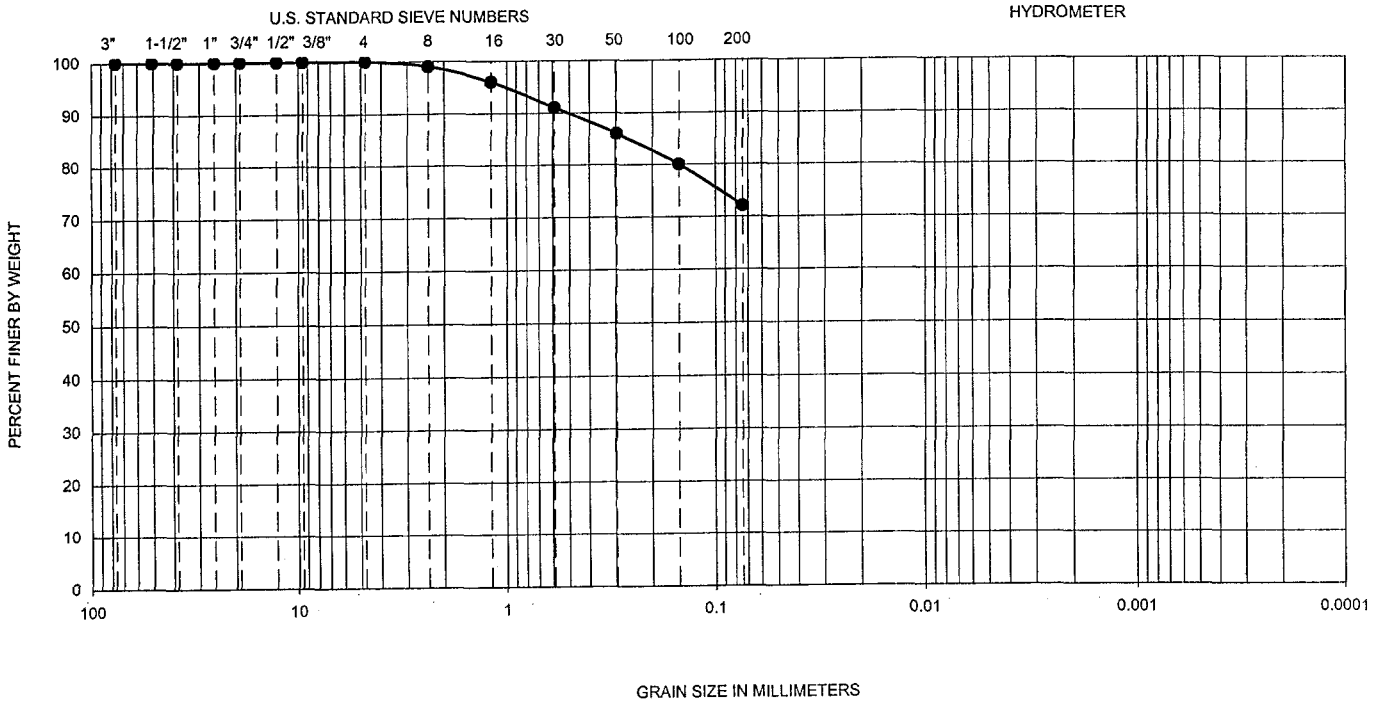
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-13

SIEVE RH-07@17

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-8	7.5-8.9	32	21	11	--	--	--	--	--	72	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

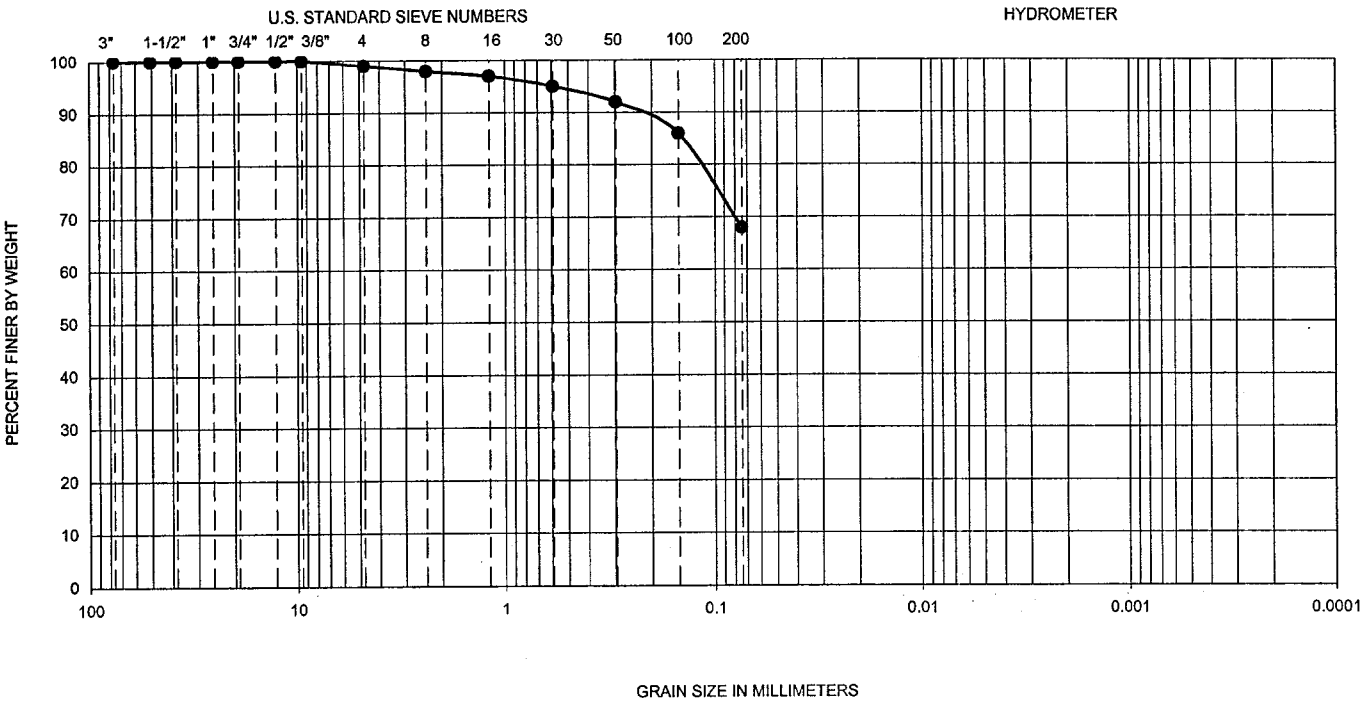
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-14

SIEVE RH-08@7.xls

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-8	17.5-18.9	36	16	20	--	--	--	--	--	68	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

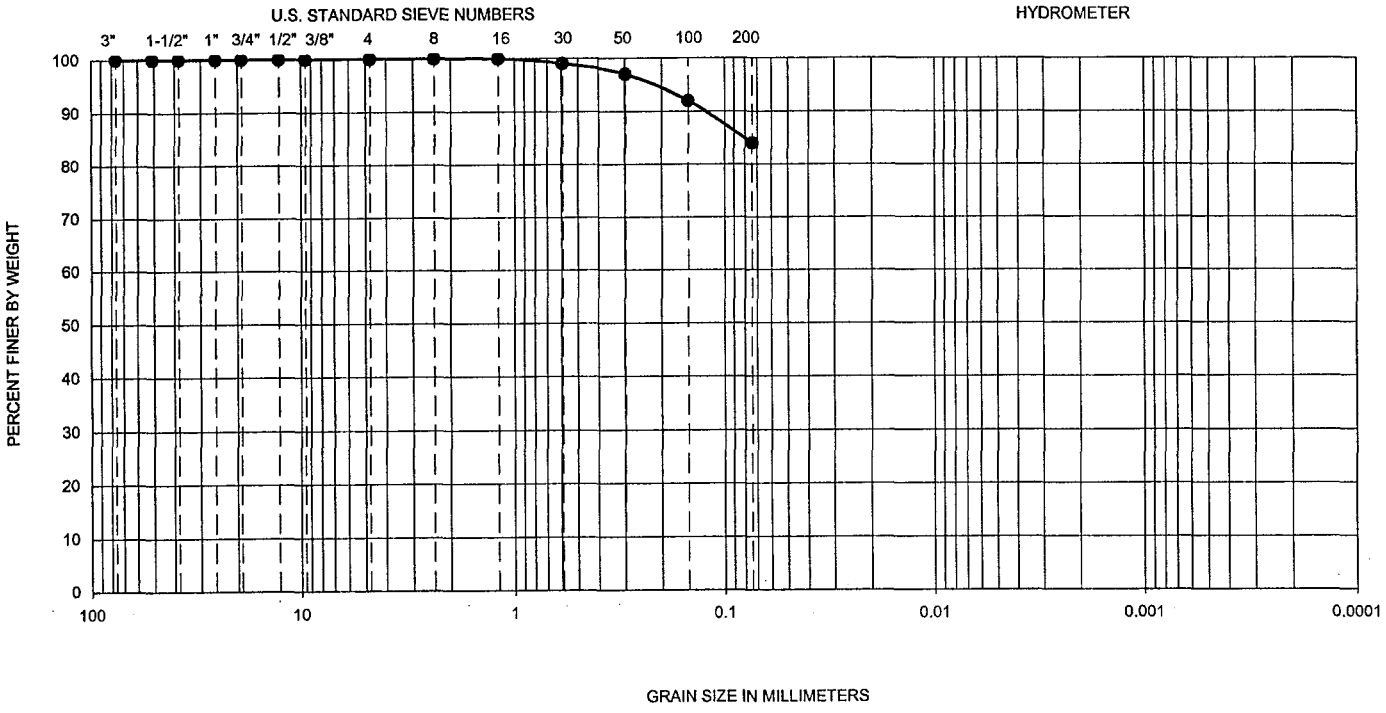
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-15

SIEVE RH-08@17

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-9	5-6.5	28	17	11	--	--	--	--	--	84	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

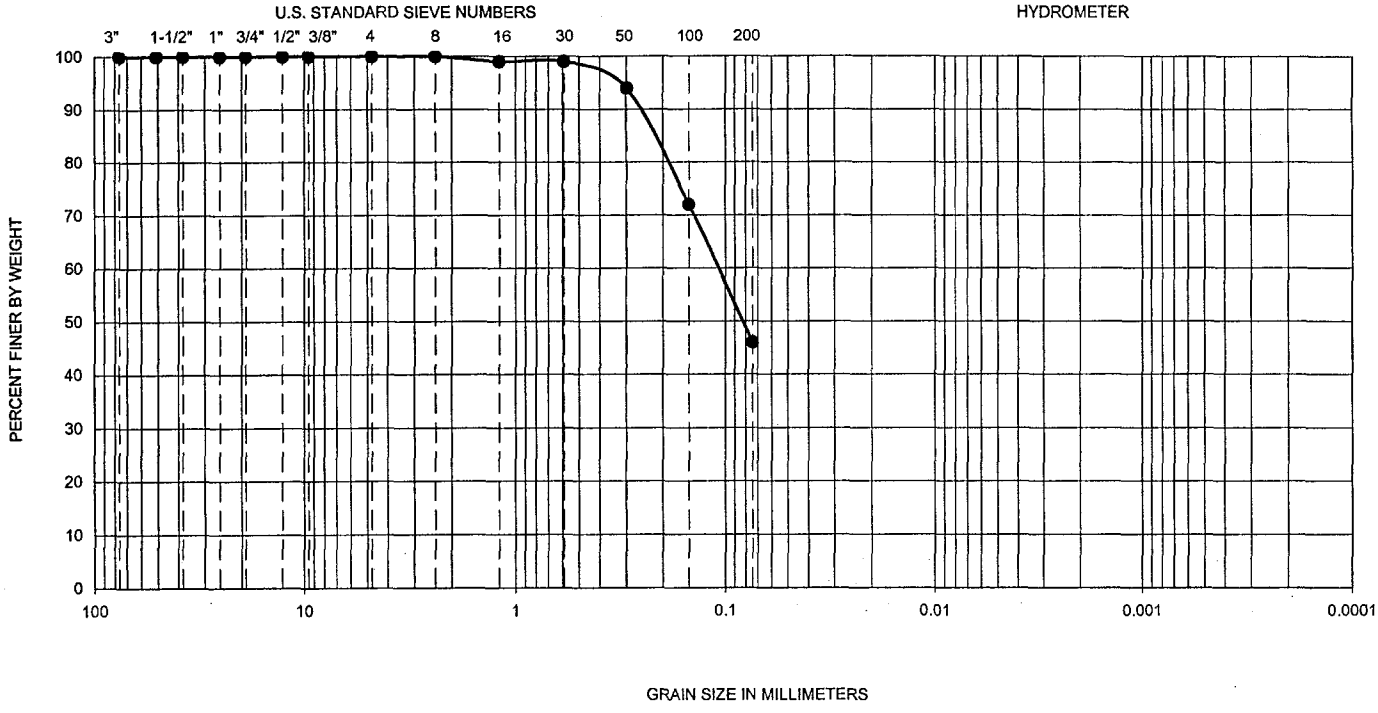
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-16

SIEVE RH-09@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-9	20-21.5	--	--	NP	--	--	--	--	--	46	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

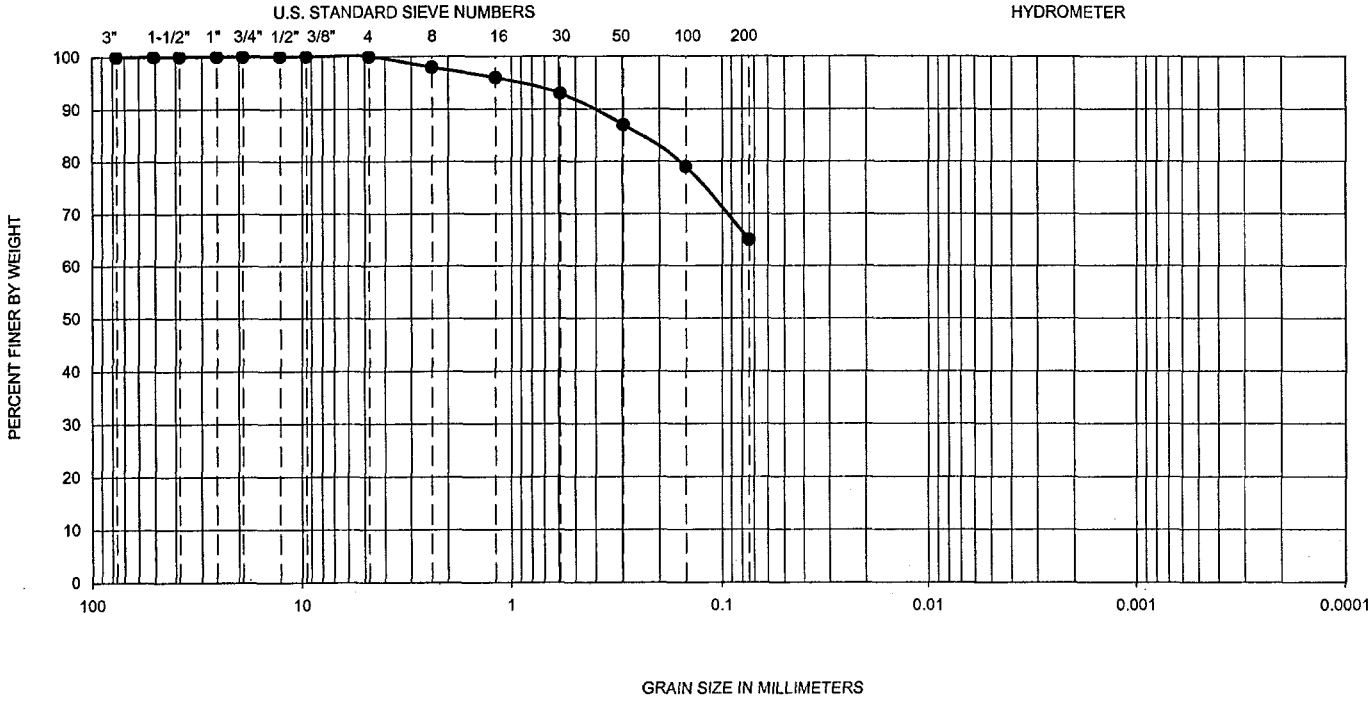
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-17

SIEVE RH-09@20

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-10	12.5-14	30	23	7	--	--	--	--	--	65	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

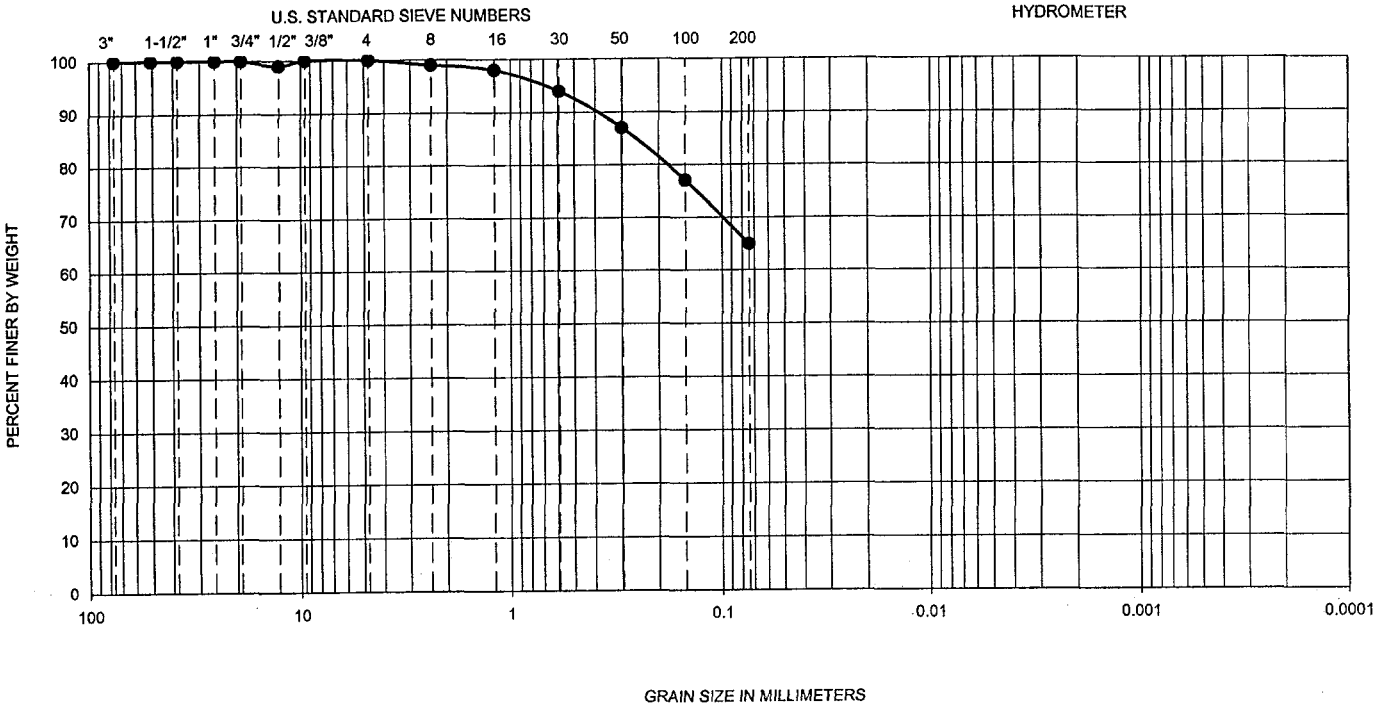
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-18

SIEVE RH-10@12

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-11	10-11.5	36	19	17	--	--	--	--	--	65	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

GRADATION TEST RESULTS

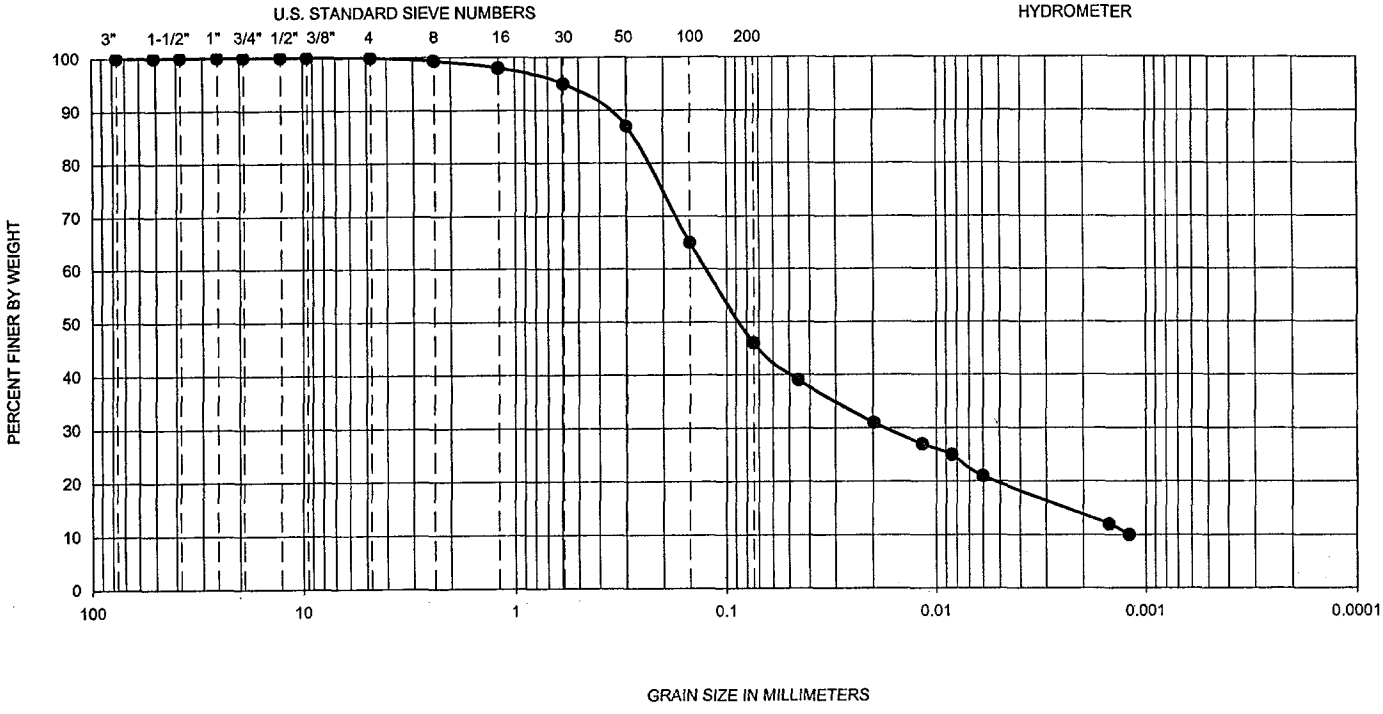
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE
600198002	10/02

FIGURE B-19

SIEVE RH-11@10

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-11	17.5-19.0	35	17	8	0.001	0.02	0.13	129.0	2.8	46	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

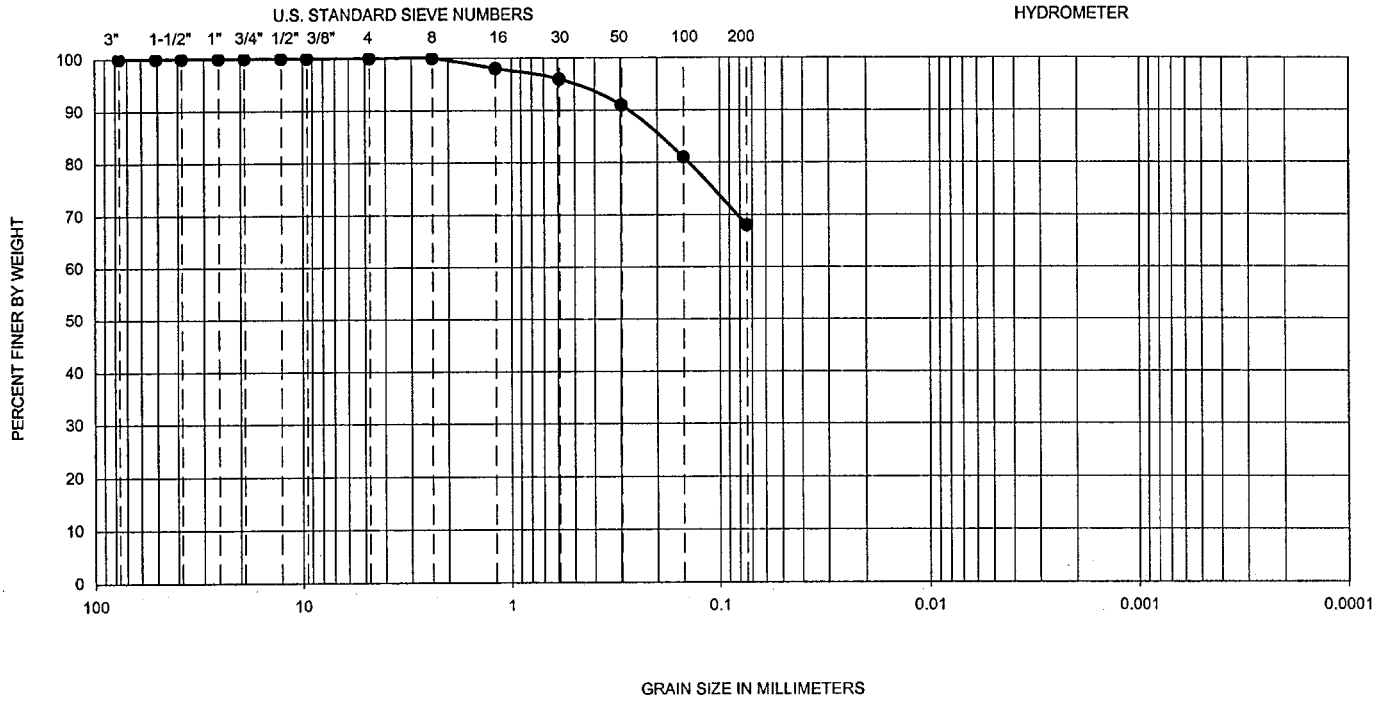
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-20

RH-11 17.5 TO 19.0 SIEVE+HYDRO1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-12	5-5.5	--	--	NP	--	--	--	--	--	68	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

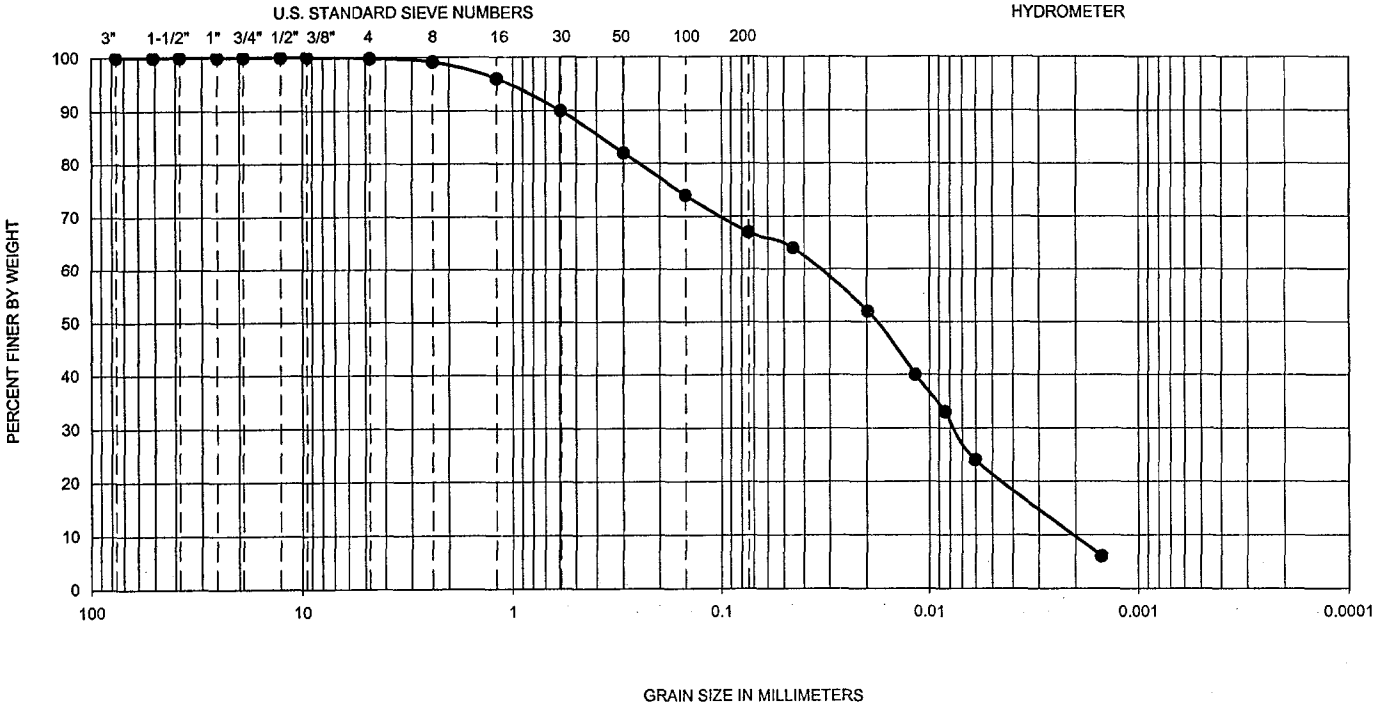
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-21

SIEVE RH-12@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-12	10.0-11.5	--	--	NP	0.002	0.01	0.03	15.0	1.1	67	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

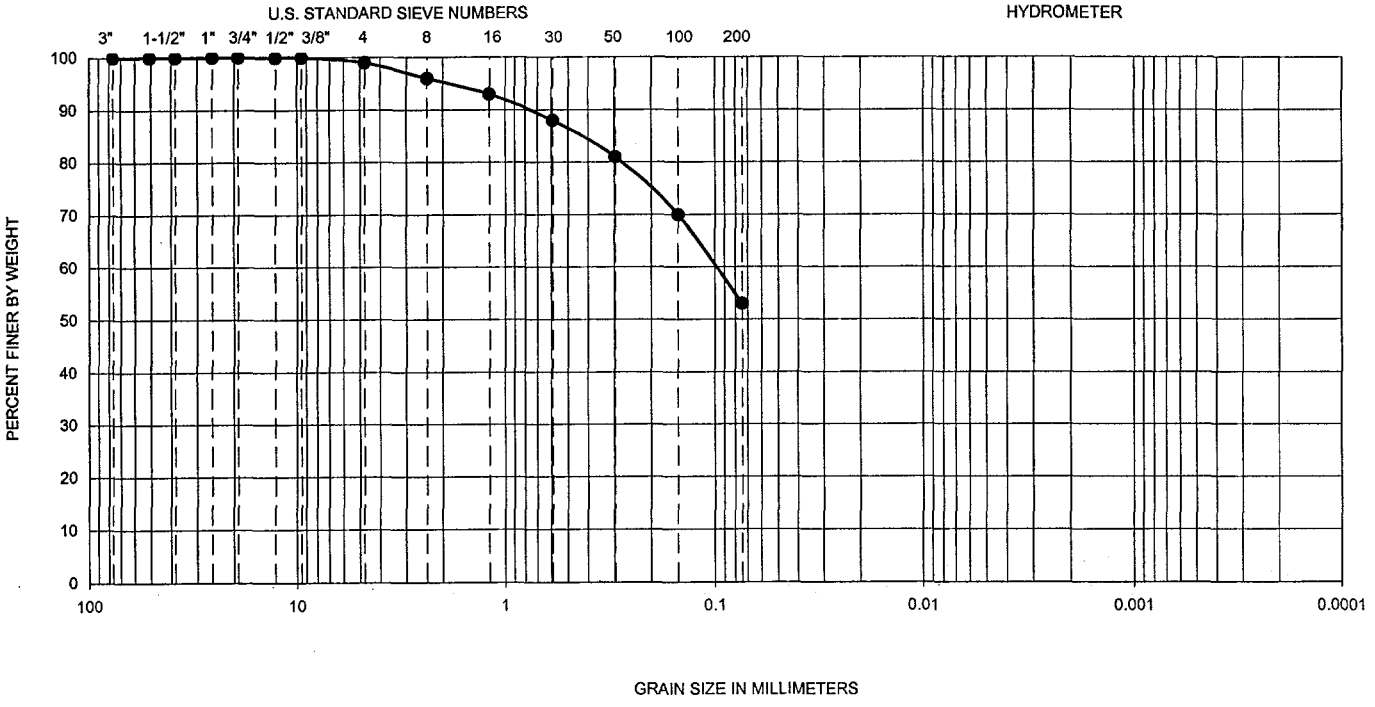
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-22

RH-12 10.0 TO 11.5 SIEVE+HYDRO1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-12	15-15.4	26	18	8	--	--	--	--	--	53	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

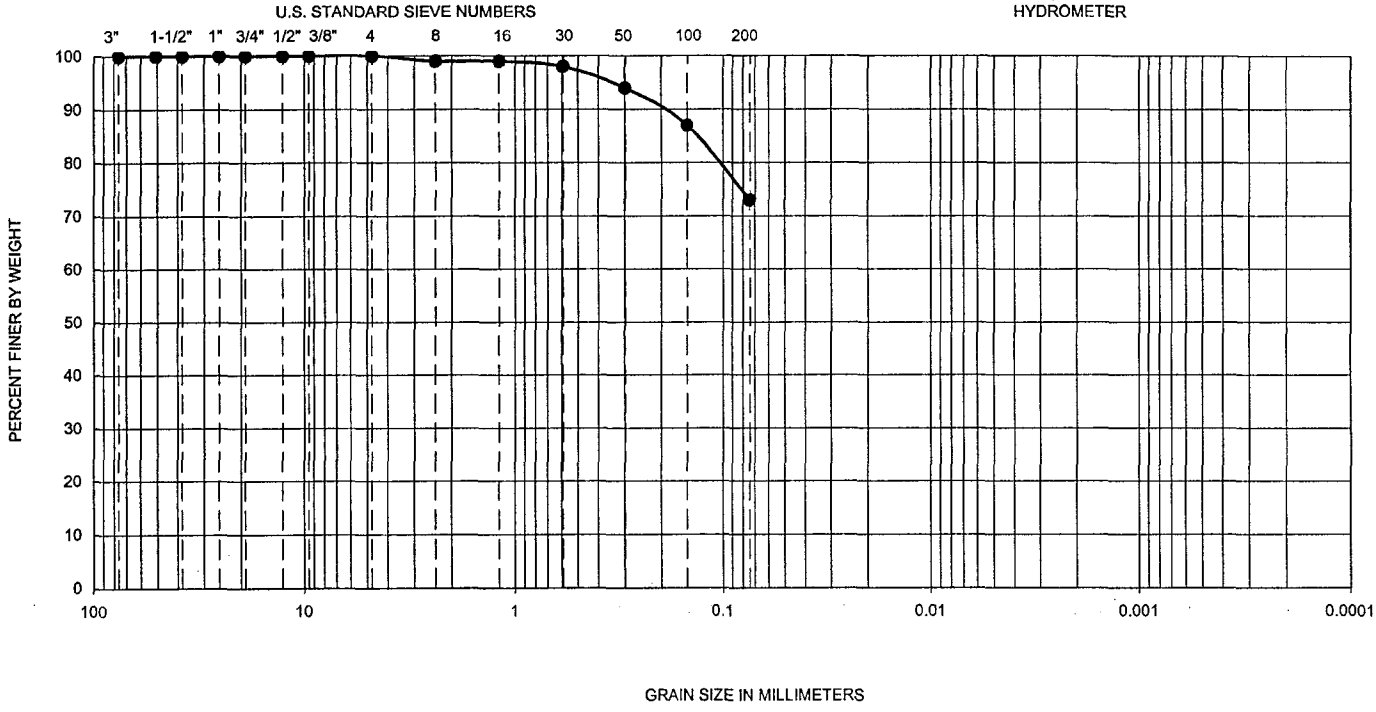
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-23

SIEVE RH-12@15

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-13	5-6.5	43	17	26	--	--	--	--	--	73	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

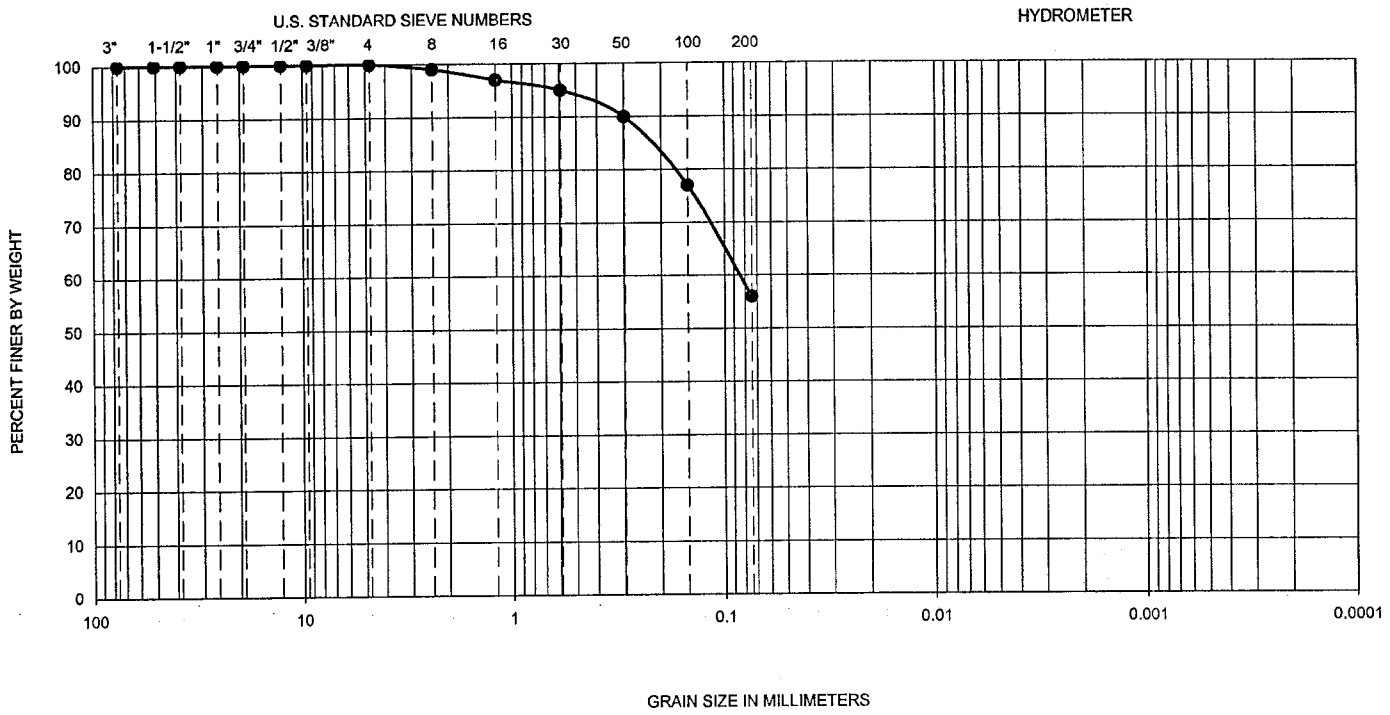
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-24

SIEVE RH-13@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-13	20-21.5	--	--	NP	--	--	--	--	--	56	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

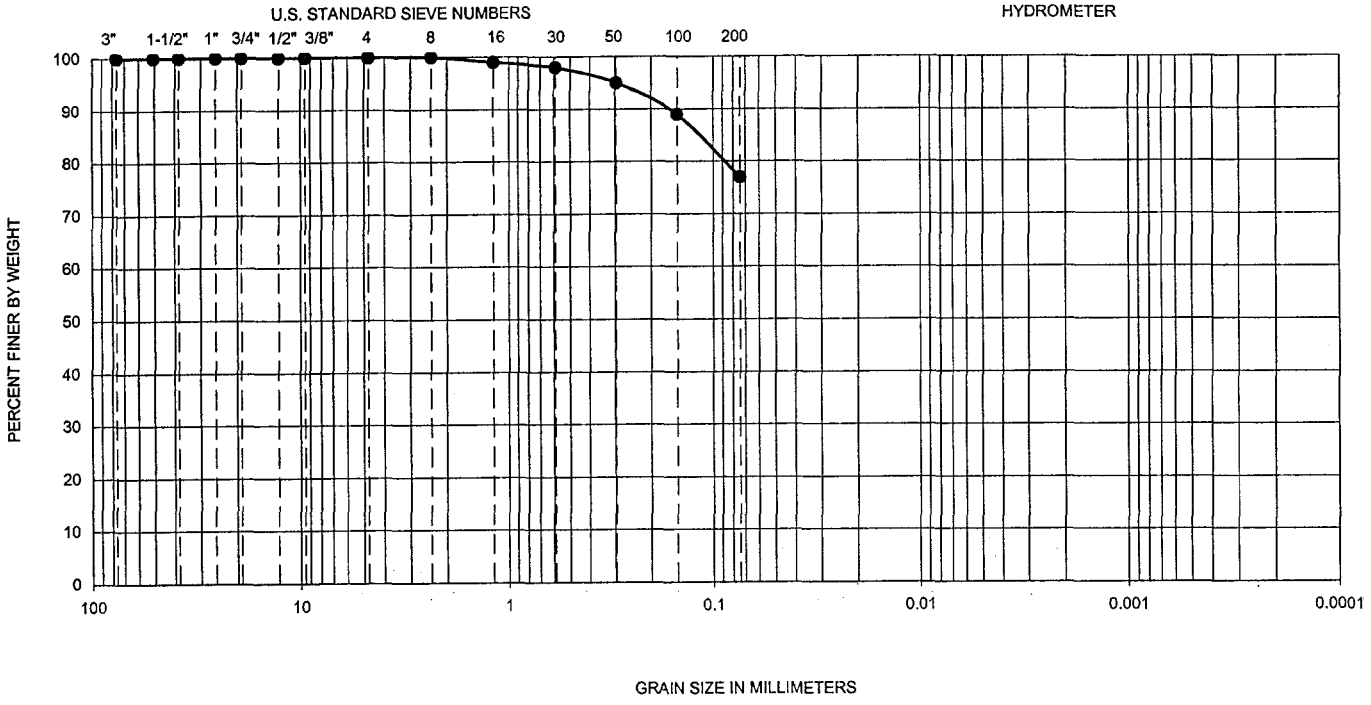
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-25

SIEVE RH-13@20

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-14	2.5-3.5	29	16	13	--	--	--	--	--	77	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

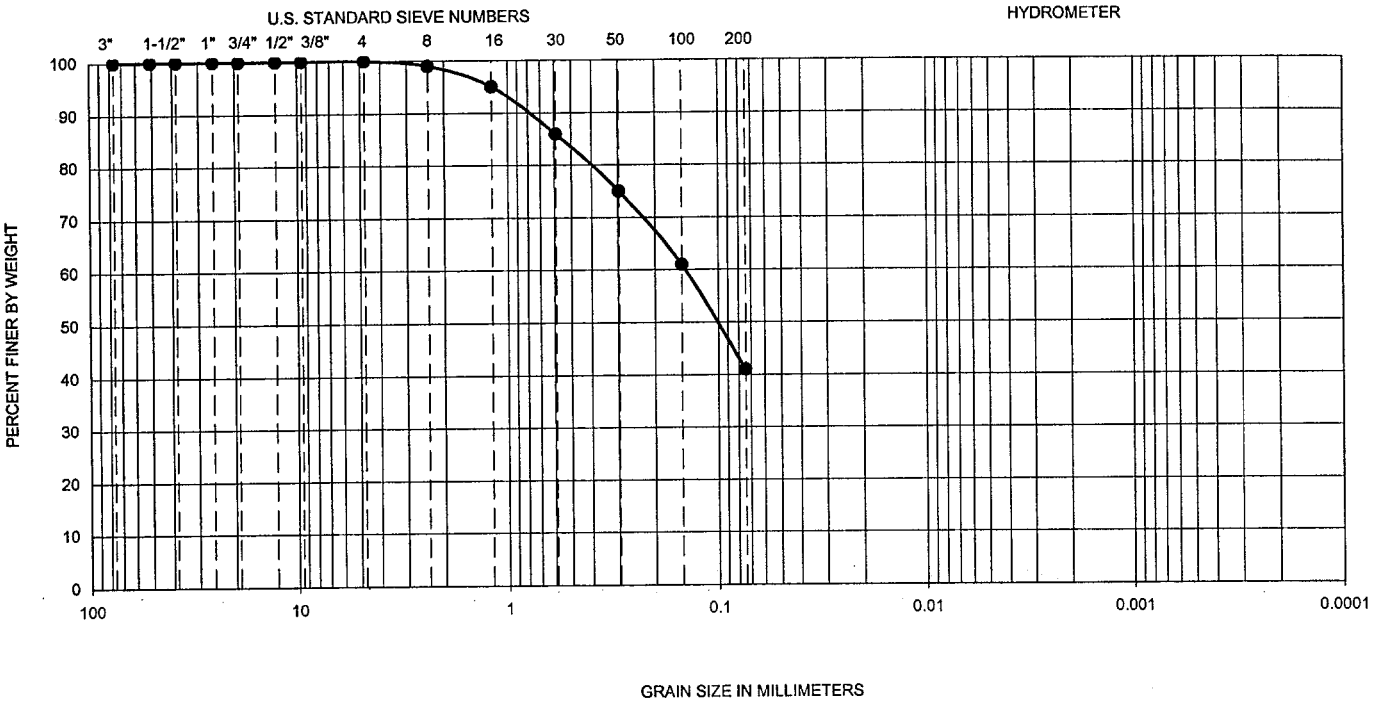
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-26

SIEVE RH-14@2

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-14	15-15.8	30	18	12	--	--	--	--	--	41	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

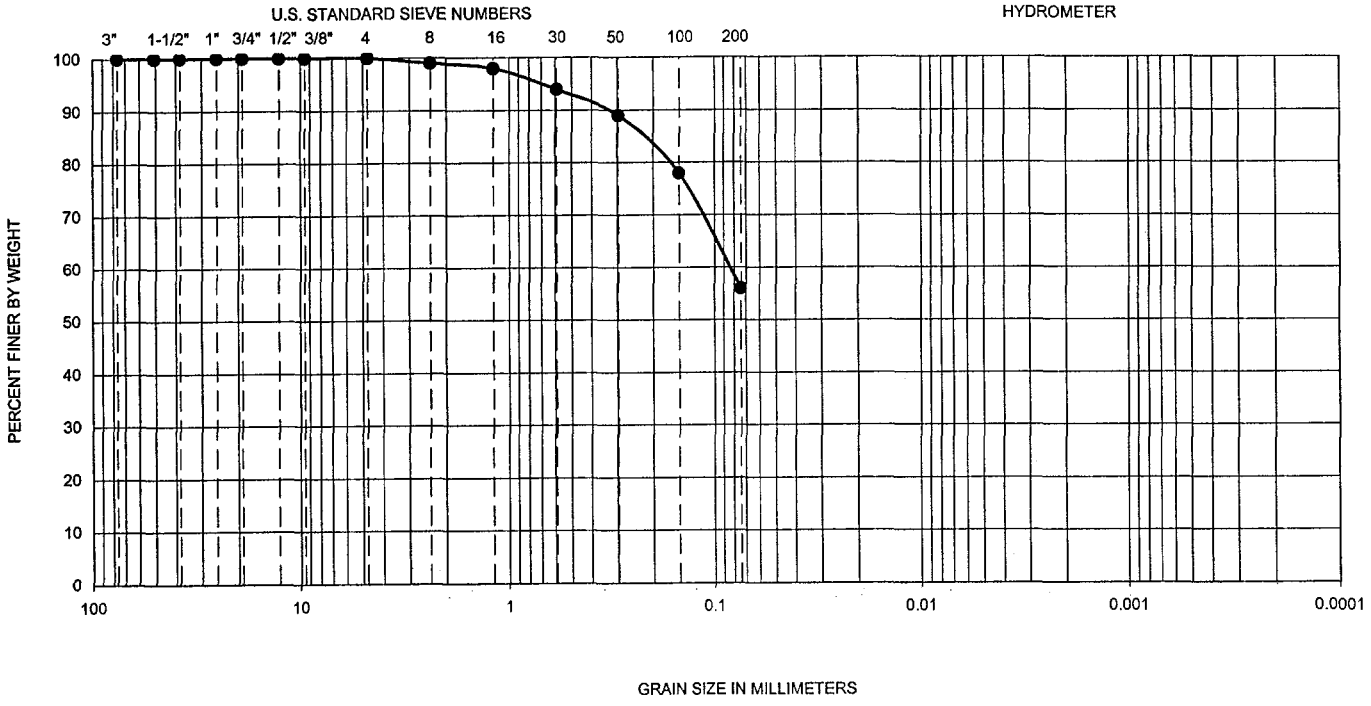
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-27

SIEVE RH-14@15

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-15	5-5.9	--	--	NP	--	--	--	--	--	56	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

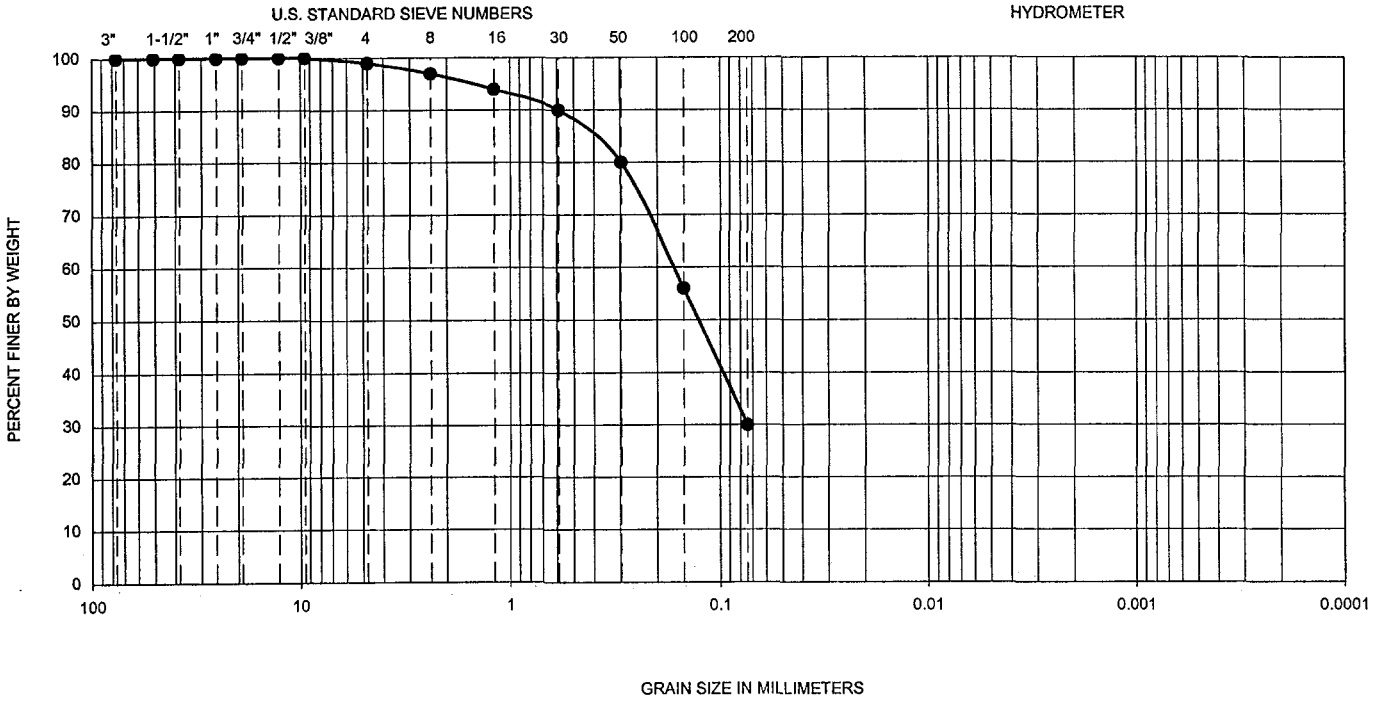
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-28

SIEVE RH-15@5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-15	15-16.5	--	--	NP	--	--	--	--	--	30	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

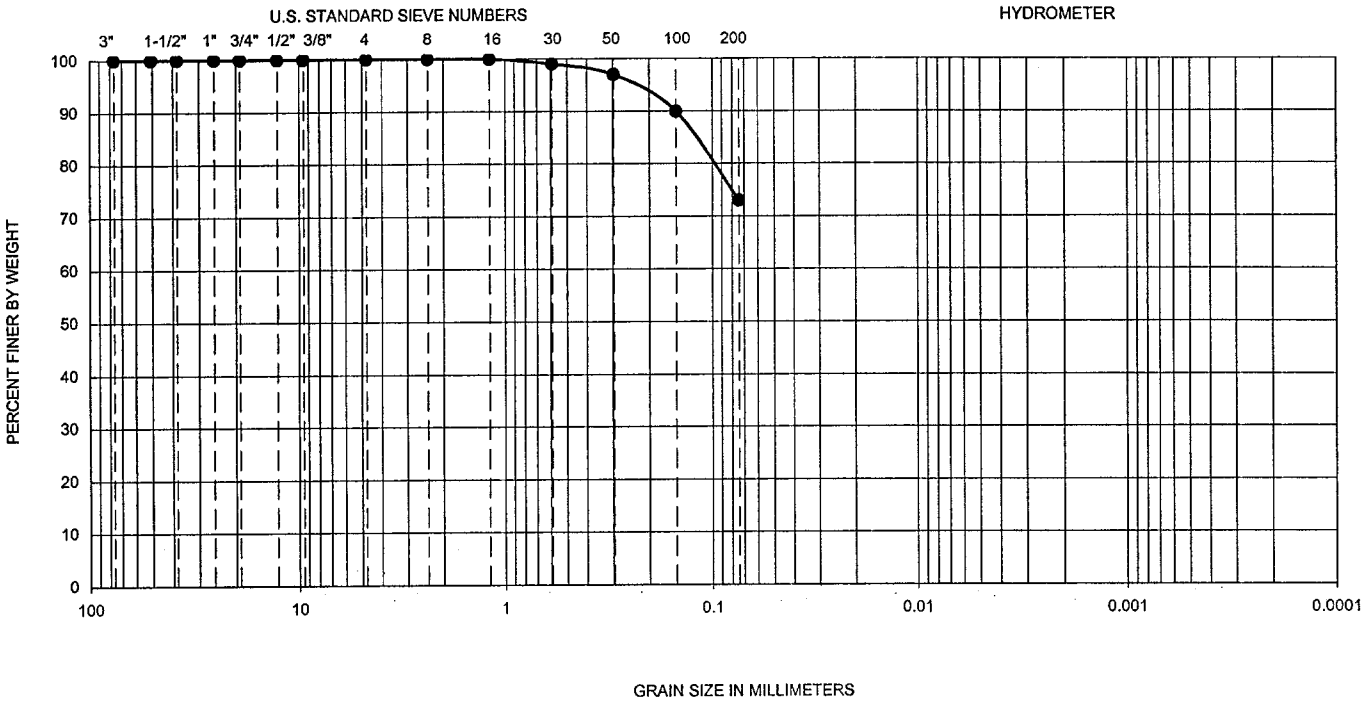
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-29

SIEVE RH-15@15

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-16	2.5-4	27	16	11	--	--	--	--	--	73	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

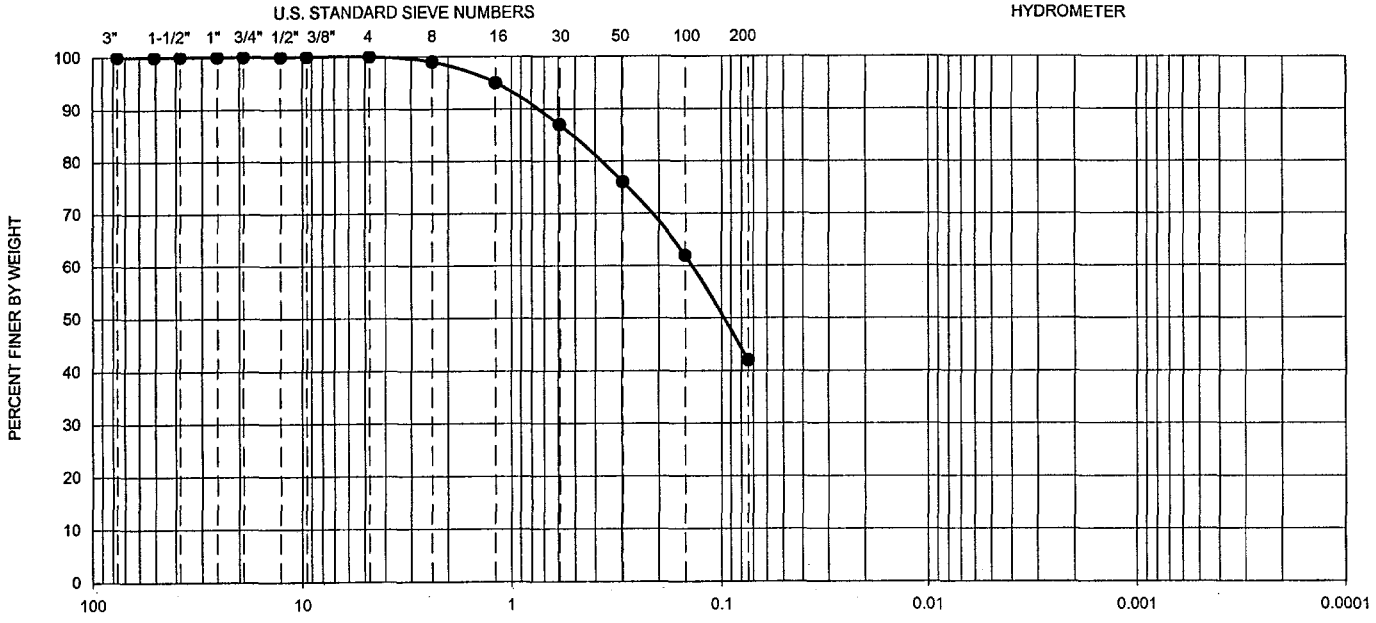
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-30

SIEVE RH-16@2

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-16	7.5-8.8	--	--	NP	--	--	--	--	--	42	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

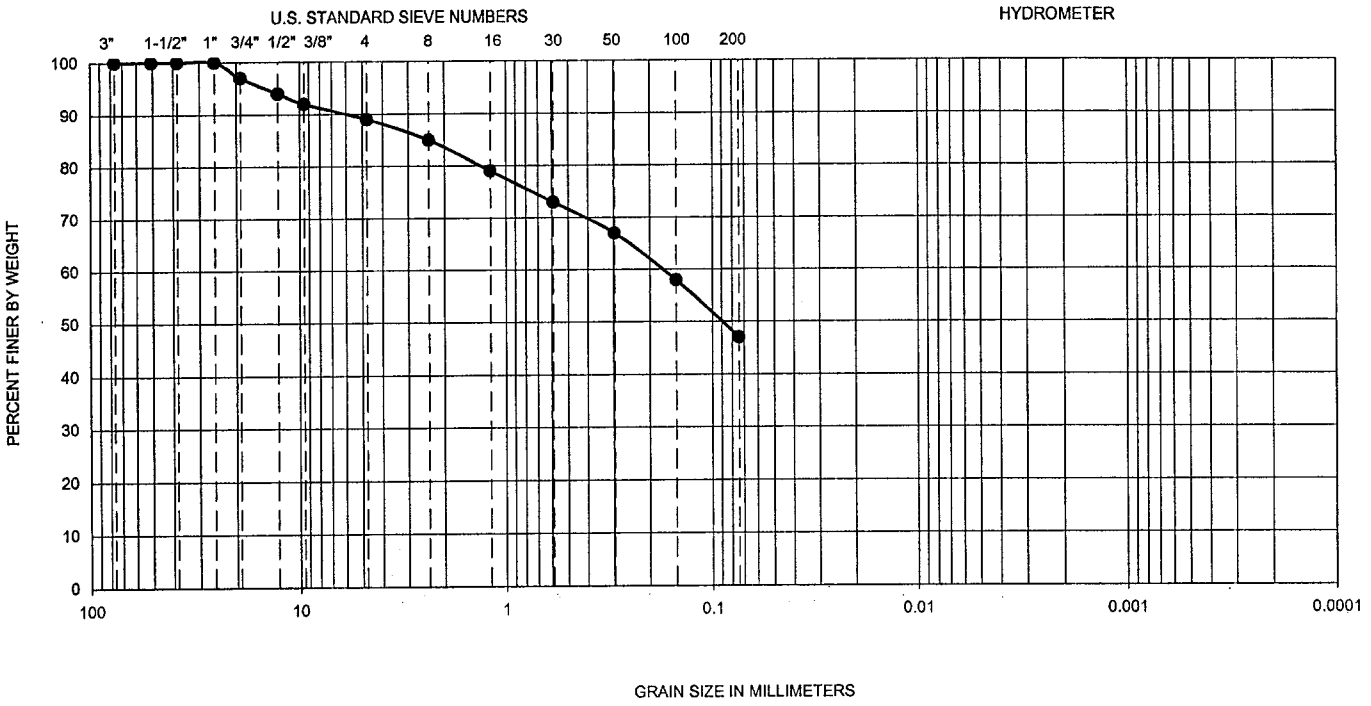
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-31

SIEVE RH-16@7

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-17	2.5-4	22	15	7	--	--	--	--	--	47	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

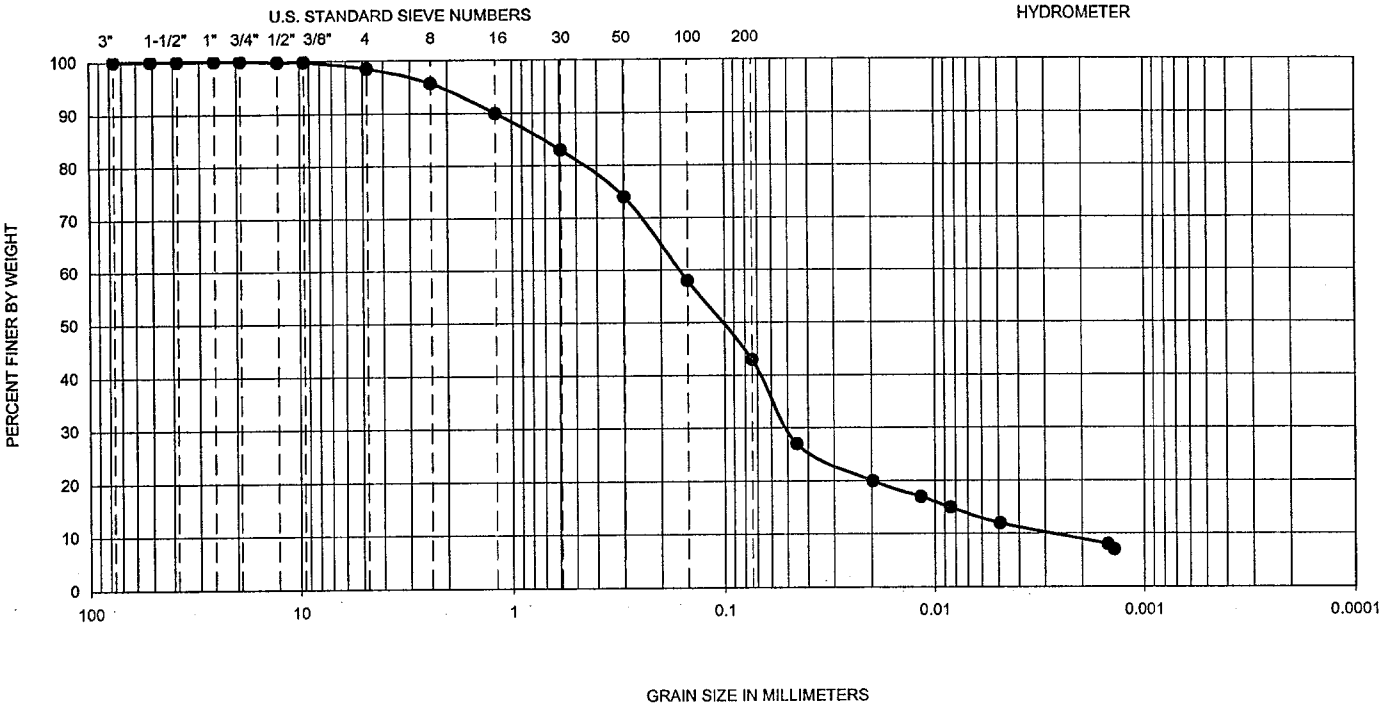
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-32

SIEVE RH-17@2

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-17	10.0-11.5	--	--	NP	0.004	0.05	0.17	41.3	4.1	43	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

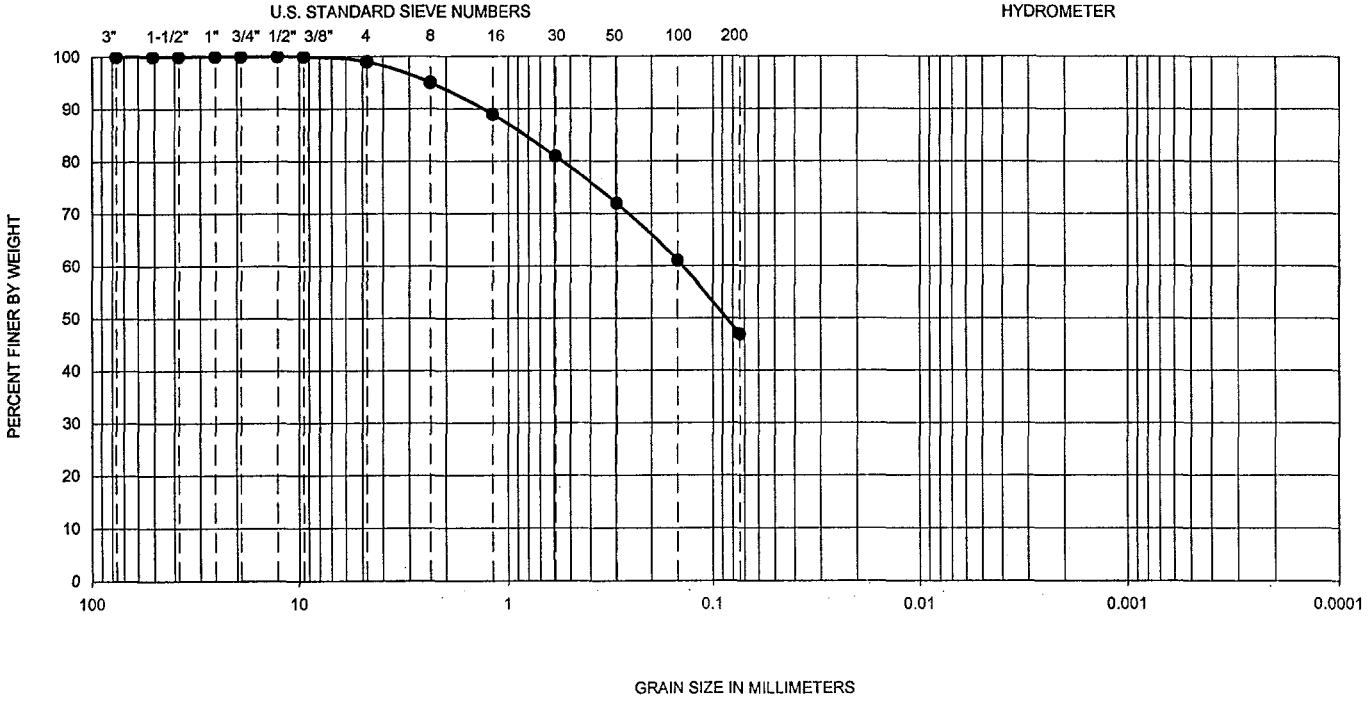
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-33

RH-17 10.0 TO 11.0 SIEVE+HYDRO1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-17B	5-6.5	30	20	10	--	--	--	--	--	47	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

GRADATION TEST RESULTS

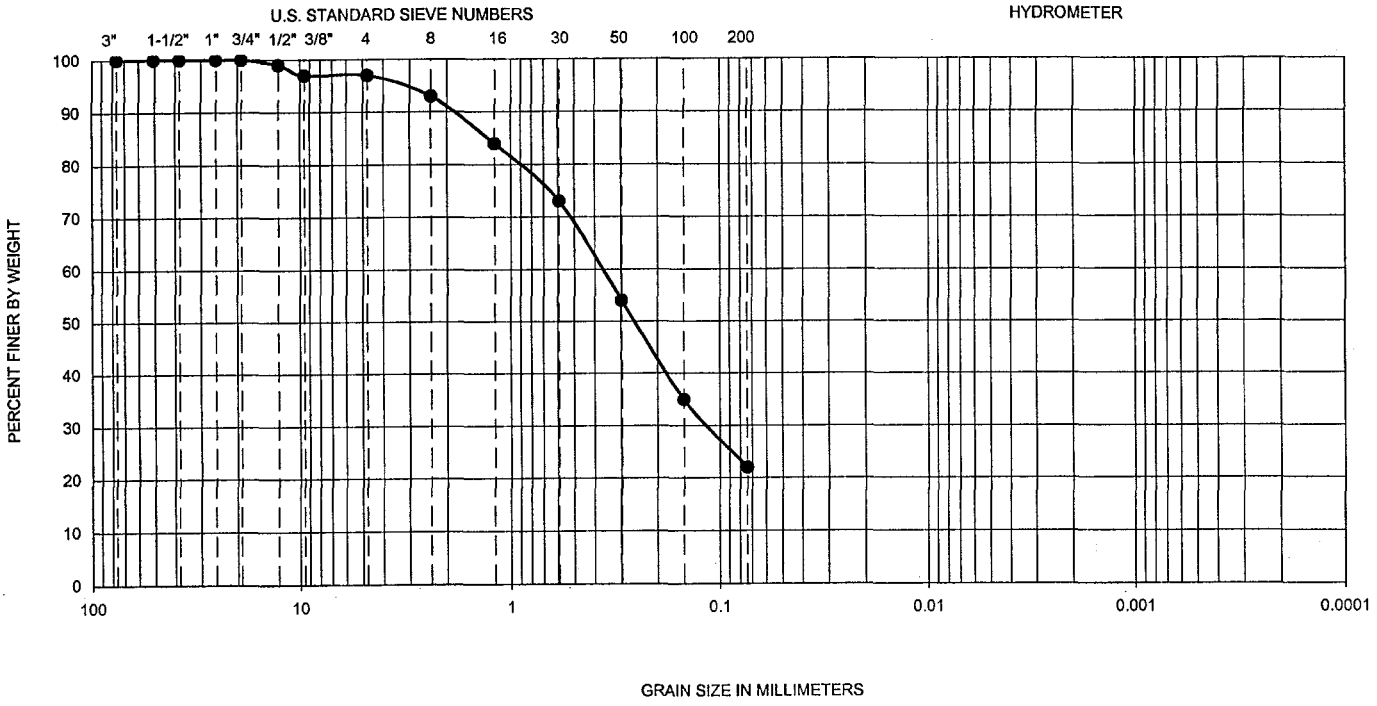
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE
600198002	10/02

FIGURE B-34

SIEVE-RH-17 5-6.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-17B	15-16.5	33	17	16	--	--	--	--	--	22	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

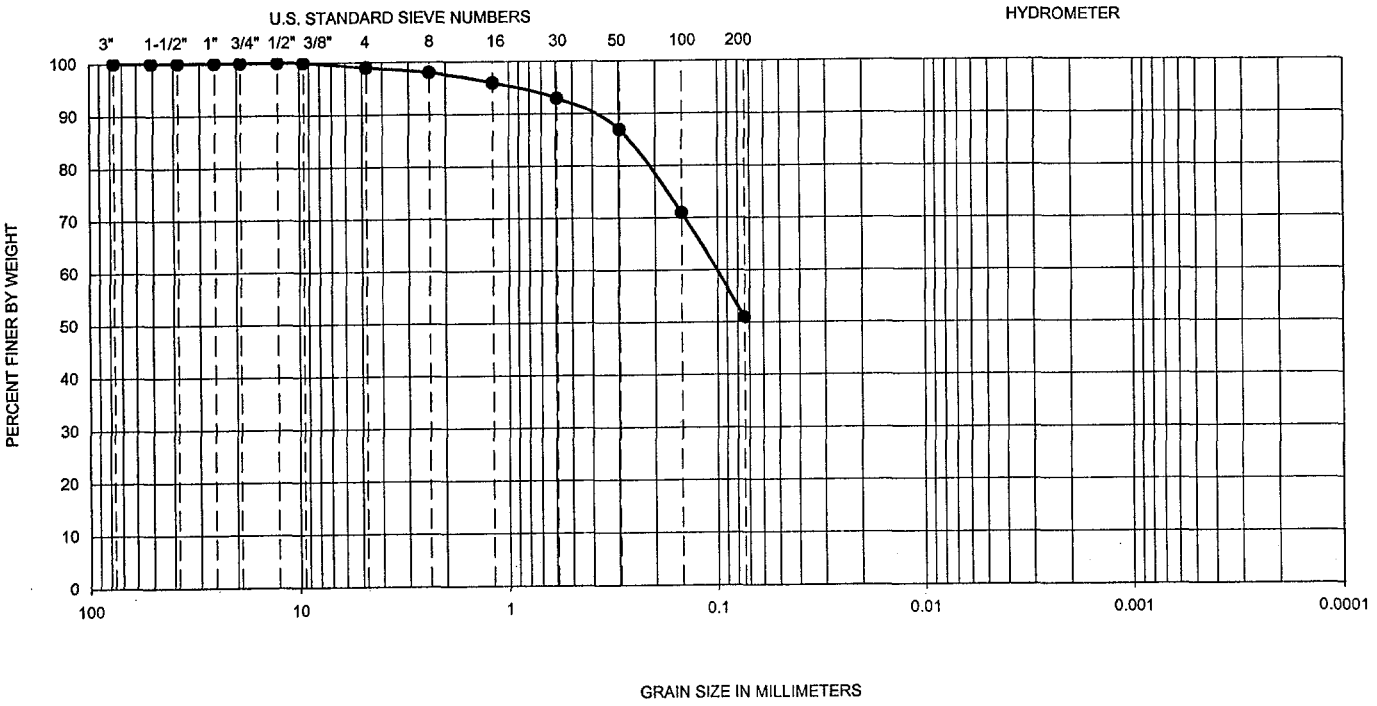
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-35

SIEVE-RH-17 15-16.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-18	5-6.5	33	16	17	--	--	--	--	--	51	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

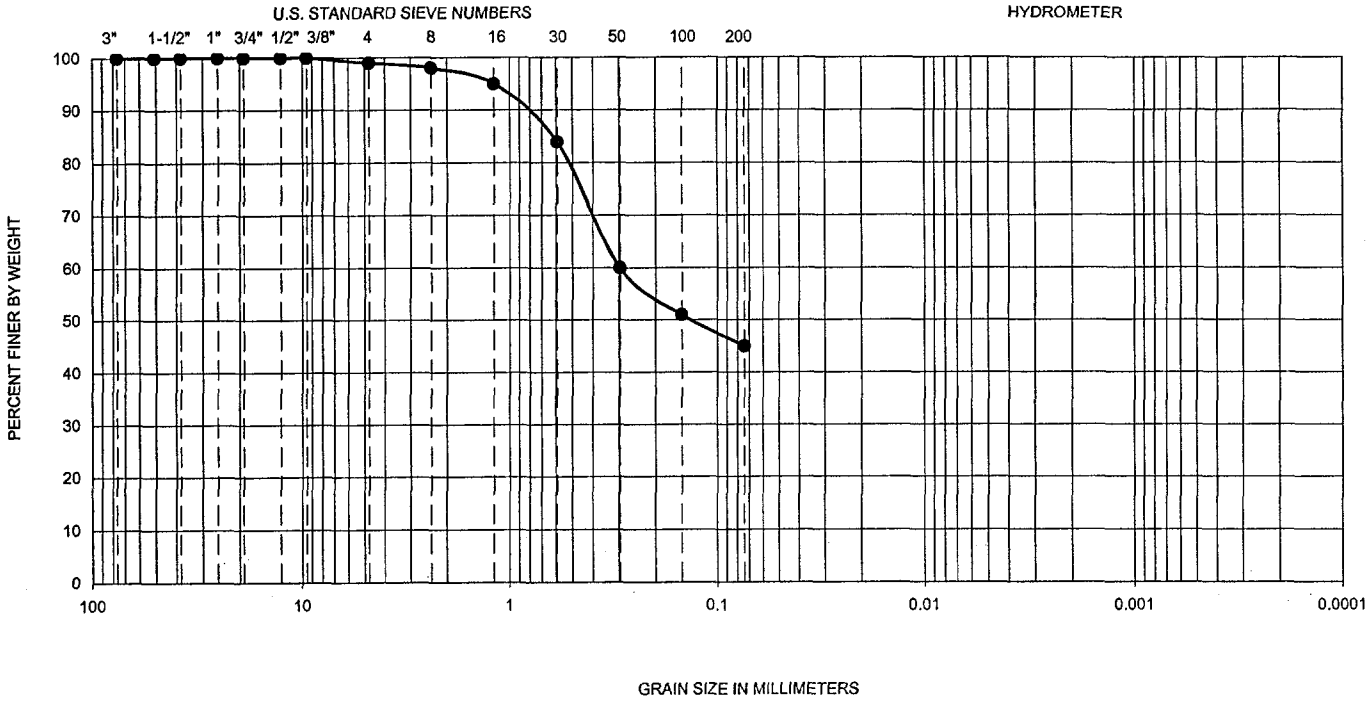
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-36

SIEVE-RH-18 5-6.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-18	15-15.5	32	16	16	--	--	--	--	--	45	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

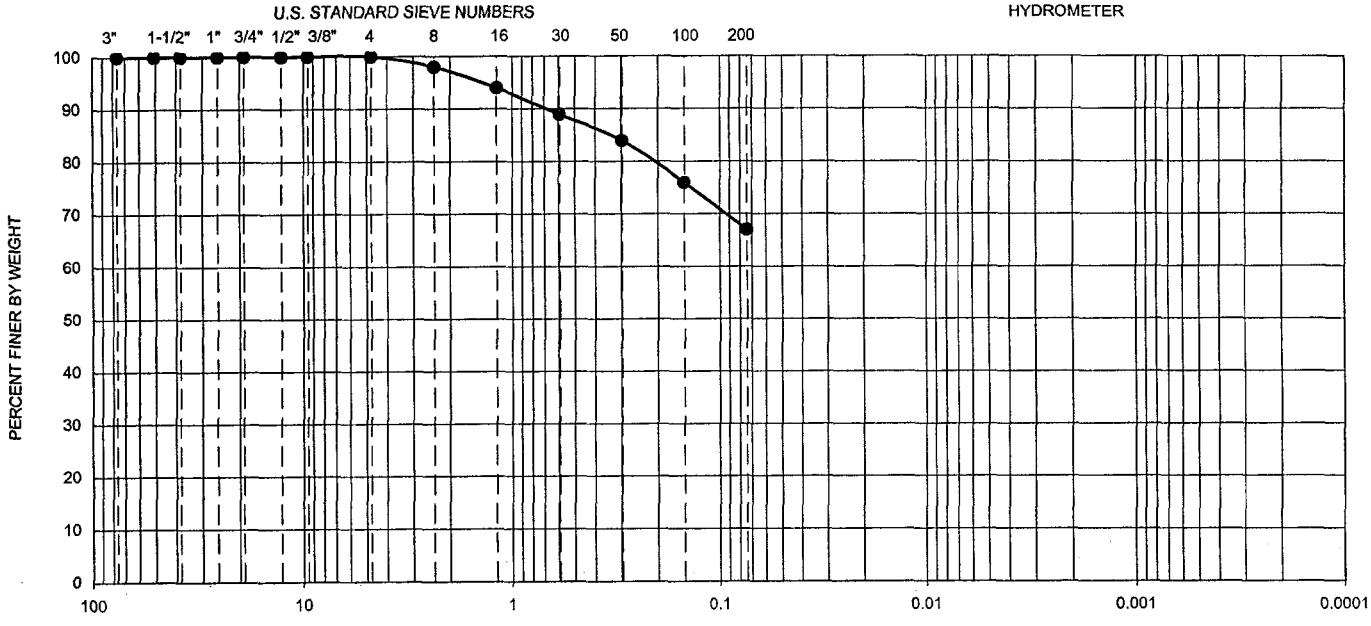
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-37

SIEVE-RH-18 15-15.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-19	10-11.5	40	24	16	--	--	--	--	--	67	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

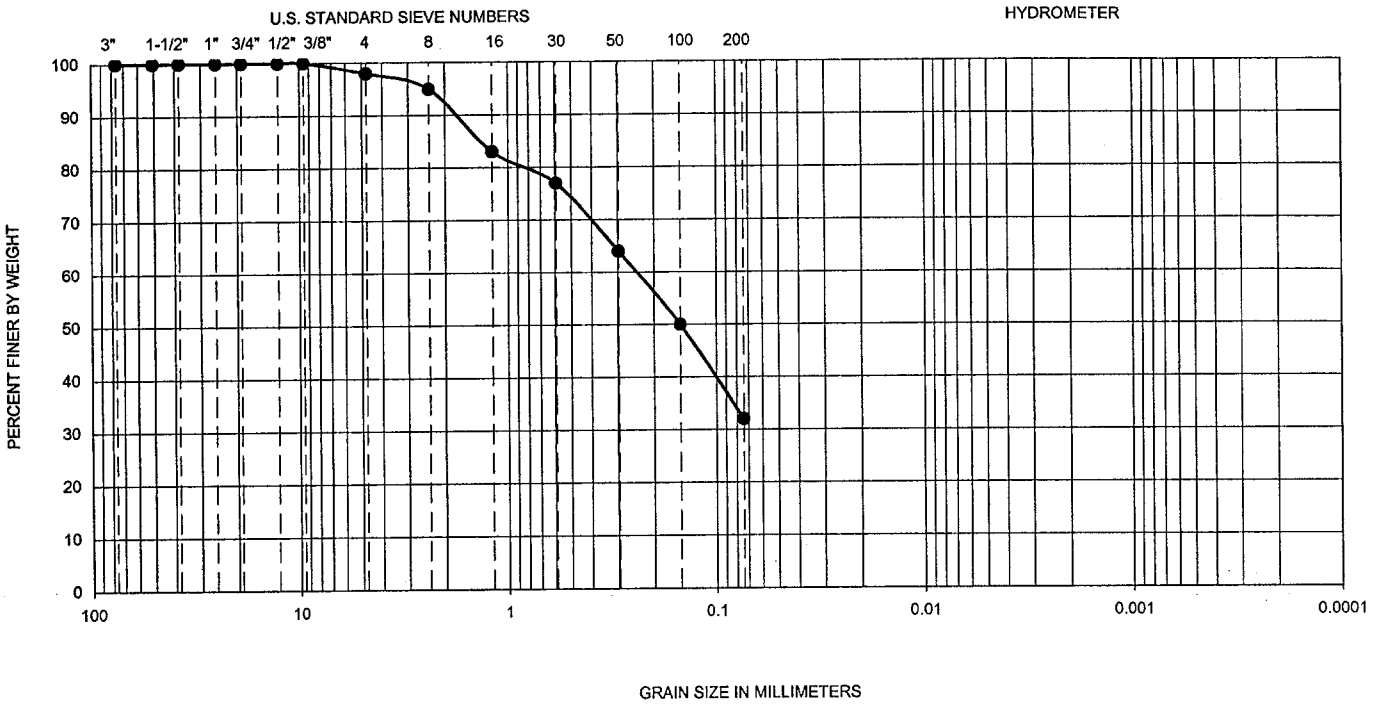
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-38

SIEVE-RH-19 10-11.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-19	15-16.5	29	19	10	--	--	--	--	--	32	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

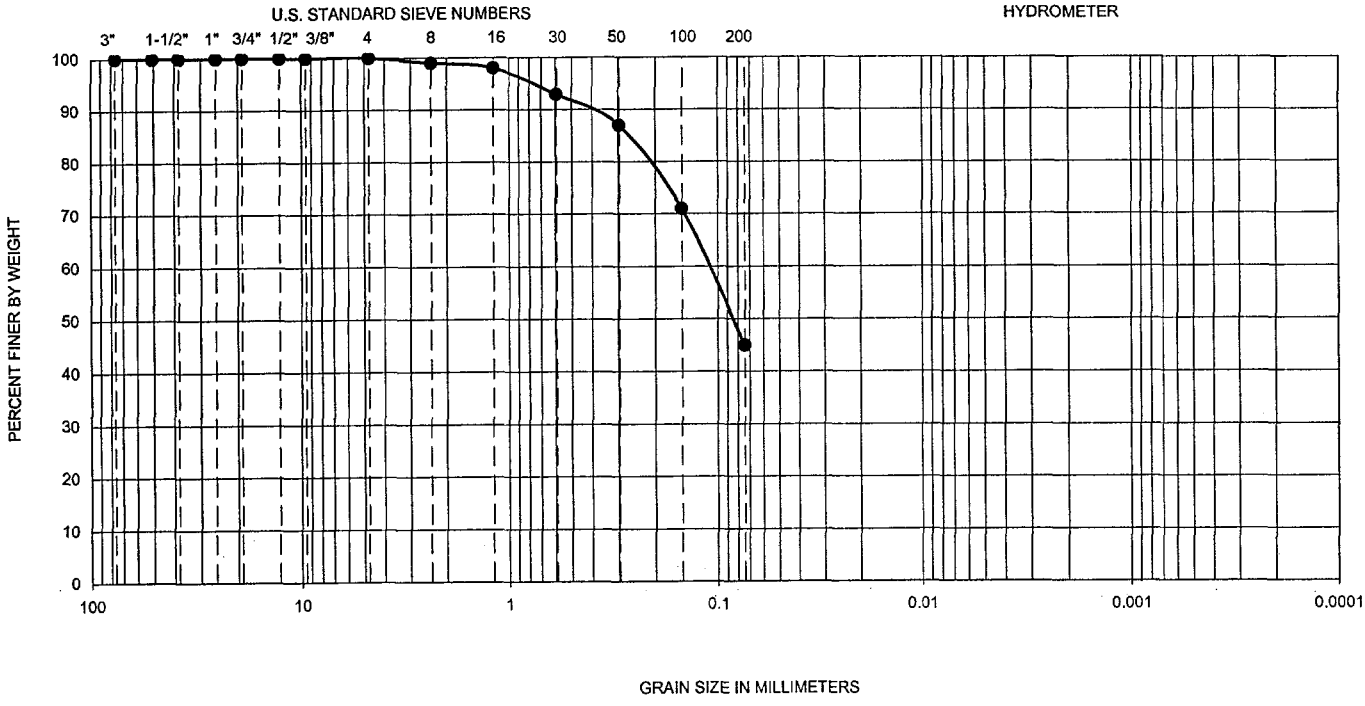
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-39

SIEVE-RH-19 15-16.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-20	10-11.5	*	*	*	--	--	--	--	--	45	SM

*ATTERBERG LIMITS TEST INDICATES NON-PLASTIC
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

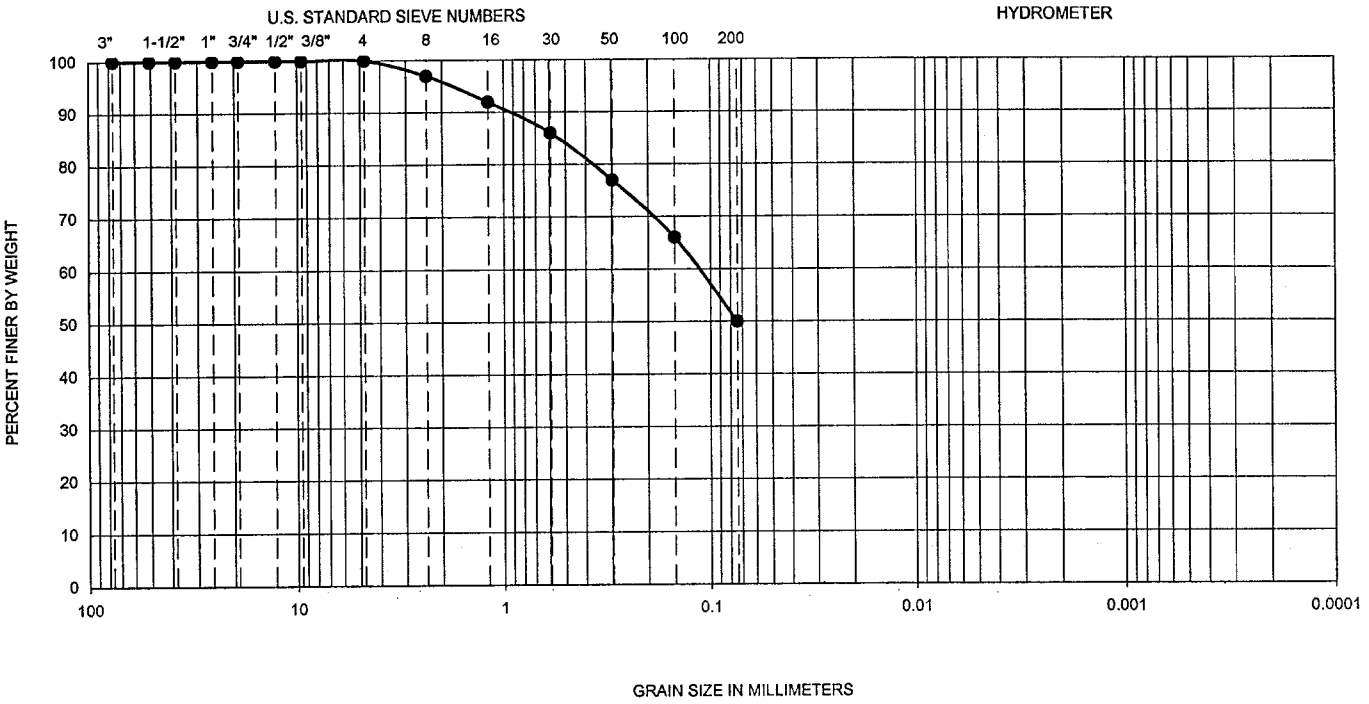
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-40

SIEVE-RH-20 10-11.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-21	5-6.5	*	*	*	--	--	--	--	--	50	ML

*ATTERBERG LIMITS TEST INDICATES NON-PLASTIC
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

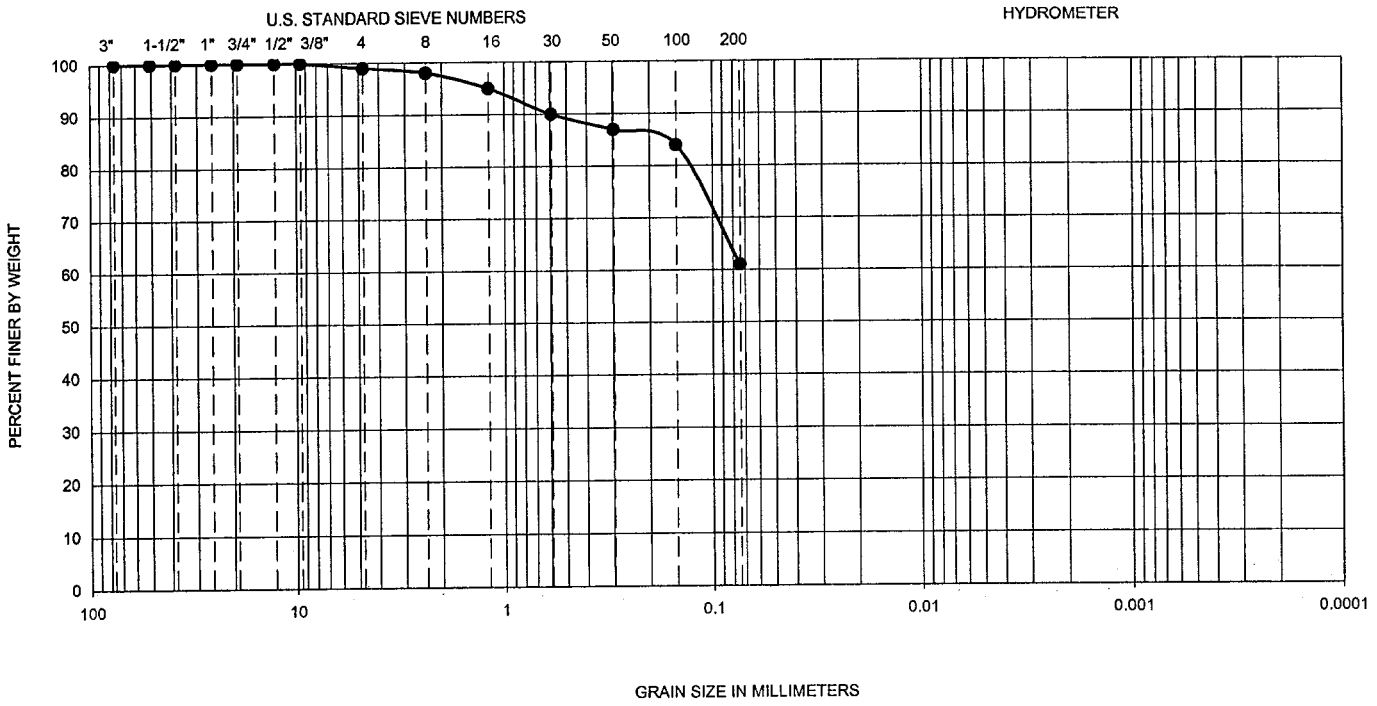
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-41

SIEVE-RH-21 5-6.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-22	5-6	51	24	27	--	--	--	--	--	61	CH

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

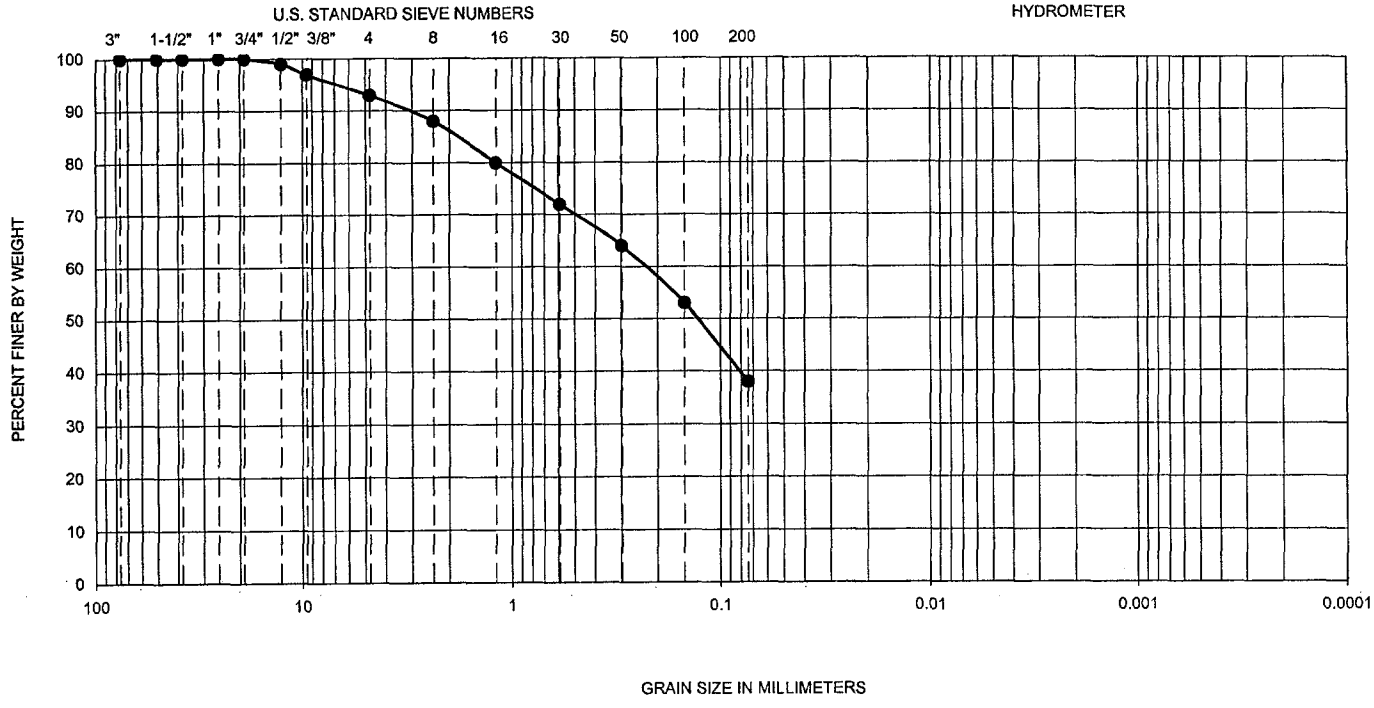
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-42

SIEVE-RH-22 5-6.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-23	5-6.5	*	*	*	--	--	--	--	--	38	SM

*ATTERBERG LIMITS TEST INDICATES NON-PLASTIC
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

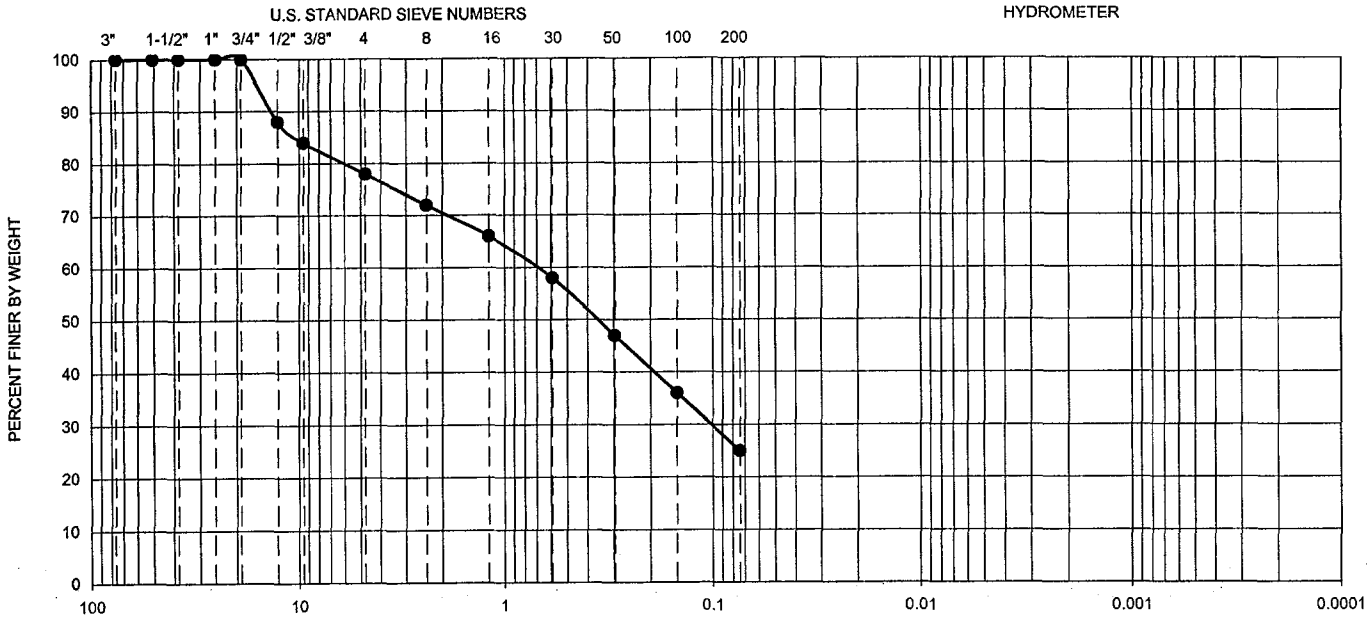
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-43

SIEVE-RH-23 5-6.5

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole No.	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	RH-23	20-21.5	*	*	*	--	--	--	--	--	25	SM

*ATTERBERG LIMITS TEST INDICATES NON-PLASTIC
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

GRADATION TEST RESULTS

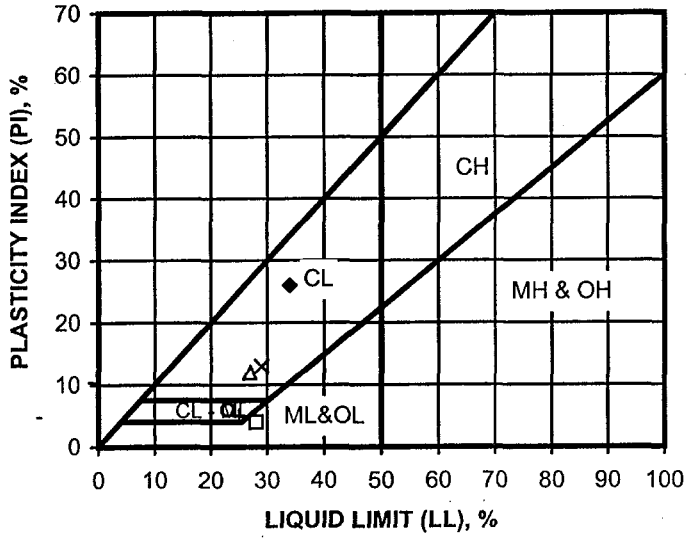
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-44

SIEVE-RH-23 20-21.5

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-1	10-11.5	-	-	NP	SC	SC
■	RH-1	25-26.5	-	-	NP	ML	SM
◆	RH-2	2.5-4	34	8	26	CL	CL
o	RH-2	12.5-14	23	17	6	CL-ML	SC-SM
□	RH-3	5-6.5	28	24	4	ML	SM
Δ	RH-4	5-6.5	27	15	12	CL	CL
X	RH-4	15-16.5	29	16	13	CL	SC
+	RH-5	5-6.5	25	20	5	ML-CL	CL

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

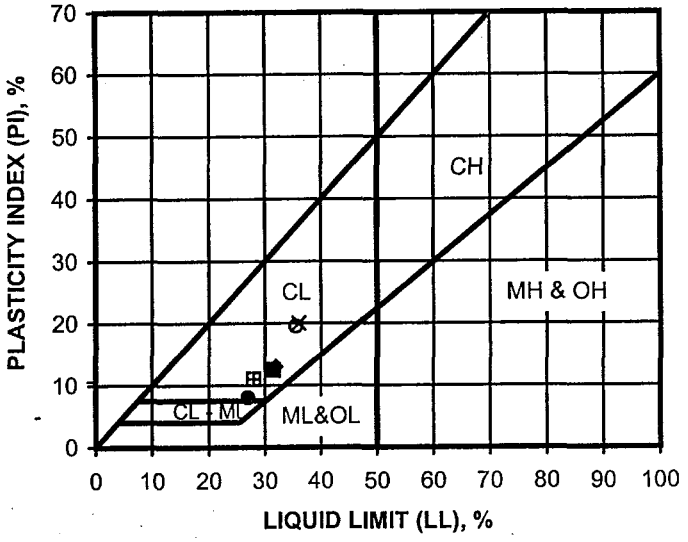
ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-45

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-5	20-21.5	27	19	8	CL	SC
■	RH-6	10-11.5	32	19	13	CL	CL
◆	RH-6	15-16.5	32	19	13	CL	CL
o	RH-7	2.5-4	36	16	20	CL	CL
□	RH-7	17.5-19	28	17	11	CL	CL
Δ	RH-8	7.5-9	32	21	NP	CL	CL
X	RH-8	17.5-19	36	16	20	CL	CL
+	RH-9	5-6.5	28	17	11	CL	CL

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

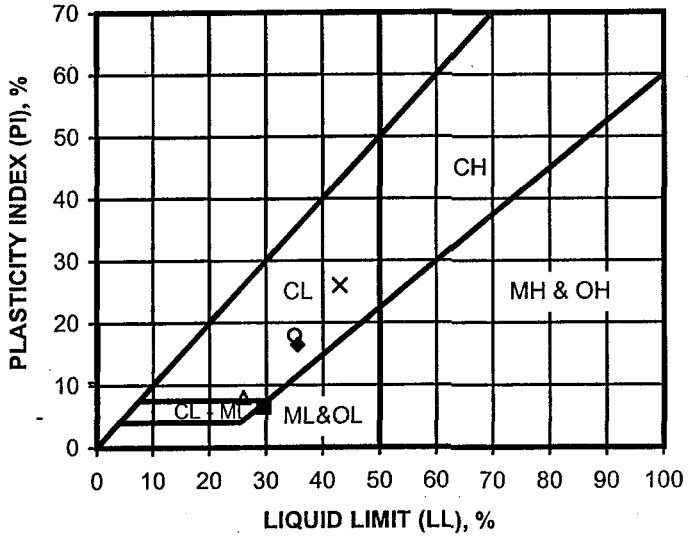
ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-46

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-9	20-21.5	-	-	NP	SC	SC
■	RH-10	12.5-14	30	23	7	ML	ML
◆	RH-11	10-11.5	36	19	17	CL	CL
o	RH-11	17.5-19	35	17	18	CL	SC
□	RH-12	5-6.5	-	-	NP	ML	ML
Δ	RH-12	15-16.5	26	18	8	CL	CL
X	RH-13	5-6.5	43	17	26	CL	CL
+	RH-13	20-21.5	-	-	NP	ML	ML

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

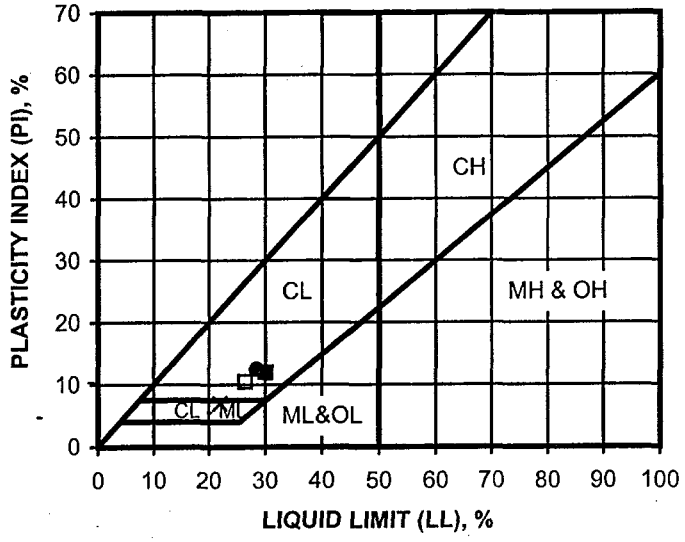
ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-47

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-14	2.5-3.5	29	16	13	CL	CL
■	RH-14	15-15.8	30	18	12	CL	SC
◆	RH-15	5-5.9	-	-	NP	ML	ML
o	RH-15	15-16.5	-	-	NP	SC	SC
□	RH-16	2.5-4	27	16	11	CL	CL
Δ	RH-16	7.5-8.8	-	-	NP	SM	SM
X	RH-17	2.5-4	22	15	7	CL-ML	SC
+	RH-17	10-11	-	-	NP	ML	SM

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

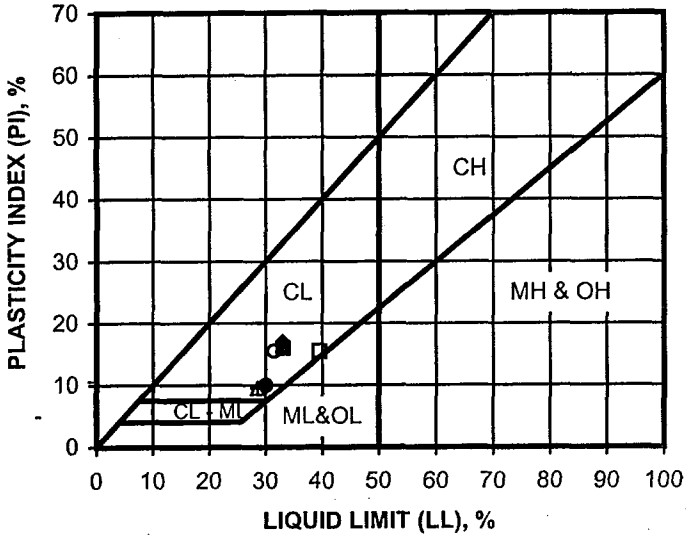
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-48

RH ATTERBERG 4

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-17B	5-6.5	30	20	10	CL	SC
■	RH-17B	15-16.5	33	17	16	CL	SC
◆	RH-18	5-6.5	33	16	17	CL	CL
o	RH-18	15-15.5	32	16	16	CL	SC
□	RH-19	10-11.5	40	24	16	CL	CL
Δ	RH-19	15-16.5	29	19	10	CL	SC
X	RH-20	10-11.5				NP	SM
+	RH-21	5-6.5	29	19	10	CL	ML

NP - Indicates non-plastic



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

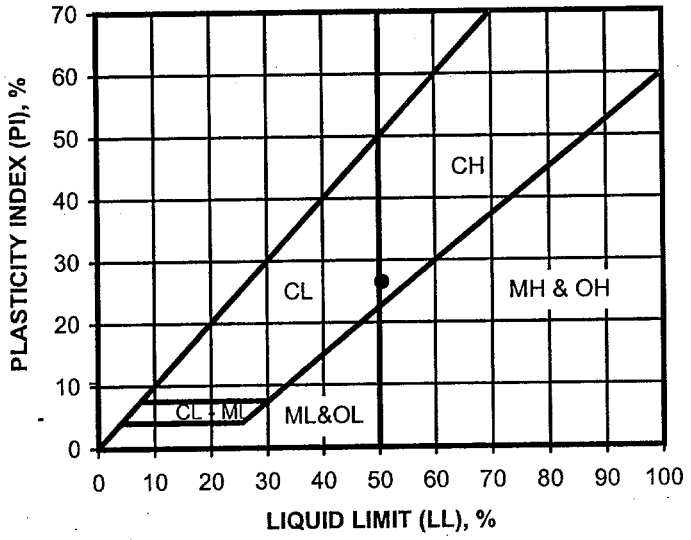
ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-49

SYMBOL	LOCATION	DEPTH (FT)	LL (%)	PL (%)	PI (%)	U.S.C.S. CLASSIFICATION (Minus No. 40 Sieve Fraction)	U.S.C.S. (Entire Sample)
●	RH-22	5-6.5	51	24	27	CH	CH
■	RH-23	5-6.5				NP	SM
◆	RH-23	20-21.5				NP	SM

NP - Indicates non-plastic



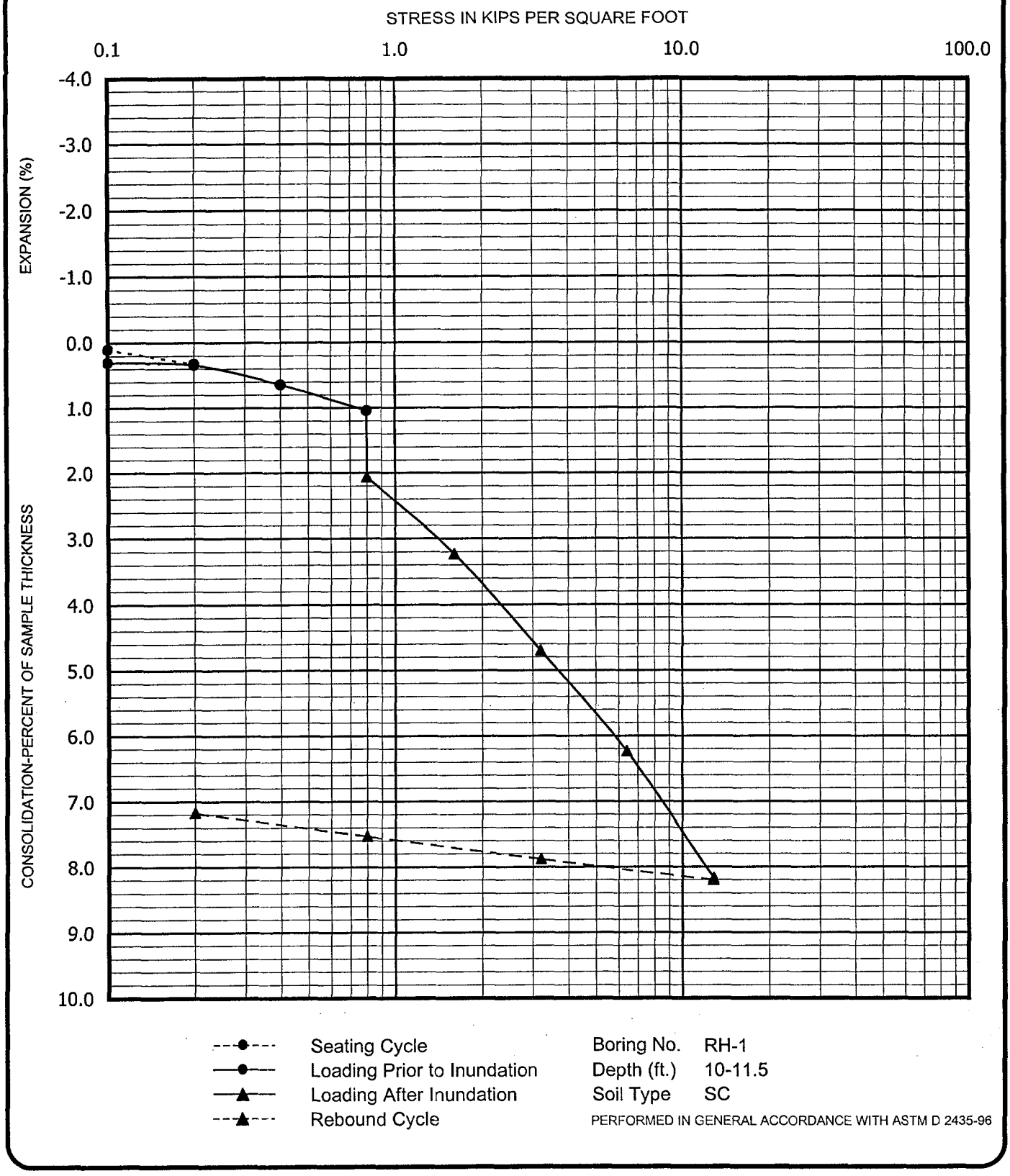
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318-00

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-50



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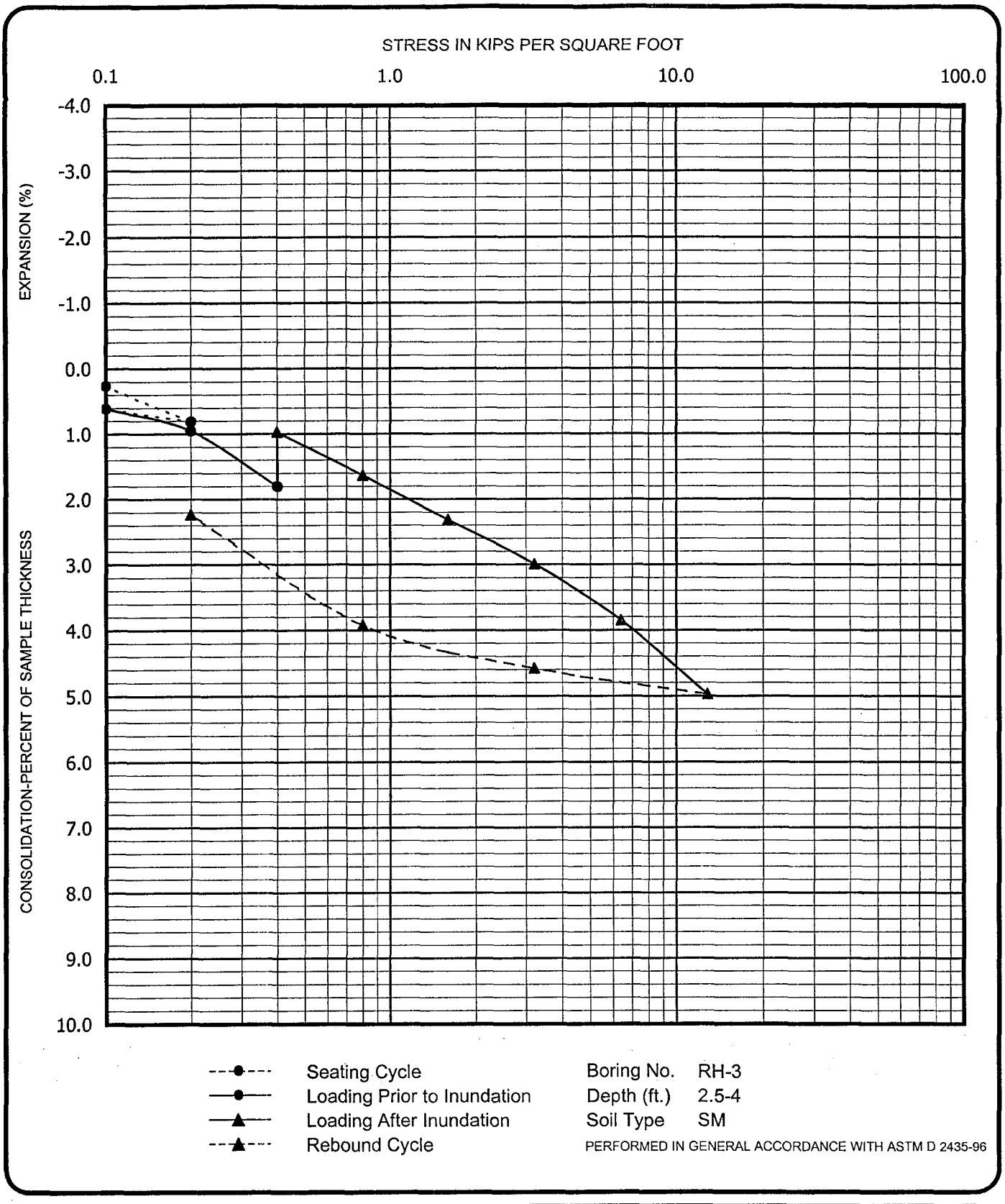
CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-51

CONSOLIDATION RH-1 10-11

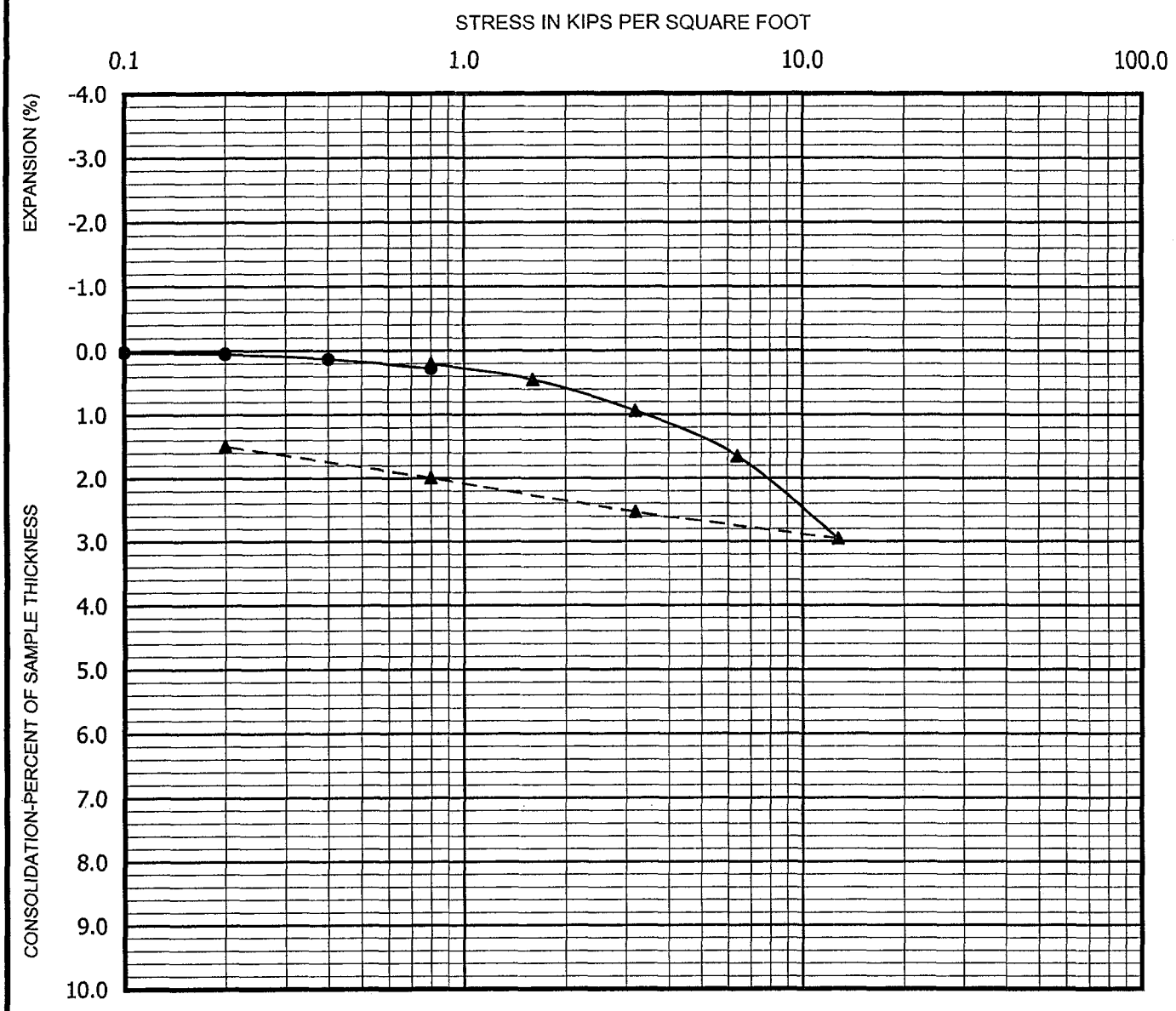


Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-52



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

Boring No. RH-4
Depth (ft.) 5-6.5
Soil Type CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96

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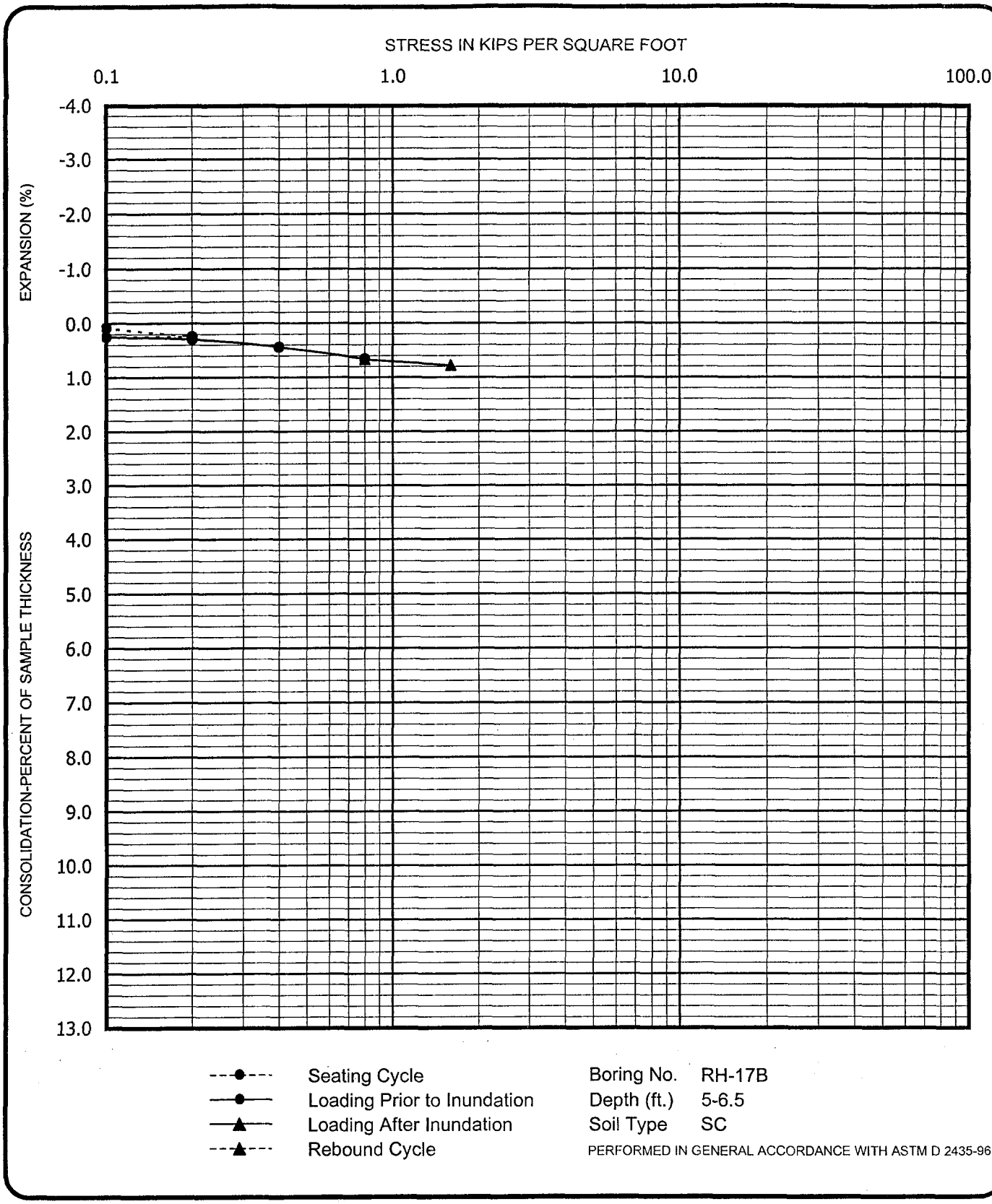
CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE HEIGHTS DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-53



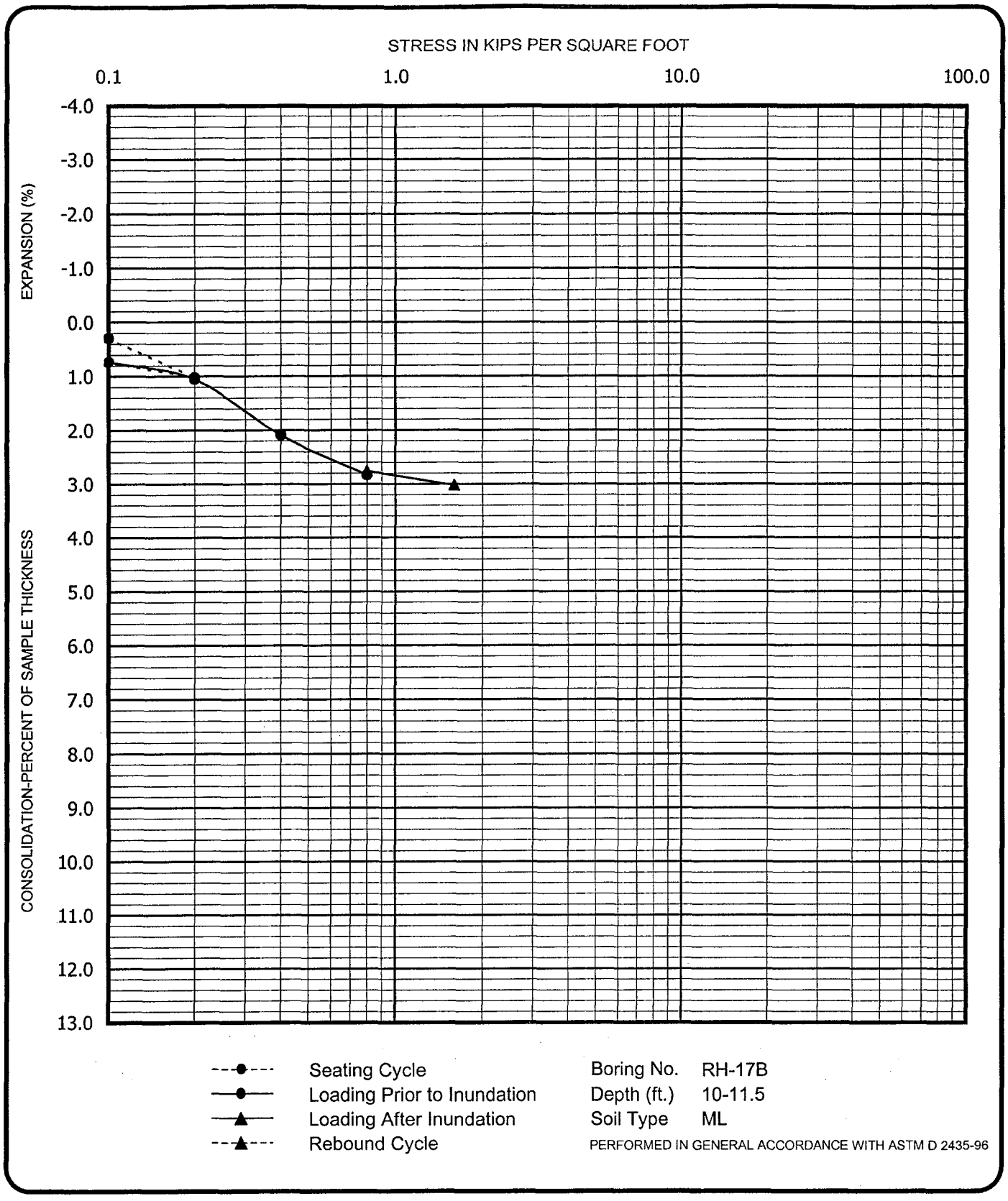
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-54

CONSOLIDATION-RH-17 5-6.5



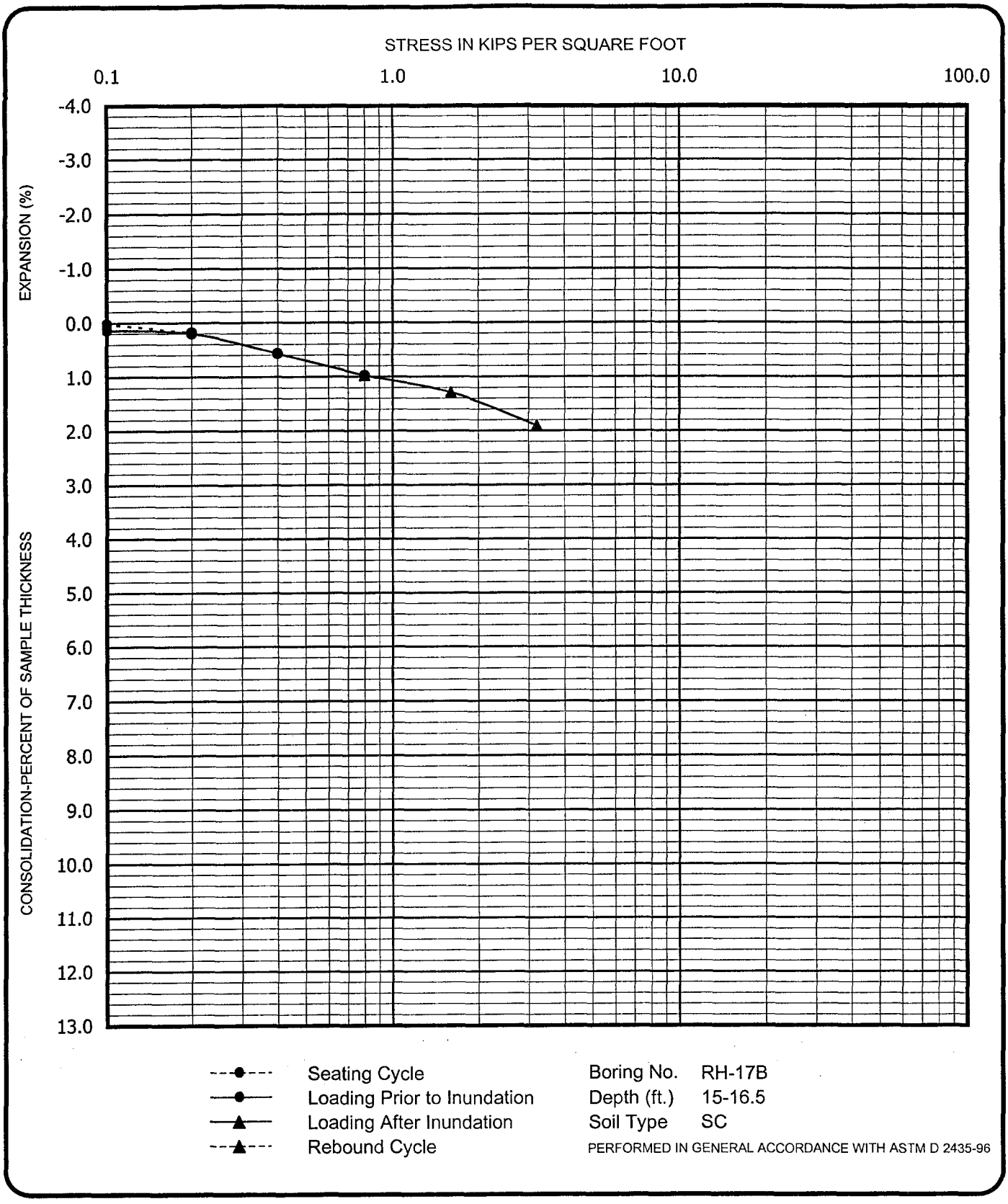
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-55

CONSOLIDATION-RH-17 10-11.5



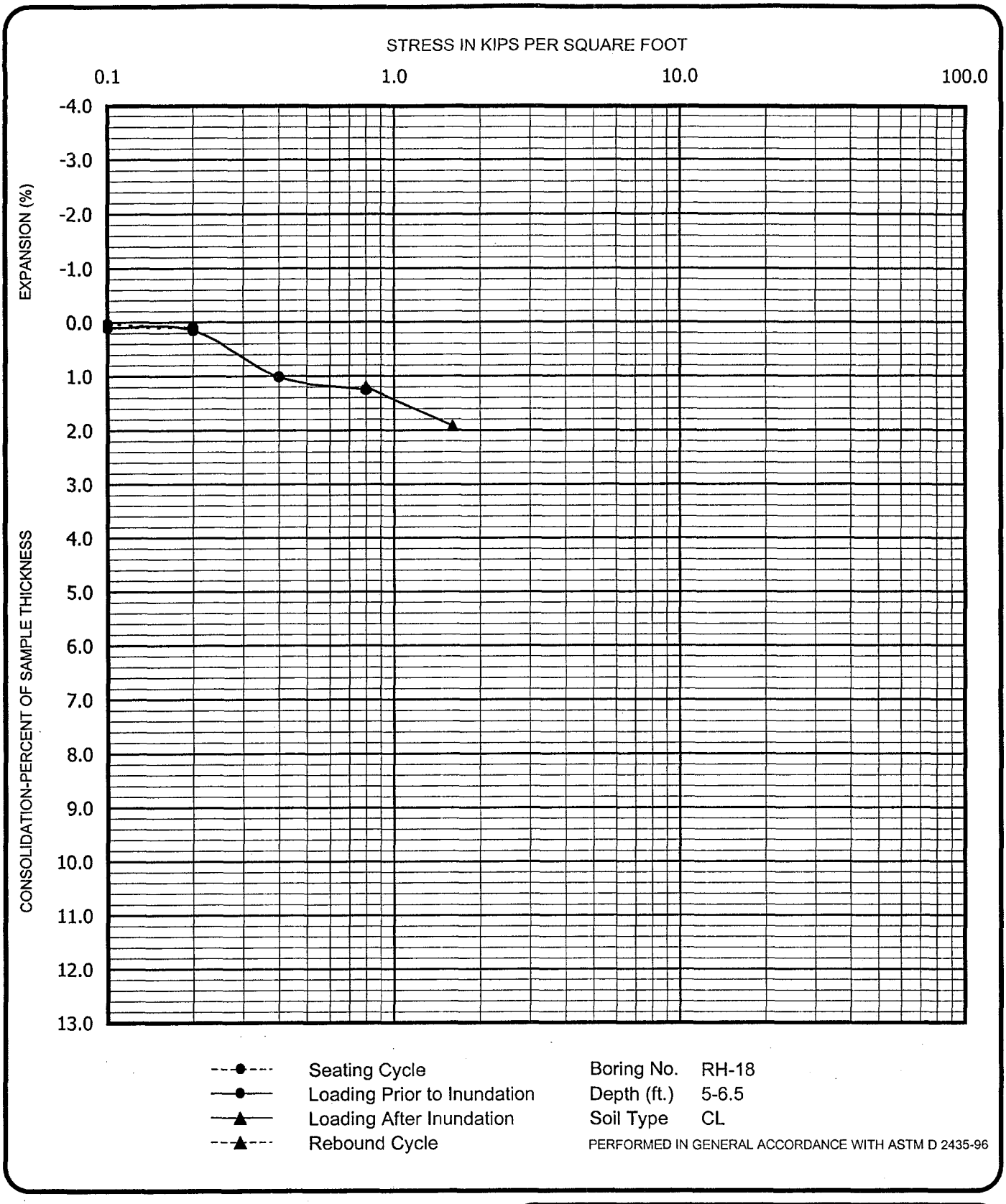
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-56

CONSOLIDATION-RH-17 15-16.5

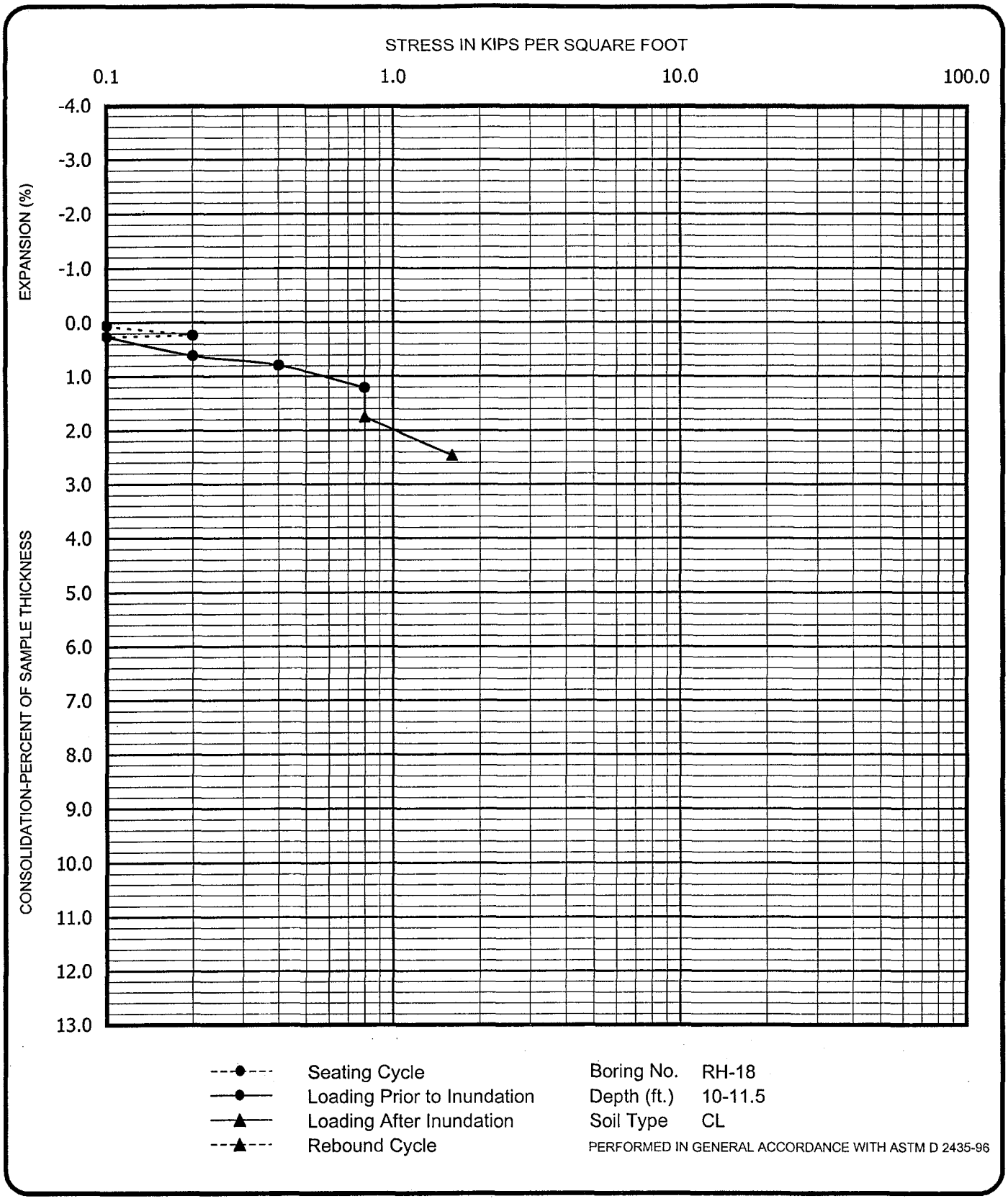


Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-57

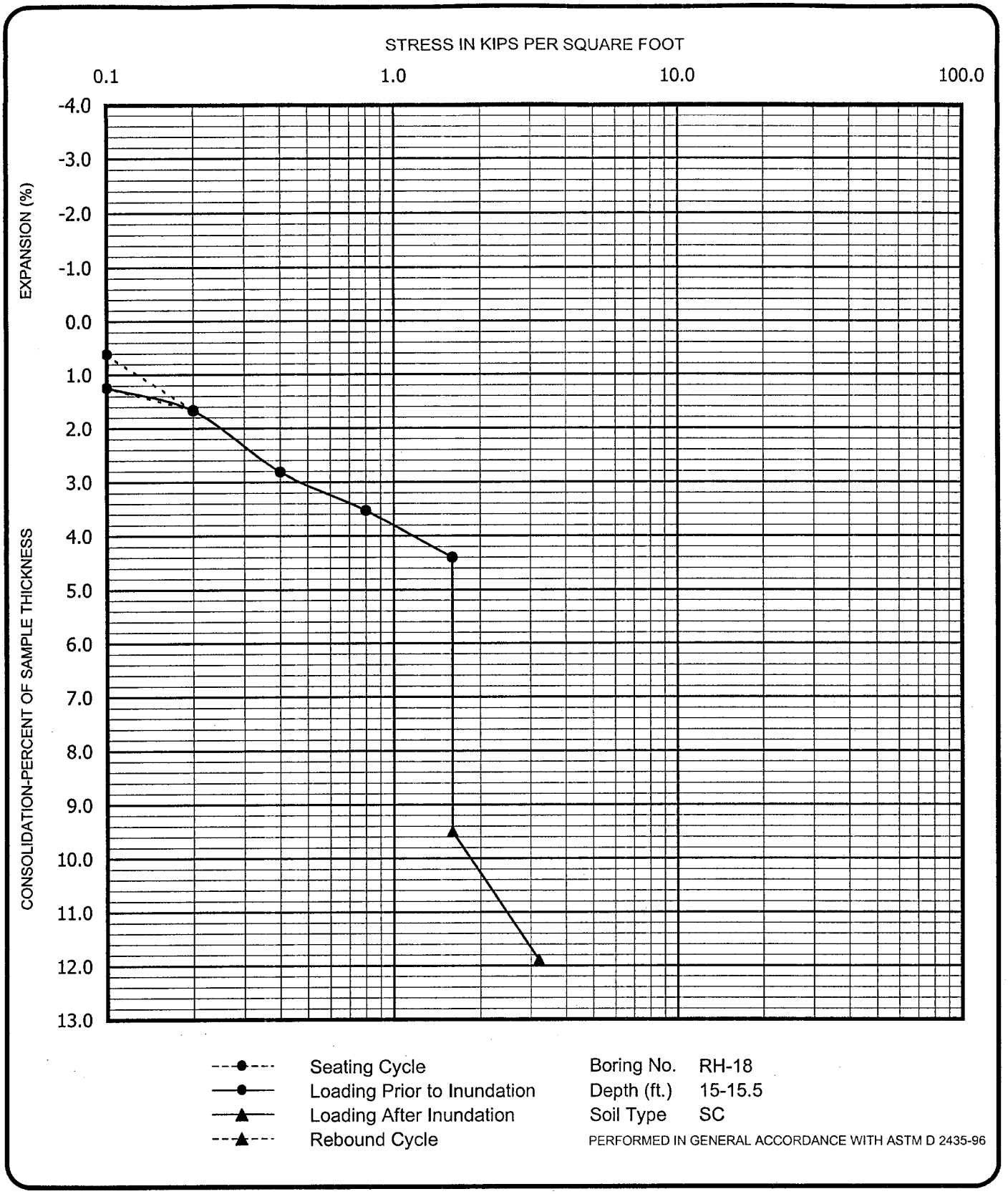


Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-58

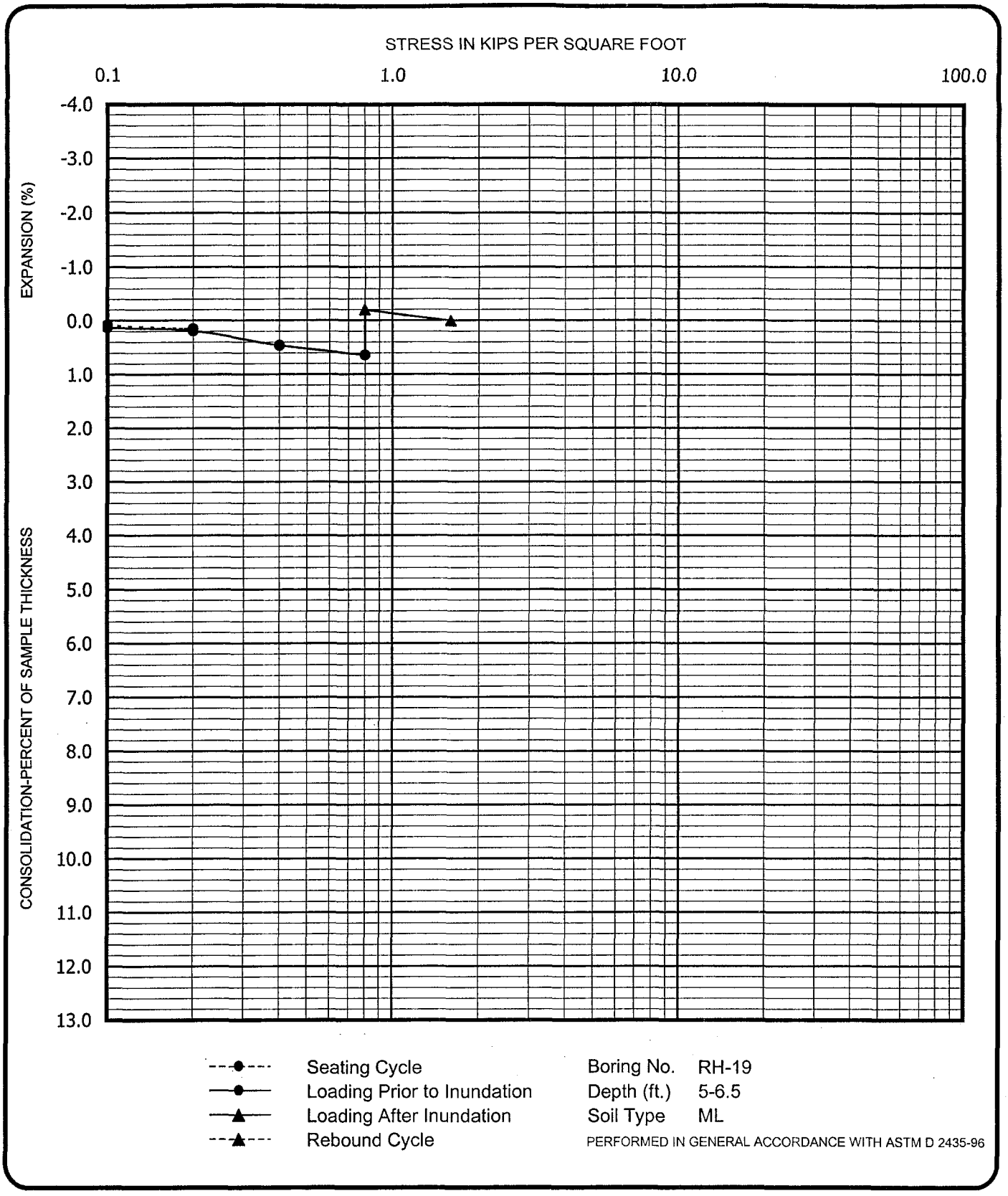


Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-59



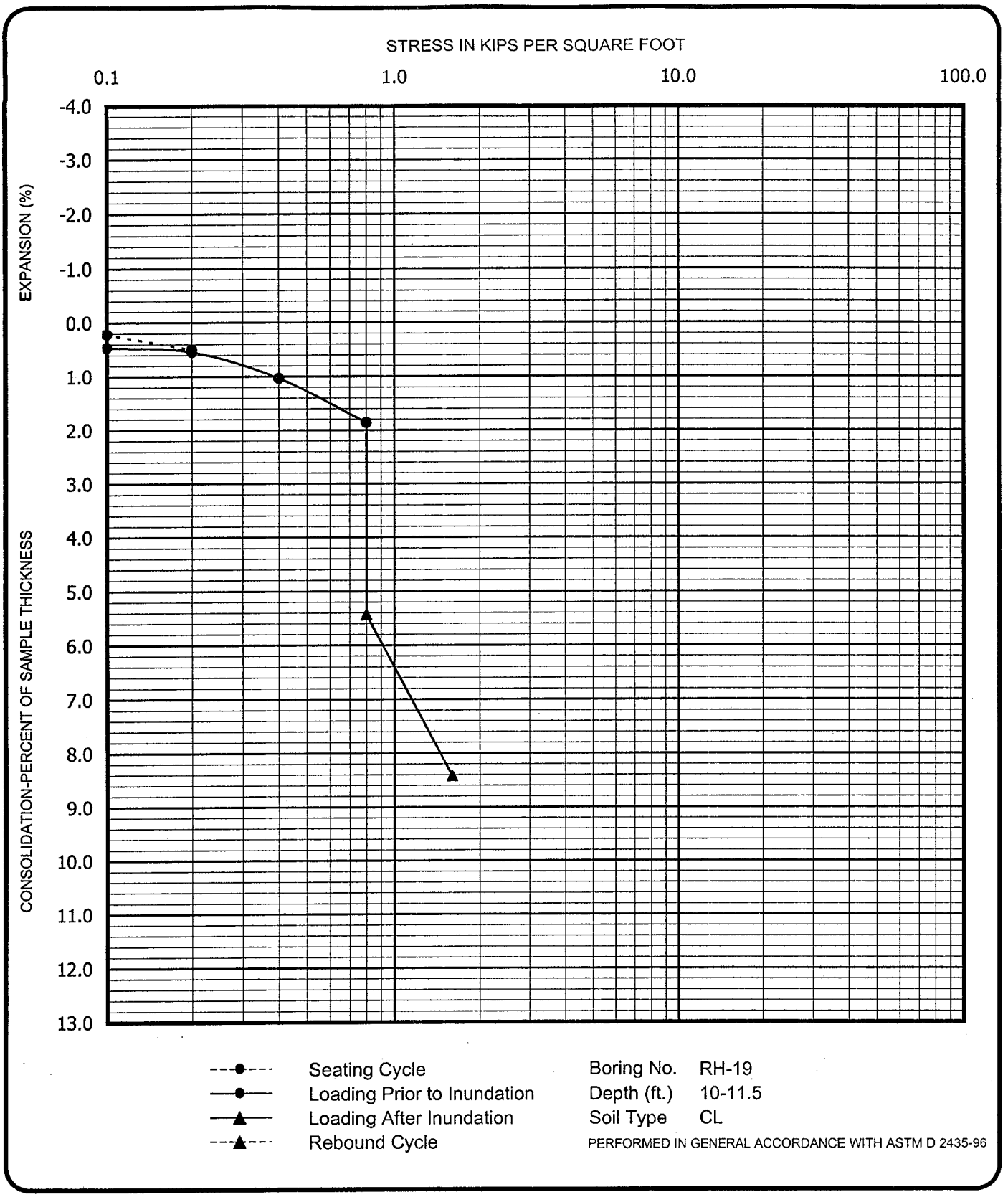
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-60

CONSOLIDATION-RH-19 5-6.5



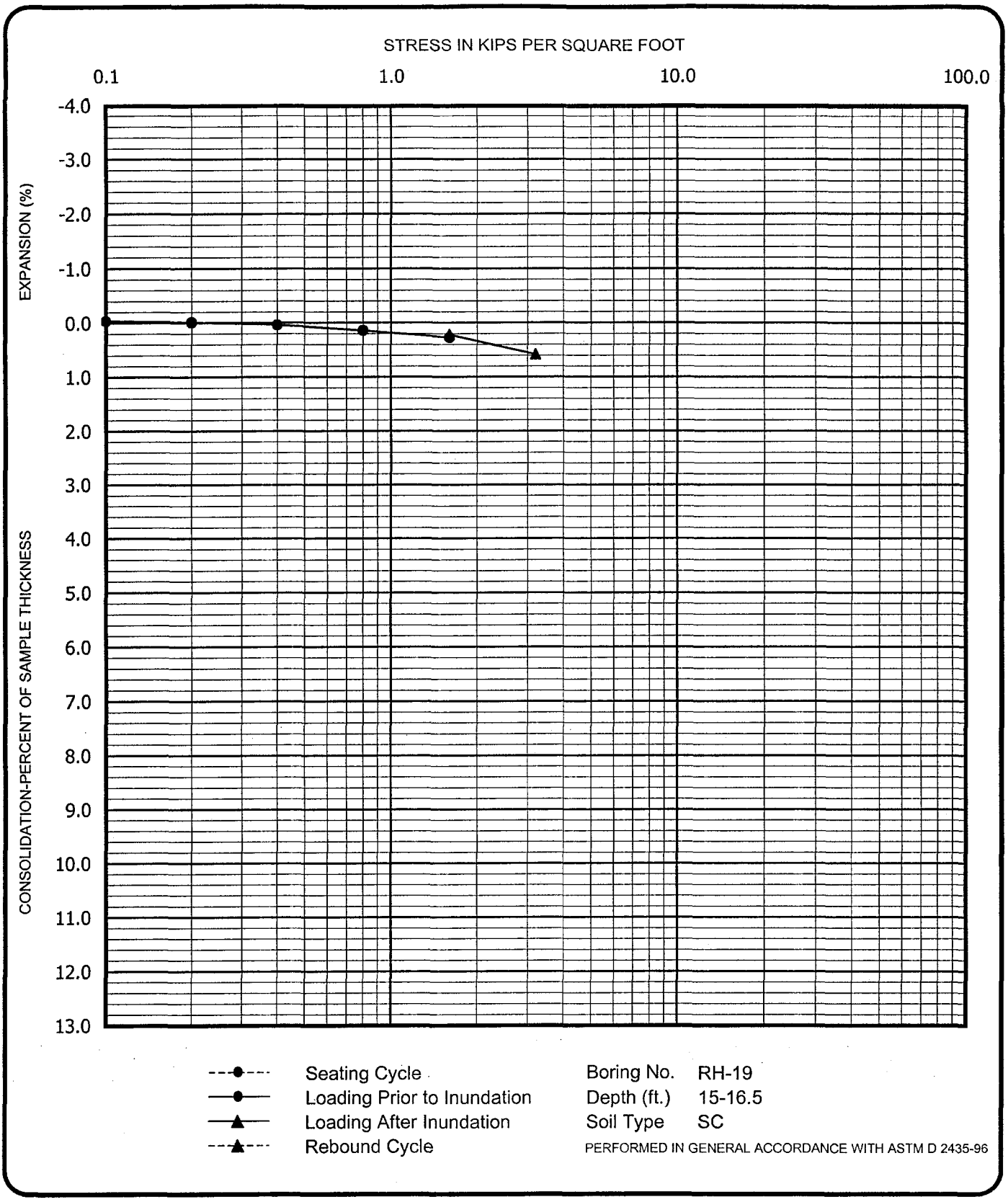
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-61

CONSOLIDATION-RH-19 10-11.5

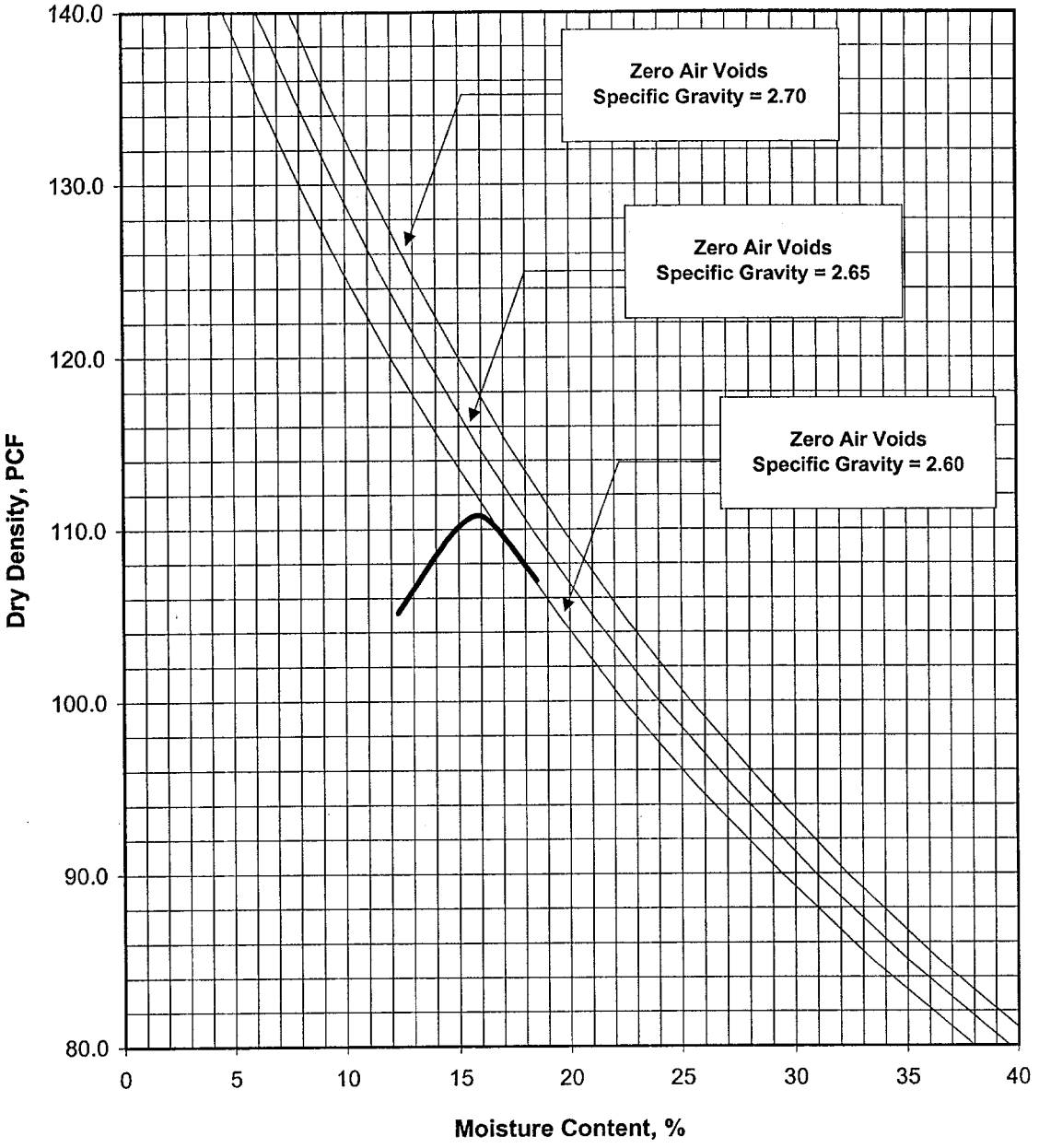


Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-62



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
RH-6	0-2	Silty CLAY	110.8	15.8

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00

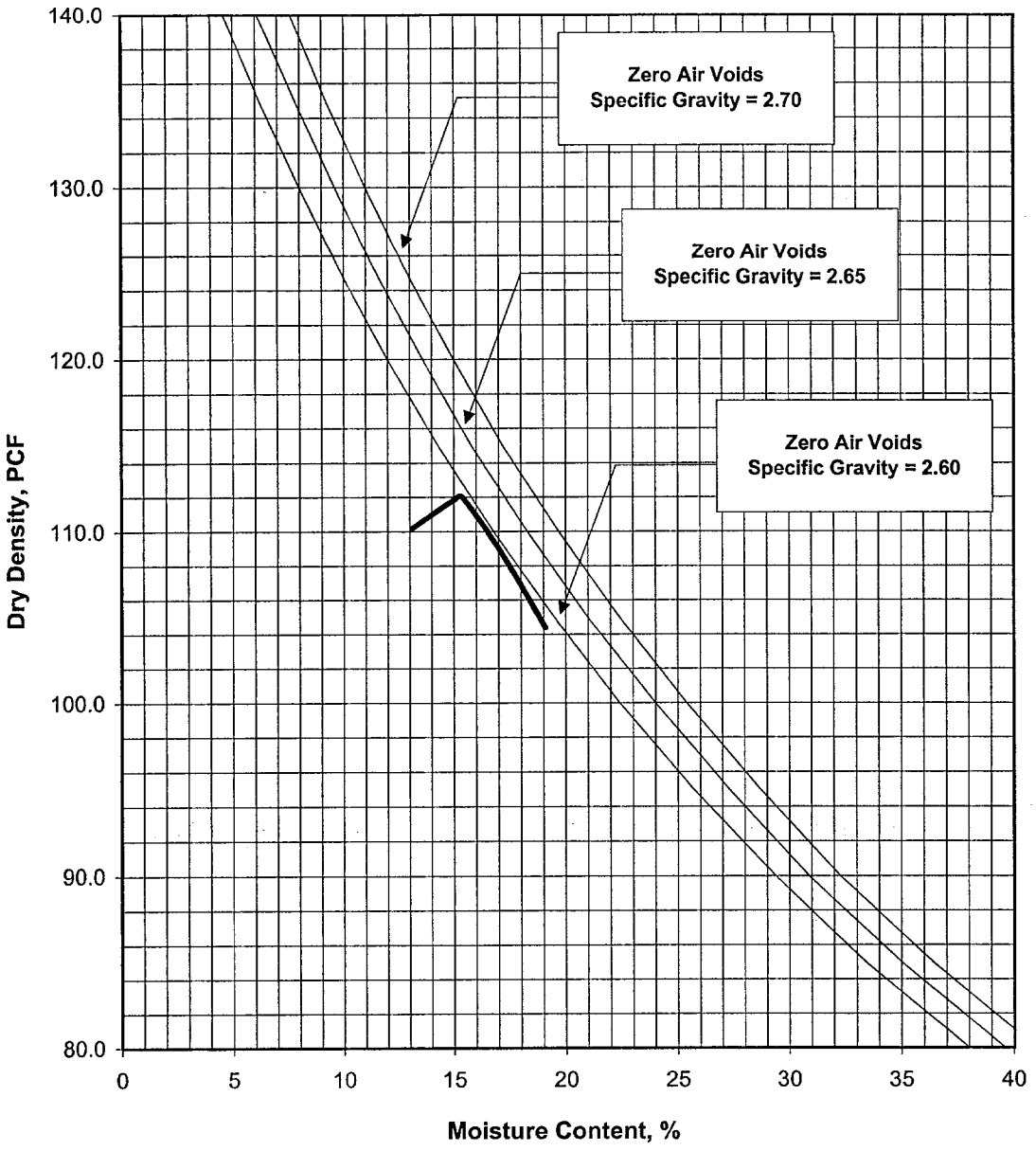
Ninyo & Moore

MAXDENSITY RH-6@0

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-63



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
RH-12	12-15	Silty SAND	112.0	15.4

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00

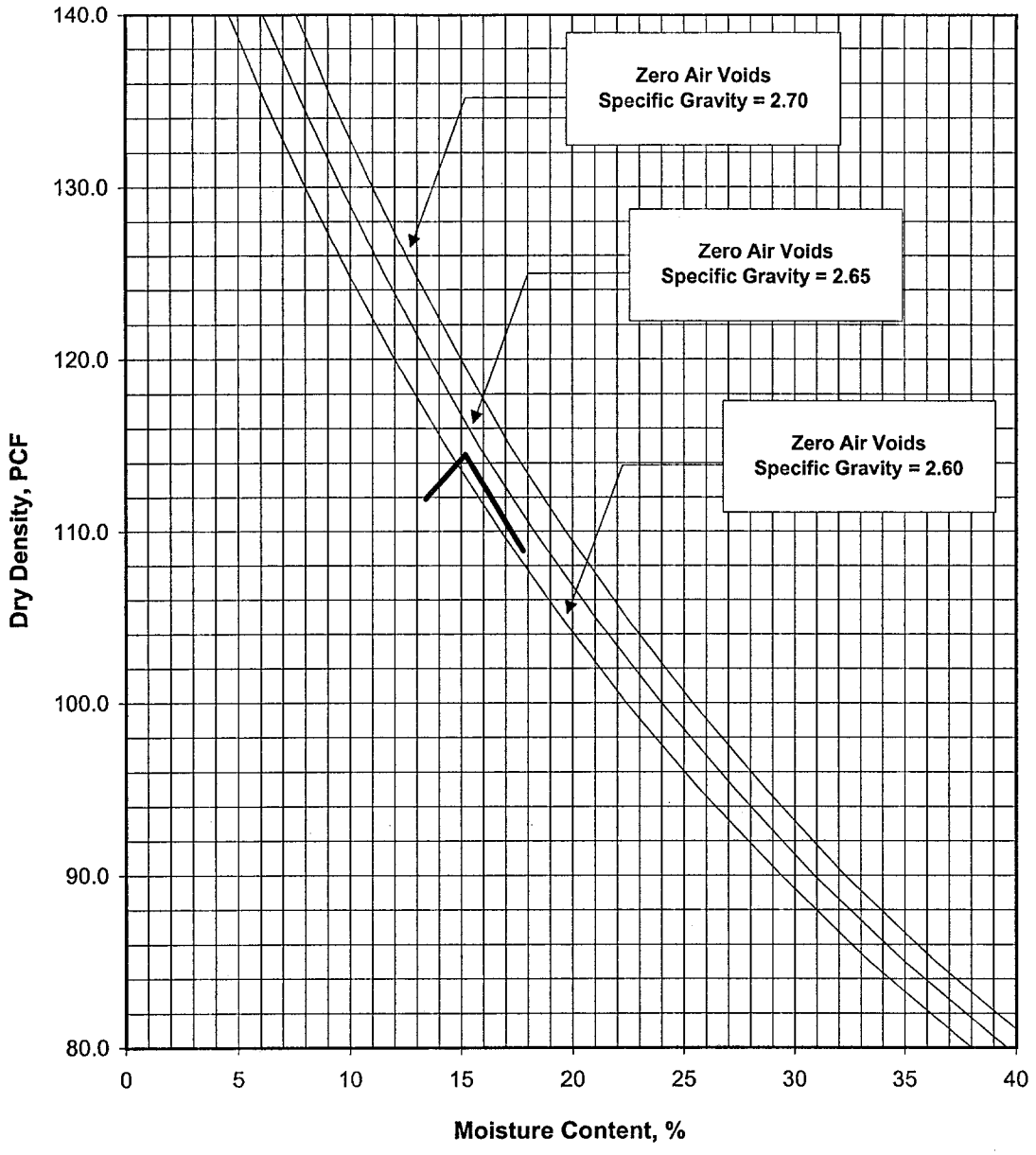
Ninyo & Moore

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-64

MAXDENSITY RH-12@12



SAMPLE LOCATION	DEPTH (FT)	SOIL DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
RH-14	0-5	Silty CLAY	114.5	15.2

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 698-00

Ninyo & Moore

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-65

MAXDENSITY RH-14@0

EXPANSION INDEX TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (PCF)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (IN)	EXPANSION INDEX	EXPANSION POTENTIAL
RH-6	0-2	11.0	101.3	15.7	0.0175	18	Very Low
RH-12	12-15	12.0	107.7	18.0	0.0003	0	Very Low
RH-14	0-5	10.0	99.5	22.1	0.0063	6	Very Low
RH-16	12-15	15.7	96.8	22.6	0.0074	7	Very Low

PERFORMED IN GENERAL ACCORDANCE WITH UBC STANDARD 18-2

Ninyo & Moore

EXPANSION INDEX TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-66

CORROSIVITY TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH *	RESISTIVITY * (ohm-cm)	WATER-SOLUBLE SULFATE CONTENT IN SOIL ** (%)	CHLORIDE CONTENT *** (ppm)
RH-14	0-5	7.8	726	0.002	55.6
RH-16	12-15	8.7	2,046	0.006	73.0

* PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 236b
** PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 733
*** PERFORMED IN GENERAL ACCORDANCE WITH ARIZONA TEST METHOD 736

Ninyo & Moore

CORROSIVITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-67

PERMEABILITY TEST RESULTS

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)	DRY DENSITY (PCF)	VARIATION IN HEAD (cm)	AVERAGE PERMEABILITY (cm/sec)
RH-1	25.0-26.5	8.1	8.9	79.2	0.6 - 22.8	1.47×10^{-3}
RH-2	12.5-14.0	8.7	9.5	86.0	2.7 - 12.8	1.02×10^{-4}
RH-5	20.0-21.5	4.4	4.6	86.2	2.1 - 13.4	5.20×10^{-4}
RH-17	10.0-11.0	11.1	12.5	74.7	2.4 - 16.8	6.27×10^{-4}

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2434-68

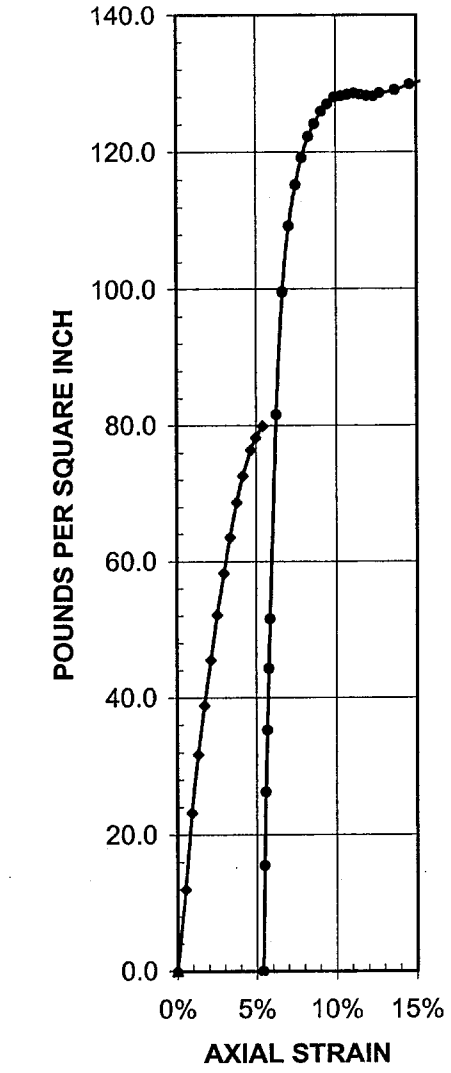
Ninyo & Moore

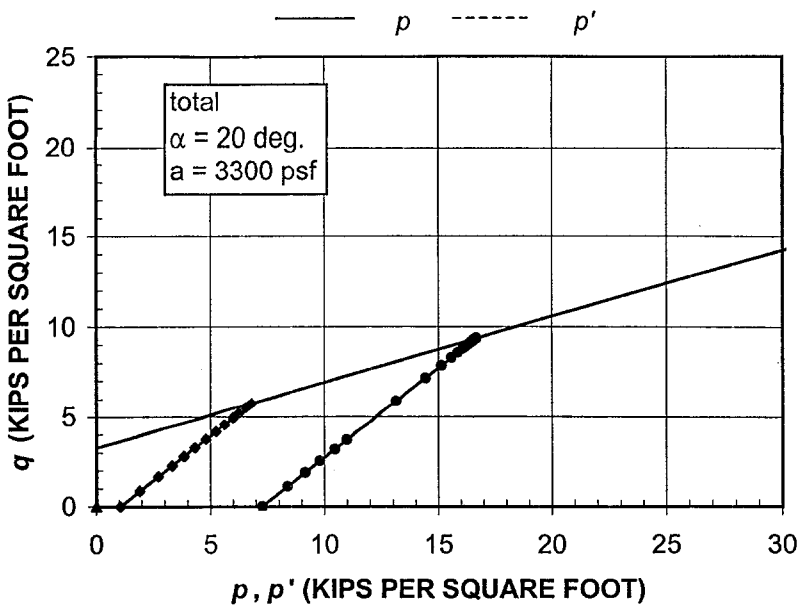
PERMEABILITY TEST RESULTS

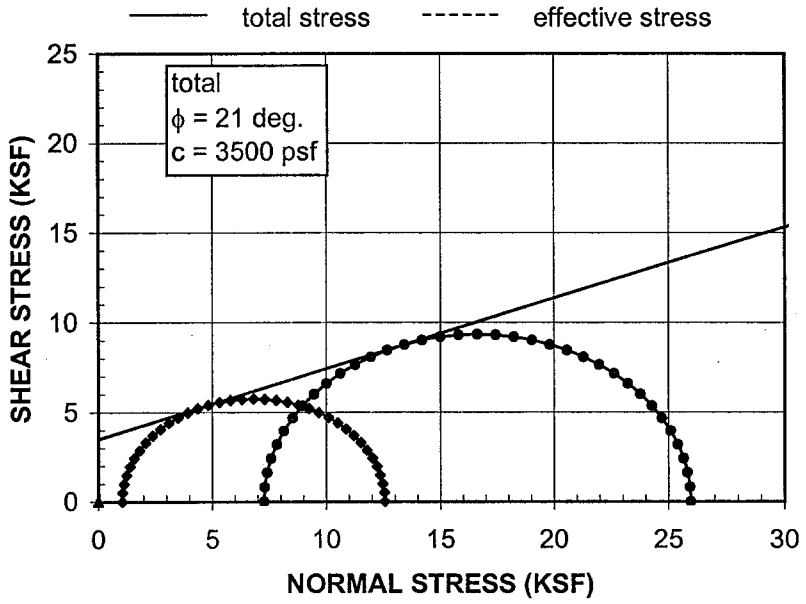
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-68

Permeab1







Sym.	Description	Soil Type	Sample Location	Sample Depth (ft.)	Initial Moisture (%)	Initial Dry Density (pcf)	Final Degree Saturation	Confining Stress (ksf)	Rate of Strain (%/min)
◆	Clayey Sand	SC	RH-11	17.5-19.0	5.6%	111.6	104%	1.05	1.1%
●	Clayey Sand	SC	RH-11	17.5-19.0	5.6%	111.6	104%	7.27	0.9%

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2850

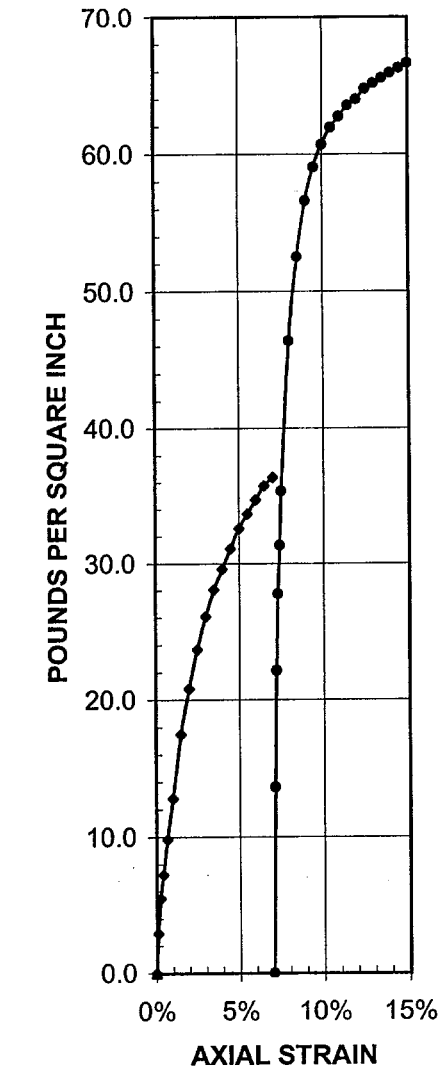
Ninyo & Moore

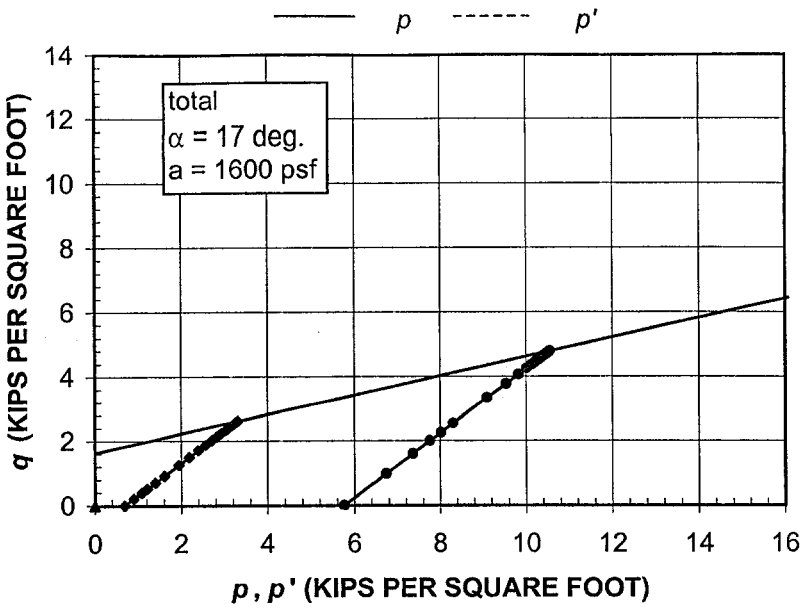
UU TRIAXIAL COMPRESSION RESULTS

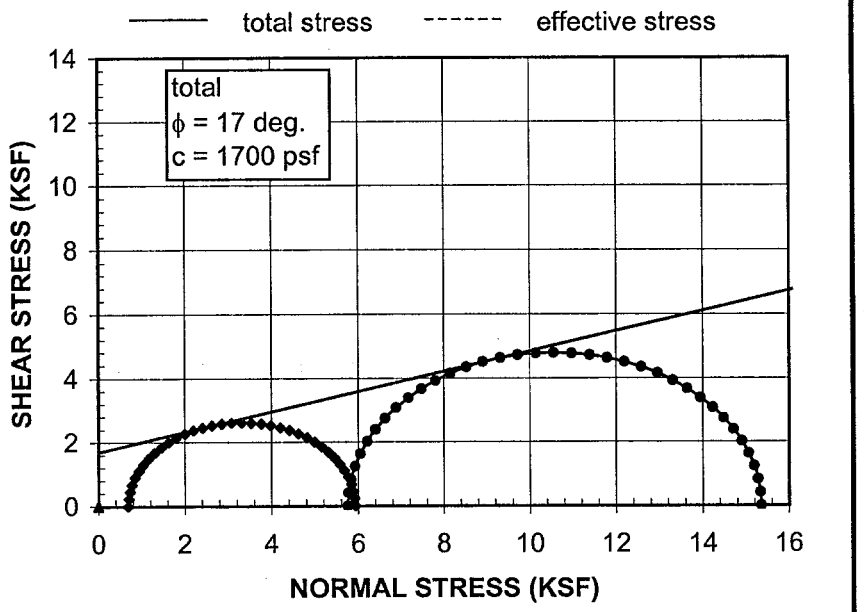
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-69

UUTRIAXIM1







Sym.	Description	Soil Type	Sample Location	Sample Depth (ft.)	Initial Moisture (%)	Initial Dry Density (pcf)	Final Degree Saturation	Confining Stress (ksf)	Rate of Strain (%/min)
◆	Silt	ML	RH-12	10.0-11.5	15.4%	81.3	96%	0.69	1.2%
●	Silt	ML	RH-12	10.0-11.5	15.4%	81.3	96%	5.76	1.0%

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2850

Ninyo & Moore

UU TRIAXIAL COMPRESSION RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198002	10/02	B-70

UUTRIAXIII12

APPENDIX C

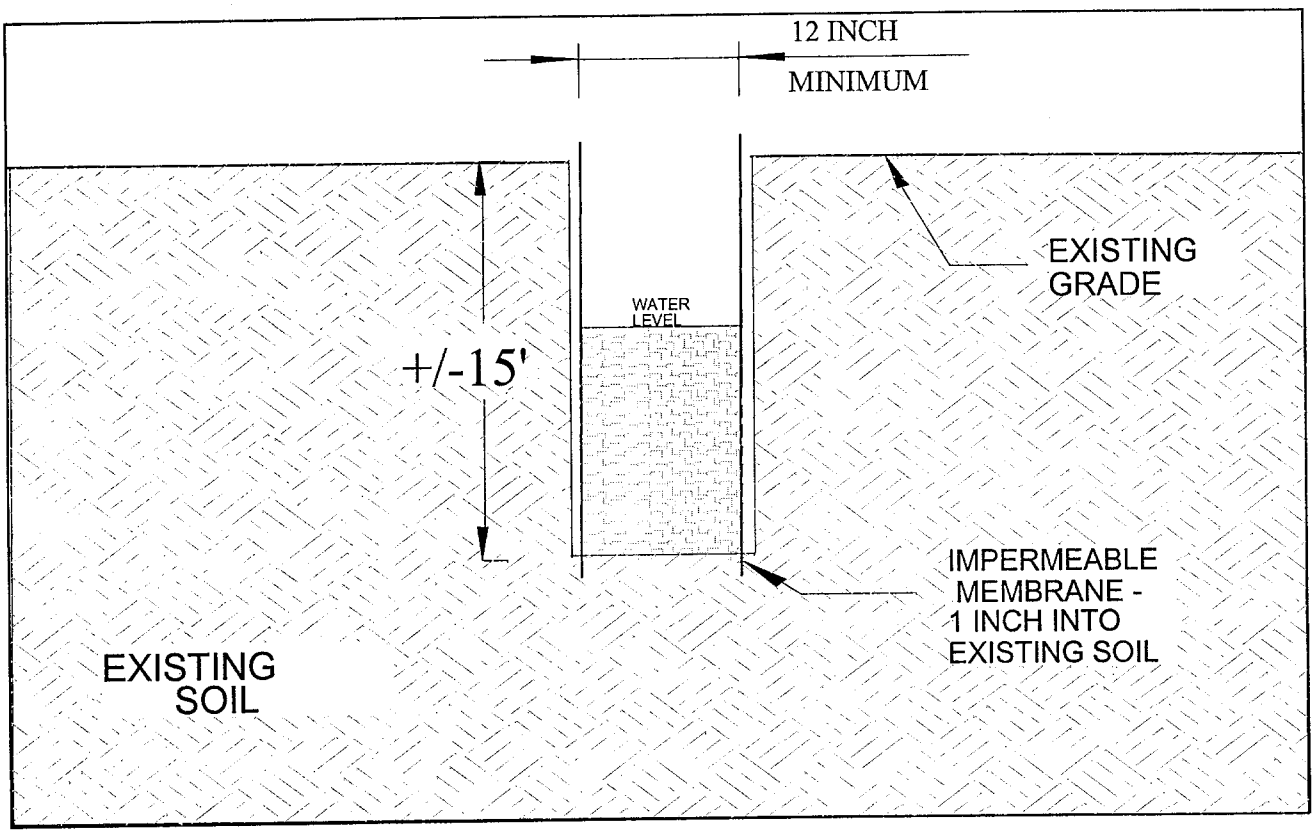
PERCOLATION TEST RESULTS

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198002

TECHNICIAN: MDE DATE: 07/19/01 LOCATION: PT-1 (Near RH-14)



START TIME (Hr:Min)	ENDING TIME (Hr:Min)	ELAPSED TIME (Hr:Min)	INITIAL READING (Feet)	FINAL READING (Feet)	CHANGE IN WATER LEVEL (Feet)	PERCOLATION RATE*
11:00	11:28	0:28	0.35	0.36	0.01	0.02
11:28	11:47	0:19	0.36	0.40	0.04	0.13
11:47	12:11	0:24	0.40	0.44	0.04	0.10
12:11	12:30	0:19	0.44	0.46	0.02	0.06
12:30	12:50	0:20	0.46	0.49	0.03	0.09

* Note: Percolation Rate is reported in Cubic Feet per Hour per Square Foot of percolation area.

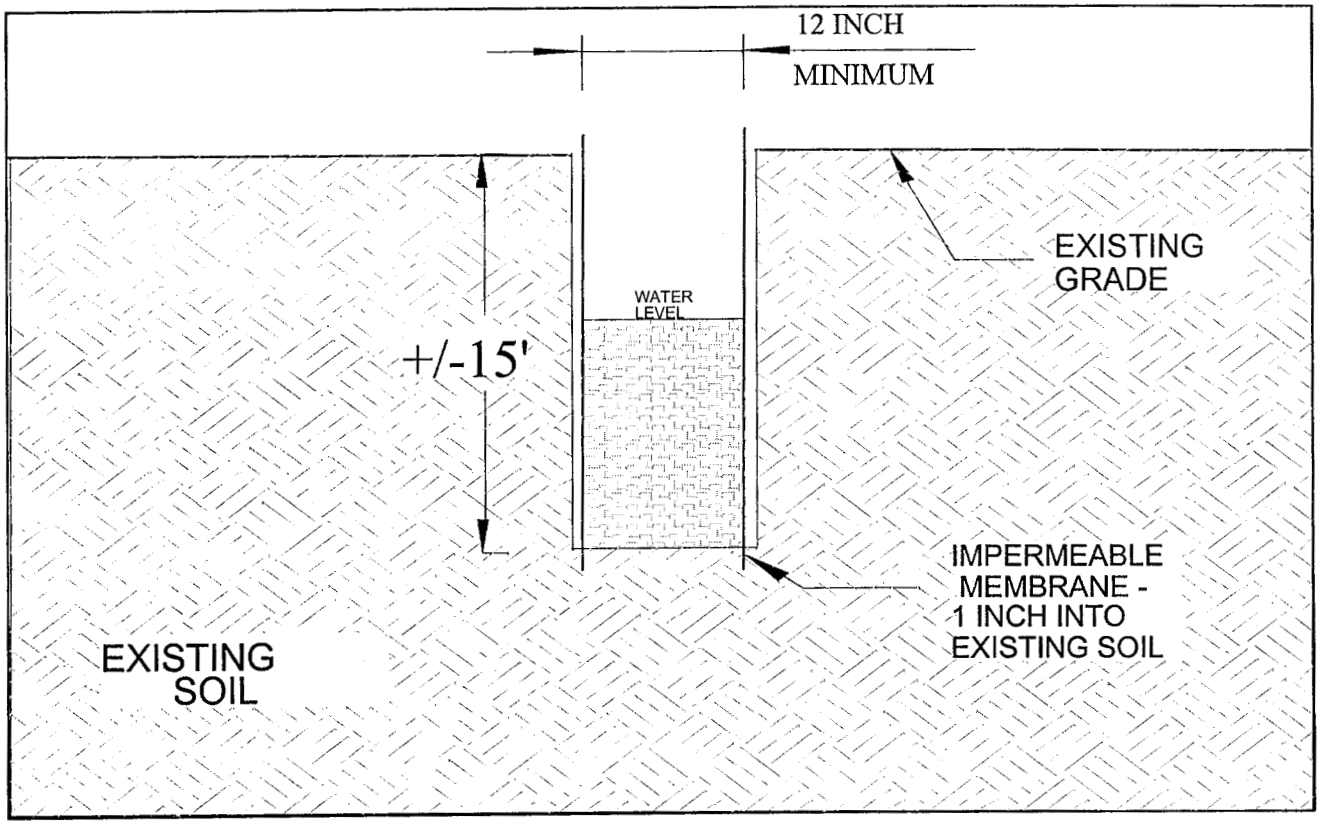
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS	**0.08**	$FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198002

TECHNICIAN: MDE DATE: 07/19/01 LOCATION: PT-2 (Near RH-15)



START TIME (Hr:Min)	ENDING TIME (Hr:Min)	ELAPSED TIME (Hr:Min)	INITIAL READING (Feet)	FINAL READING (Feet)	CHANGE IN WATER LEVEL (Feet)	PERCOLATION RATE*
10:48	11:24	0:36	0.90	4.40	3.50	5.83
11:24	11:43	0:19	4.40	5.40	1.00	3.16
11:43	12:00	0:17	5.40	6.11	0.71	2.51
12:00	12:25	0:25	6.11	6.99	0.88	2.11
12:25	12:45	0:20	6.99	7.54	0.55	1.65

* Note: Percolation Rate is reported in Cubic Feet per Hour per Square Foot of percolation area.

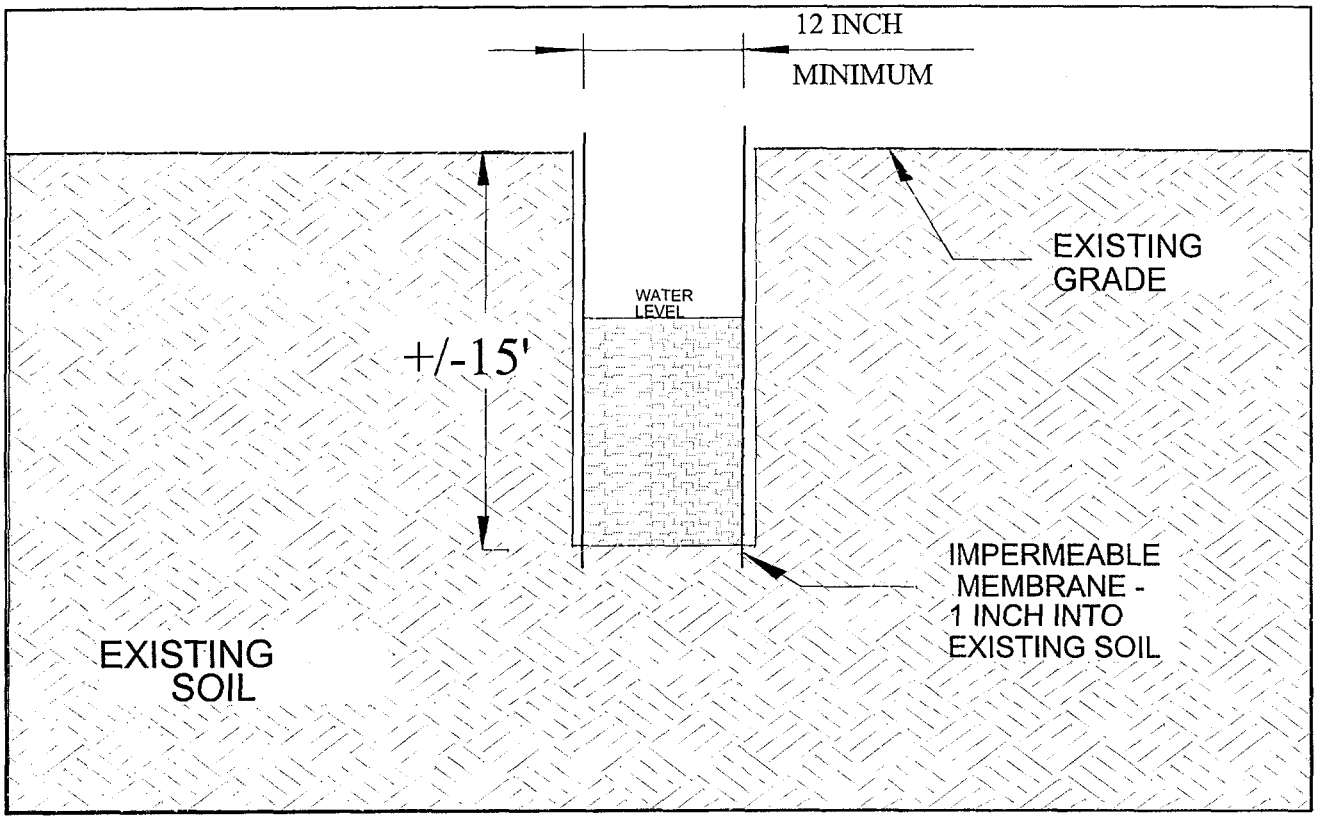
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS	**2.09**	$FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198002

TECHNICIAN: MDE DATE: 07/19/01 LOCATION: PT-3 (Near RH-16)



START TIME (Hr:Min)	ENDING TIME (Hr:Min)	ELAPSED TIME (Hr:Min)	INITIAL READING (Feet)	FINAL READING (Feet)	CHANGE IN WATER LEVEL (Feet)	PERCOLATION RATE*
10:36	11:17	0:41	0.40	1.20	0.80	1.17
11:17	11:36	0:19	1.20	1.52	0.32	1.01
11:36	11:54	0:18	1.52	1.81	0.29	0.97
11:54	12:19	0:25	1.81	2.20	0.39	0.94
12:19	12:39	0:20	2.20	2.45	0.25	0.75

* Note: Percolation Rate is reported in Cubic Feet per Hour per Square Foot of percolation area.

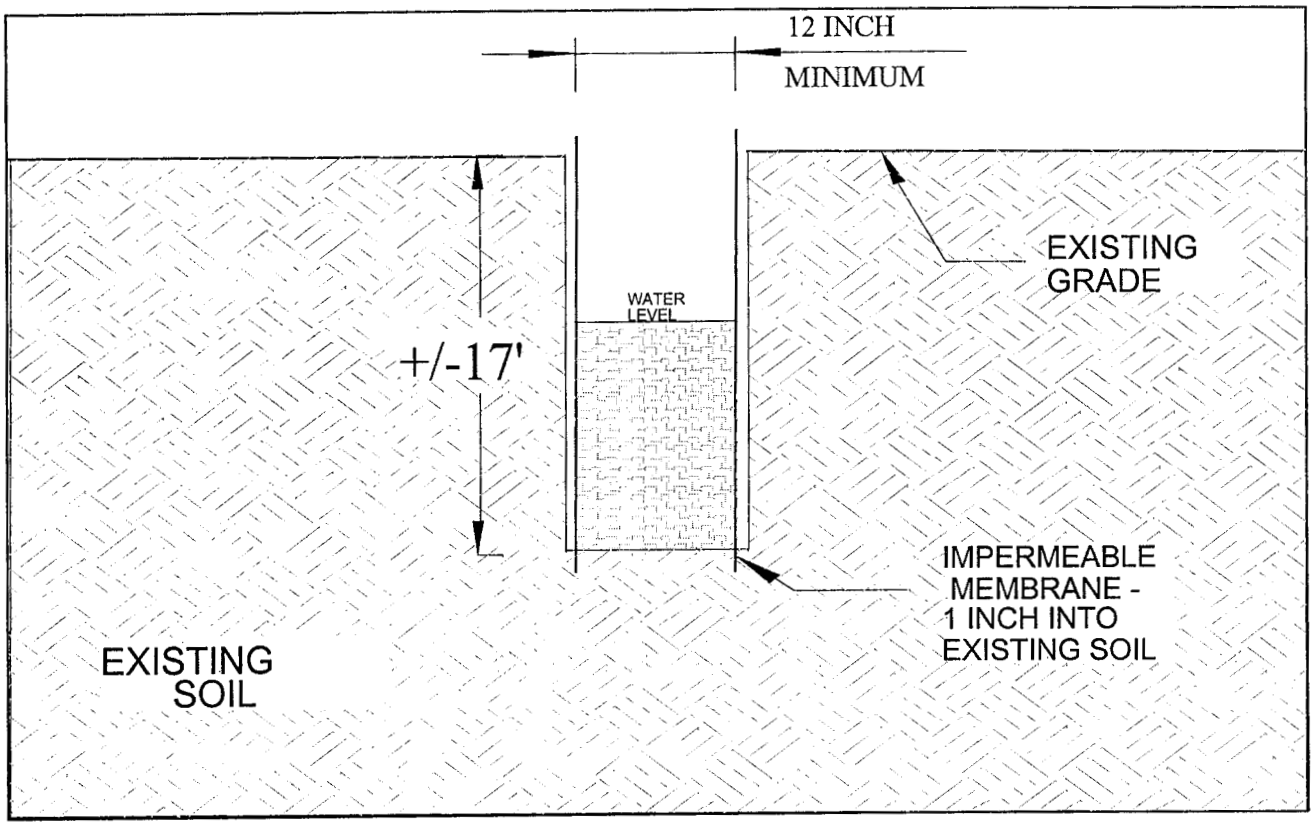
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS	**0.88**	$FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198002

TECHNICIAN: MDE DATE: 07/19/01 LOCATION: PT-4 (Near RH-17)



START TIME (Hr:Min)	ENDING TIME (Hr:Min)	ELAPSED TIME (Hr:Min)	INITIAL READING (Feet)	FINAL READING (Feet)	CHANGE IN WATER LEVEL (Feet)	PERCOLATION RATE*
10:27	11:12	0:45	3.10	4.40	1.30	1.73
11:12	11:39	0:27	4.40	4.85	0.45	1.00
11:39	11:51	0:12	4.85	5.22	0.37	1.85
11:51	12:15	0:24	5.22	5.78	0.56	1.40
12:15	12:35	0:20	5.78	6.01	0.23	0.69

* Note: Percolation Rate is reported in Cubic Feet per Hour per Square Foot of percolation area.

AVERAGE PERCOLATION RATE FOR LAST THREE READINGS	**1.31**	$FT^3/HOUR/FT^2$

APPENDIX D

AGRONOMIC TESTS RESULTS

FRUIT GROWERS LABORATORY, INC.

ANALYTICAL CHEMISTS

August 21, 2001 Lab #: SP 107342-01

Ninyo & Moore
5035 South 33rd St.
Phoenix, AZ 85040

Recommendations for Rittenhouse Basin

The following report presents the results of analyses conducted on your soil. See page 4 for sample information and analyses results. The following recommendations are based upon the current conditions of the soil. All application recommendations are for each 1,000 square feet of growing area. Please be sure to read the standard application notes presented on page 3.

I. Plant Selection

The analyses of this soil indicates the following plant selection requirements:

A. Select only non-acidic loving plants for this soil.
B. Select only those plants that have a slight or greater tolerance to free limestone for planting at this site.

II. Preplant Soil Amendments and Fertilizers

A. Turf and Groundcover

	Apply per 1000 sq. ft.
1. Soil amendments	
a. Organic (well-composted)	2.00 cu. yds.
b. Limestone	0.00 lbs.
c. Soil Sulfur	25.0 lbs.
	Apply per 1000 sq. ft.
2. Fertilizers	
a. Nitrogen (N)	1.00 lbs.
b. Phosphorus (P_2O_5)	4.10 lbs.
c. Potassium (K_2O)	3.40 lbs.
d. Magnesium (Mg)	0.00 lbs.
e. Zinc (Zn)	1.30 lbs.
f. Manganese (Mn)	0.00 lbs.
g. Iron (Fe)	0.55 lbs.
h. Copper (Cu)	.025 lbs.
i. Boron (B)	.009 lbs.

Corporate Offices & Laboratory
PO Box 272 / 853 Corporation Street
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Stockton, CA 95215
TEL: 209/942-0181
FAX: 209/942-0423

Field Office
Visalia, CA
TEL: 559/734-9473
FAX: 559/734-8435
Mobile: 559/737-2399

B. **Tree and Shrub Backfill Mix**

1.	Native (site) soil	66%
2.	Nitrogen Fertilized Organic Material	33%
3.	Commercial Fertilizer (8-8-4)	1 lb./cu. yd.
4.	Iron	2 oz./cu. yd.
5.	Zinc	1 oz./cu. yd.
6.	Manganese	1 oz./cu. yd.

When planting specifications do not call for a separate backfill mix then backfill the holes that are excavated to install containerized plants using the native (site) soil amended according to the preplant recommendations given on page 1.

III. Leaching Requirement

No Leaching Requirement for this soil.

IV. Post-Plant Fertilization - lbs./1000 sq. ft.

Nitrogen	1/2 lb.
Phosphorus	1/2 lb.
Potassium	1/2 lb.

The actual post-plant requirements for fertilizers and soil amendments will vary depending upon the specific site conditions. Periodic post-plant analyses can be used to assure proper soil conditions and balanced levels of plant nutrition.

V. Irrigation

Make certain that the irrigation water being applied is penetrating to a depth slightly greater than the root zone of the plants being grown. Water with a frequency needed to maintain moist soil at all times - never wet for long periods and never let the soil dry out.

Application Notes

The application instructions listed below apply only if the material(s) is recommended in this report on page 1. Materials not included in the recommendations are excluded either because the analyses data did not indicate a need or the analysis to determine if a need existed was not requested.

Organic Materials

Nitrolized redwood compost is preferred but other organic mixes may be substituted depending upon the site requirements. Organic materials should be spread uniformly over the surface soils and when possible should be incorporated to a depth of two to three inches.

Limestone, Dolomite & Sulfur

These materials should be broadcast uniformly over the surface soils and then incorporated to a depth of two to three inches.

Gypsum

This material should be broadcast uniformly over surface soils for water penetration. For best results do not incorporate.

Preplant Phosphorous, Zinc, Manganese, Iron & Copper

These materials should be broadcast uniformly over the surface soils and then incorporated to a depth of two to three inches. Post-plant applications can be surface applied for water penetration.

Nitrogen, Potassium & Magnesium

These materials are highly water soluble and can be applied uniformly over the surface soils for water penetration or they can be incorporated with the other materials. Magnesium sources for plant nutrition include Epsom salts (Magnesium Sulfate), and the double salt of Potasium-Magnesium Sulfate (Sulfate of Potash-magnesia).

FRUIT GROWERS LABORATORY, INC.

ANALYTICAL CHEMISTS

August 21, 2001

Ninyo & Moore
5035 South 33rd St.
Phoenix, AZ 85040

Description : RH-8
Project : Rittenhouse Basin

Lab ID : SP 107342-01
Customer ID: 2-18569

Sampled On : July 11, 2001
Sampled By : Ninyo & Moore
Received On: August 15, 2001
Depth : 12-15'
Meth. Irrg. : S.S. Sprinklers

LANDSCAPE SOIL ANALYSIS

Test Description	Result		Optimum Range	Graphical Results Presentation
				Very Low / Moderately Low / Optimum / Moderately High / Very High
Primary Nutrients				
Nitrate-Nitrogen	5.8	PPM	10 - 70	
Phosphorus	2	PPM	12 - 60	
Potassium (Exch)	300	PPM	81 - 500	
Potassium (Sol)	0.17	meq/L	0.25 - 1.0	
Secondary Nutrients				
Calcium (Exch)	3800	PPM	---	
Calcium (Sol)	1.2	meq/L	2.0 - 50	
Magnesium (Exch)	780	PPM	---	
Magnesium (Sol)	1.0	meq/L	1.5 - 60	
Sodium (Exch)	200	PPM	---	
Sodium (Sol)	4.7	meq/L	See SAR	
Sulfate	2.1	meq/L	0.6 - 20	
Micro Nutrients				
Zinc	0.2	PPM	0.7 - 50	
Manganese	4.1	PPM	1.4 - 50	
Iron	9.7	PPM	8.0 - 100	
Copper	0.8	PPM	0.2 - 15	
Boron	0.23	PPM	0.3 - 2.1	
Chloride	1.42	meq/L	0.1 - 4.0	
CEC	26.8	meq/100g	Variable	
% Base Saturation				
CEC - Calcium	70.1	%	60 - 80	
CEC - Magnesium	23.9	%	10 - 20	
CEC - Potassium	2.8	%	2 - 5	
CEC - Sodium	3.2	%	0 - 5	
CEC - Hydrogen	0.0	%	0 - 3	
				Strongly Acidic / Moderately Acidic / Near Neutral / Moderately Alkaline / Strongly Alkaline
pH	8.2	---	5.8 - 8.2	

Good Problem

Table continued next page...

Corporate Offices & Laboratory
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Field Office
Visalia, CA
TEL: 559/734-9473
FAX: 559/734-8435
Mobile: 559/737-2399

August 21, 2001

Ninyo & Moore

Lab ID : SP 107342-01
Customer ID: 2-18569
Description : RH-8

LANDSCAPE SOIL ANALYSIS

Test Description	Result	Optimum Range	Graphical Results Presentation
Others			Satisfactory / Possible Problem / Moderate Problem / Increasing Problem
Soil Salinity	0.75 mmhos/cm	0.5 - 2.0	
SAR	4.5	0.1 - 6	
Limestone	3.0 %	0 - 0.1	
			0 / 1 / 2 / 3 / 4 / 5 / 6
Lime Requirement	0.0 Tons/AF	---	
			Very Low / Moderately Low / Optimum / Moderately High / Very High
Moisture	11.2 %	1/2 Satn. %	
			Loamy Sand / Sandy Loam / Loam / Silt Loam / Clay Loam / Clay / Organic
Saturation	38.8 %	20 - 60	

Good Problem

Soil pH & Limestone levels are important to consider when making plant selections. Soil pH levels above 7.0 are not suitable for acid loving plants. Soils containing limestone are not suitable for plants sensitive to Limestone.

FRUIT GROWERS LABORATORY, INC.

DHN:md

Darrell H. Nelson, President

FRUIT GRO WERS LABORATO , INC.

ANALYTICAL CHEMISTS

August 21, 2001

Lab #: SP 107342-02

Ninyo & Moore
5035 South 33rd St.
Phoenix, AZ 85040

Recommendations for Rittenhouse Basin

The following report presents the results of analyses conducted on your soil. See page 4 for sample information and analyses results. The following recommendations are based upon the current conditions of the soil. All application recommendations are for each 1,000 square feet of growing area. Please be sure to read the standard application notes presented on page 3.

I. Plant Selection

The analyses of this soil indicates the following plant selection requirements:

A. Select only non-acidic loving plants for this soil.
B. Select only those plants that have a high or greater tolerance to free limestone for planting at this site.

II. Preplant Soil Amendments and Fertilizers

A. Turf and Groundcover

	Apply per 1000 sq. ft.
1. Soil amendments	
a. Organic (well-composted)	2.00 cu. yds.
b. Limestone	0.00 lbs.
c. Soil Sulfur	25.0 lbs.
	Apply per 1000 sq. ft.
2. Fertilizers	
a. Nitrogen (N)	0.00 lbs.
b. Phosphorus (P_2O_5)	4.50 lbs.
c. Potassium (K_2O)	3.60 lbs.
d. Magnesium (Mg)	0.00 lbs.
e. Zinc (Zn)	0.00 lbs.
f. Manganese (Mn)	0.00 lbs.
g. Iron (Fe)	0.00 lbs.
h. Copper (Cu)	.000 lbs.
i. Boron (B)	.000 lbs.

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TEL: 559/734-9473
FAX: 559/734-8435
Mobile: 559/737-2399

B. **Tree and Shrub Backfill Mix**

1.	Native (site) soil	66%
2.	Nitrogen Fertilized Organic Material	33%
3.	Commercial Fertilizer (8-8-4)	1 lb./cu. yd.
4.	Iron	2 oz./cu. yd.
5.	Zinc	1 oz./cu. yd.
6.	Manganese	1 oz./cu. yd.

When planting specifications do not call for a separate backfill mix then backfill the holes that are excavated to install containerized plants using the native (site) soil amended according to the preplant recommendations given on page 1.

III. Leaching Requirement

It is recommended that you periodically add N-pHURIC to the irrigation water to obtain a water pH of 5.0 to facilitate the leaching of Sodium.

IV. Post-Plant Fertilization - lbs./1000 sq. ft.

Nitrogen	1/2 lb.
Phosphorus	1/2 lb.
Potassium	1/2 lb.

The actual post-plant requirements for fertilizers and soil amendments will vary depending upon the specific site conditions. Periodic post-plant analyses can be used to assure proper soil conditions and balanced levels of plant nutrition.

V. Irrigation

Make certain that the irrigation water being applied is penetrating to a depth slightly greater than the root zone of the plants being grown. Water with a frequency needed to maintain moist soil at all times - never wet for long periods and never let the soil dry out.

Application Notes

The application instructions listed below apply only if the material(s) is recommended in this report on page 1. Materials not included in the recommendations are excluded either because the analyses data did not indicate a need or the analysis to determine if a need existed was not requested.

Organic Materials

Nitrolized redwood compost is preferred but other organic mixes may be substituted depending upon the site requirements. Organic materials should be spread uniformly over the surface soils and when possible should be incorporated to a depth of two to three inches.

Limestone, Dolomite & Sulfur

These materials should be broadcast uniformly over the surface soils and then incorporated to a depth of two to three inches.

Gypsum

This material should be broadcast uniformly over surface soils for water penetration. For best results do not incorporate.

Preplant Phosphorous, Zinc, Manganese, Iron & Copper

These materials should be broadcast uniformly over the surface soils and then incorporated to a depth of two to three inches. Post-plant applications can be surface applied for water penetration.

Nitrogen, Potassium & Magnesium

These materials are highly water soluble and can be applied uniformly over the surface soils for water penetration or they can be incorporated with the other materials. Magnesium sources for plant nutrition include Epsom salts (Magnesium Sulfate), and the double salt of Potasium-Magnesium Sulfate (Sulfate of Potash-magnesia).

ANALYTICAL CHEMISTS

August 21, 2001

Ninyo & Moore
5035 South 33rd St.
Phoenix, AZ 85040

Description : RH-16
Project : Rittenhouse Basin

Lab ID : SP 107342-02
Customer ID: 2-18569

Sampled On : July 5, 2001
Sampled By : Ninyo & Moore
Received On: August 15, 2001
Depth : 12-15'
Meth. Irrg. : S.S. Sprinklers

LANDSCAPE SOIL ANALYSIS

Test Description	Result		Optimum Range
Primary Nutrients			
Nitrate-Nitrogen	18.3	PPM	10 - 70
Phosphorus	ND	PPM	12 - 60
Potassium (Exch)	220	PPM	81 - 500
Potassium (Sol)	0.10	meq/L	0.25 - 1.0
Secondary Nutrients			
Calcium (Exch)	3600	PPM	---
Calcium (Sol)	1.4	meq/L	2.0 - 50
Magnesium (Exch)	690	PPM	---
Magnesium (Sol)	1.2	meq/L	1.5 - 60
Sodium (Exch)	630	PPM	---
Sodium (Sol)	17.0	meq/L	See SAR
Sulfate	8.5	meq/L	0.6 - 20
Micro Nutrients			
Zinc	1.3	PPM	0.7 - 50
Manganese	8.7	PPM	1.4 - 50
Iron	22.1	PPM	8.0 - 100
Copper	1.8	PPM	0.2 - 15
Boron	0.51	PPM	0.3 - 2.1
Chloride	5.41	meq/L	0.1 - 4.0
CEC	27.2	meq/100g	Variable
% Base Saturation			
CEC - Calcium	66.9	%	60 - 80
CEC - Magnesium	21.0	%	10 - 20
CEC - Potassium	2.0	%	2 - 5
CEC - Sodium	10.1	%	0 - 5
CEC - Hydrogen	0.0	%	0 - 3
pH	8.4	---	5.8 - 8.2

Graphical Results Presentation

Very Low	Moderately Low	Optimum	Moderately High	Very High

Strongly Acidic	Moderately Acidic	Near Neutral	Moderately Alkaline	Strongly Alkaline

Good Problem

Table continued next page...

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August 21, 2001

Ninyo & Moore

Lab ID : SP 107342-02
Customer ID: 2-18569
Description : RH-16

LANDSCAPE SOIL ANALYSIS

Test Description	Result	Optimum Range	Graphical Results Presentation
Others			Satisfactory / Possible Problem / Moderate Problem / Increasing Problem
Soil Salinity	1.84 mmhos/cm	0.5 - 2.0	
SAR	14.9	0.1 - 6	
Limestone	20.9 %	0 - 0.1	
Lime Requirement	0.0 Tons/AF	---	0 / 1 / 2 / 3 / 4 / 5 / 6
Moisture	19.0 %	1/2 Satn. %	Very Low / Moderately Low / Optimum / Moderately High / Very High
Saturation	44.7 %	20 - 60	Loamy Sand / Sandy Loam / Loam / Silt Loam / Clay Loam / Clay / Organic

Good Problem

Soil pH & Limestone levels are important to consider when making plant selections. Soil pH levels above 7.0 are not suitable for acid loving plants. Soils containing limestone are not suitable for plants sensitive to Limestone.

FRUIT GROWERS LABORATORY, INC.

DHN:md

Darrell H. Nelson, President

APPENDIX E

TYPICAL EARTHWORK GUIDELINES

TABLE OF CONTENTS

TYPICAL EARTHWORK GUIDELINES

1. GENERAL

These Guidelines are presented as general procedures for earthwork construction for sites having slopes less than 15 feet high. They are to be utilized in conjunction with the approved grading plans. These Guidelines are considered a part of the geotechnical report, but are superseded by recommendations in the geotechnical report in the case of conflict. Evaluations performed by the geotechnical consultant during the course of grading may result in new recommendations which could supersede these specifications and/or the recommendations of the geotechnical report. It is the responsibility of the contractor to read and understand these Guidelines as well as the geotechnical report and approved grading plans.

1.1. The contractor shall not vary from these Guidelines without prior recommendations by the geotechnical consultant and the approval of the client or the client's authorized representative. Recommendations by the geotechnical consultant and/or client shall not be considered to preclude requirements for approval by the jurisdictional agency prior to the execution of any changes.

1.2. The contractor shall perform the grading operations in accordance with these specifications, and shall be responsible for the quality of the finished product notwithstanding the fact that grading work will be observed and tested by the geotechnical consultant.

1.3. It is the responsibility of the grading contractor to notify the geotechnical consultant and the jurisdictional agencies, as required, prior to the start of work at the site and at any time that grading resumes after interruption. Each step of the grading operations shall be observed and documented by the geotechnical consultant and, where necessary, reviewed by the appropriate jurisdictional agency prior to proceeding with subsequent work.

1.4. If, during the grading operations, geotechnical conditions are encountered which were not anticipated or described in the geotechnical report, the geotechnical consultant shall be notified immediately and additional recommendations, if applicable, may be provided.

1.5. An as-graded report shall be prepared by the geotechnical consultant and signed by a registered engineer and certified engineering geologist. The report documents the geotechnical consultants' observations, and field and laboratory test results, and provides conclusions regarding whether or not earthwork construction was performed in

accordance with the geotechnical recommendations and the grading plans. Recommendations for foundation design, pavement design, subgrade treatment, etc., may also be included in the as-graded report.

1.6. For the purpose of evaluating quantities of materials excavated during grading and/or locating the limits of excavations, a licensed land surveyor or civil engineer shall be retained.

1.7. Definitions of terms utilized in the remainder of these specifications have been provided in Section 11 of these Guidelines.

2. OBLIGATIONS OF PARTIES

The parties involved in the projects earthwork activities shall be responsible as outlined in the following sections.

2.1. The client is ultimately responsible for all aspects of the project. The client or the client's authorized representative has a responsibility to review the findings and recommendations of the geotechnical consultant. The client shall authorize the contractor and/or other consultants to perform work and/or provide services. During grading the client or the client's authorized representative shall remain on site or remain reasonably accessible to the concerned parties to make the decisions necessary to maintain the flow of the project.

2.2. The contractor is responsible for the safety of the project and satisfactory completion of grading and other associated operations, including, but not limited to, earthwork in accordance with the project plans, specifications, and jurisdictional agency requirements. During grading, the contractor or the contractor's authorized representative shall remain on site. The contractor shall further remain accessible at all times, including at night and during days off.

2.3. The geotechnical consultant shall provide observation and testing services and shall make evaluations to advise the client on geotechnical matters. The geotechnical consultant shall report findings and recommendations to the client or the client's authorized representative.

2.4. Prior to proceeding with any grading operations, the geotechnical consultant shall be notified at least two working days in advance to schedule the needed observation and testing services.

2.4.1. Prior to any significant expansion or reduction in the grading operation, the geotechnical consultant shall be provided with two working days notice to make appropriate adjustments in scheduling of on-site personnel.

2.4.2. Between phases of grading operations, the geotechnical consultant shall be provided with at least two working days notice in advance of commencement of additional grading operations.

3. SITE PREPARATION

Site preparation shall be performed in accordance with the recommendations presented in the following sections.

3.1. The client, prior to any site preparation or grading, shall arrange and attend a pre-grading meeting between the grading contractor, the design engineer, the geotechnical consultant, and representatives of appropriate governing authorities, as well as any other involved parties. All parties shall be given at least two working days notice.

3.2. Clearing and grubbing shall consist of the substantial removal of vegetation, brush, grass, wood, stumps, trees, tree roots greater than 1/2-inch in diameter, and other deleterious materials from the areas to be graded. Clearing and grubbing shall extend to the outside of the proposed excavation and fill areas.

3.3. Demolition in the areas to be graded shall include removal of building structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, etc.), and other manmade surface and subsurface improvements, and the backfilling of mining shafts, tunnels and surface depressions. Demolition of utilities shall include proper capping or rerouting of pipelines at the project perimeter, and abandonment of wells in accordance with the requirements of the governing authorities and the recommendations of the geotechnical consultant at the time of demolition.

3.4. The debris generated during clearing, grubbing and/or demolition operations shall be removed from areas to be graded and disposed of off site at a legal dump site. Clearing, grubbing, and demolition operations shall be performed under the observation of the geotechnical consultant.

3.5. The ground surface beneath proposed fill areas shall be stripped of loose or unsuitable soil. These soils may be used as compacted fill provided they are generally free of organic or other deleterious materials and approved for use by the geotechnical consultant. The resulting surface shall be evaluated by the geotechnical consultant prior to proceeding. The natural ground surface shall be overexcavated or scarified as per the geotechnical report, moisture conditioned, and compacted in accordance with the specifications presented in Section 5 of these Guidelines.

4. REMOVALS AND EXCAVATIONS

Removals and excavations shall be performed as recommended in the following sections.

4.1. Removals

4.1.1. Materials which are considered unsuitable shall be excavated under the observation of the geotechnical consultant in accordance with the recommendations contained herein. Unsuitable materials include, but may not be limited to, dry, loose, soft, wet, organic, compressible natural soils, fractured, weathered, soft bedrock, and undocumented or otherwise deleterious fill materials.

4.1.2. Materials deemed by the geotechnical consultant to be unsatisfactory due to moisture conditions shall be excavated in accordance with the recommendations of the geotechnical consultant, watered or dried as needed, and mixed to a generally uniform moisture content in accordance with the specifications presented in Section 5 of this document.

4.2. Excavations

4.2.1. Temporary excavations no deeper than 5 feet in firm fill or natural materials may be made with vertical side slopes. To satisfy OSHA requirements, any excavation deeper than 5 feet shall be shored or laid back at a 1.5:1 inclination or /flatter, depending on material type, if construction workers are to enter the excavation.

5. COMPACTED FILL

Fill shall be constructed as specified below or by other methods recommended by the geotechnical consultant. Unless otherwise specified, fill soils shall be compacted to 95 or more percent as evaluated in accordance with ASTM Test Method D698-00a.

5.1. Prior to placement of compacted fill, the contractor shall request an evaluation of the exposed ground surface by the geotechnical consultant. The evaluation by the geotechnical consultant shall not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify the geotechnical consultant and the appropriate governing agency when project areas are ready for observation, and to provide reasonable time for that review.

5.2. Excavated on-site materials which are in general compliance with the recommendations of the geotechnical consultant may be utilized as compacted fill provided they are generally free of organic or other deleterious materials and do not contain rock fragments greater than 6 inches in dimension. During grading, the contractor may

encounter soil types other than those analyzed during the preliminary geotechnical study. The geotechnical consultant shall be consulted to evaluate the suitability of any such soils for use as compacted fill.

5.3. Where imported materials are to be used on site, the geotechnical consultant shall be notified at least three working days in advance of importation in order that it may sample and test the materials from the proposed borrow sites. No imported materials shall be delivered for use on site without prior sampling, testing, and evaluation by the geotechnical consultant.

5.4. Soils imported for on-site use shall preferably have very low to low expansion potential (based on ASTM D 4829-95 test procedures). Expansive soils exposed at grade shall be undercut as per the geotechnical report and capped with very low to low expansion potential fill. In the event expansive soils are present near the ground surface, special design and construction considerations shall be utilized in general accordance with the recommendations of the geotechnical consultant.

5.5. Fill materials shall be moisture conditioned to near optimum moisture content prior to placement as outlined in the geotechnical report. The optimum moisture content will vary with material type and other factors. Moisture conditioning of fill soils shall be generally uniform throughout the soil mass.

5.6. Prior to placement of additional compacted fill material following a delay in the grading operations, the exposed surface of previously compacted fill shall be prepared to receive fill. Preparation may include scarification, moisture conditioning, and recompaction.

5.7. Compacted fill shall be placed in horizontal lifts of approximately 8 inches in loose thickness. Prior to compaction, each lift shall be watered or dried as needed to achieve near optimum moisture condition, mixed, and then compacted by mechanical methods, using sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other appropriate compacting rollers, to the specified relative compaction. Successive lifts shall be treated in a like manner until the desired finished grades are achieved.

5.8. Fill shall be tested in the field by the geotechnical consultant for evaluation of general compliance with the recommended relative compaction and moisture conditions. Field density testing shall conform to ASTM D1556-90 (Sand Cone method), D2937-83 (Drive-Cylinder method), and/or D2922-91 and D3017-88 (Nuclear Gauge method). Generally, one test shall be provided for approximately every 2 vertical feet of fill placed, or for approximately every 1000 cubic yards of fill placed. In addition, on slope faces one or more tests shall be taken for approximately every 10,000 square feet of slope face and/or approximately every 10 vertical feet of slope height. Actual test intervals may vary as field conditions dictate. Fill found to be out of conformance with the grading recommendations shall be removed, moisture con-

ditioned, and compacted or otherwise handled to accomplish general compliance with the grading recommendations.

5.9. The contractor shall assist the geotechnical consultant by excavating suitable test pits for removal evaluation and/or for testing of compacted fill.

5.10. At the request of the geotechnical consultant, the contractor shall "shut down" or restrict grading equipment from operating in the area being tested to provide adequate testing time and safety for the field technician.

5.11. The geotechnical consultant shall maintain a map with the approximate locations of field density tests. Unless the client provides for surveying of the test locations, the locations shown by the geotechnical consultant will be estimated. The geotechnical consultant shall not be held responsible for the accuracy of the horizontal or vertical control points.

5.12. Grading operations shall be performed under the observation of the geotechnical consultant. Testing and evaluation by the geotechnical consultant does not preclude the need for approval by or other requirements of the jurisdictional agencies.

5.13. Fill materials shall not be placed, spread or compacted during unfavorable weather conditions. When work is interrupted by heavy rains, the filling operation shall not be resumed until tests indicate that moisture content and density of the fill meet the project specifications. Regrading of the near-surface soil may be needed to achieve proper moisture content and density.

5.14. Upon completion of grading and termination of observation by the geotechnical consultant, no further filling or excavating, including that necessary for footings, foundations, retaining walls or other features, shall be performed without the involvement of the geotechnical consultant.

5.15. Fill placed in areas not previously viewed and evaluated by the geotechnical consultant may have to be removed and recompacted at the contractor's expense. The depth and extent of removal of the unobserved and undocumented fill will be decided based upon review of the field conditions by the geotechnical consultant.

5.16. Off-site fill shall be treated in the same manner as recommended in these specifications for on-site fills. Off-site fill subdrains temporarily terminated (up gradient) shall be surveyed for future locating and connection.

6. OVERSIZED MATERIAL

Oversized material shall be placed in accordance with the following recommendations.

6.1. During the course of grading operations, rocks or similar irreducible materials greater than 6 inches in dimension (oversized material) may be generated. These materials shall not be placed within the compacted fill unless placed in general accordance with the recommendations of the geotechnical consultant.

6.2. Where oversized rock (greater than 6 inches in dimension) or similar irreducible material is generated during grading, it is recommended, where practical, to waste such material off site, or on site in areas designated as "nonstructural rock disposal areas." Rock designated for disposal areas shall be placed with sufficient sandy soil to generally fill voids. The disposal area shall be capped with a 5-foot thickness of fill which is generally free of oversized material.

6.3. Rocks 6 inches in dimension and smaller may be utilized within the compacted fill, provided they are placed in such a manner that nesting of rock is not permitted. Fill shall be placed and compacted over and around the rock. The amount of rock greater than 3/4-inch in dimension shall generally not exceed 40 percent of the total dry weight of the fill mass, unless the fill is specially designed and constructed as a "rock fill."

6.4. Rocks or similar irreducible materials greater than 6 inches but less than 4 feet in dimension generated during grading may be placed in windrows and capped with finer materials in accordance with the recommendations of the geotechnical consultant and the approval of the governing agencies. Selected native or imported granular soil (Sand Equivalent of 30 or higher) shall be placed and flooded over and around the windrowed rock such that voids are filled. Windrows of oversized materials shall be staggered so that successive windrows of oversized materials are not in the same vertical plane. Rocks greater than 4 feet in dimension shall be broken down to 4 feet or smaller before placement, or they shall be disposed of off site.

7. SLOPES

The following sections provide recommendations for cut and fill slopes.

7.1. Cut Slopes

7.1.1. The geotechnical consultant shall observe cut slopes during excavation. The geotechnical consultant shall be notified by the contractor prior to beginning slope excavations.

7.1.2. If, during the course of grading, adverse or potentially adverse geotechnical conditions are encountered in the slope which were not anticipated in the preliminary evaluation report, the geotechnical consultant shall evaluate the conditions and provide appropriate recommendations.

7.2. Fill Slopes

7.2.1. When placing fill on slopes steeper than 5:1 (horizontal:vertical), topsoil, slope wash, colluvium, and other materials deemed unsuitable shall be removed. Near-horizontal keys and near-vertical benches shall be excavated into sound bedrock or firm fill material, in accordance with the recommendation of the geotechnical consultant. Keying and benching shall be accomplished. Compacted fill shall not be placed in an area subsequent to keying and benching until the area has been observed by the geotechnical consultant. Where the natural gradient of a slope is less than 5:1, benching is generally not necessary. However, fill shall not be placed on compressible or otherwise unsuitable materials left on the slope face.

7.2.2. Within a single fill area where grading procedures dictate two or more separate fills, temporary slopes (false slopes) may be created. When placing fill adjacent to a temporary slope, benching shall be conducted in the manner described in Section 7.2.1. A 3-foot or higher near-vertical bench shall be excavated into the documented fill prior to placement of additional fill.

7.2.3. Unless otherwise recommended by the geotechnical consultant and approved by the regulating agencies, permanent fill slopes shall not be steeper than 2:1 (horizontal:vertical). The height of a fill slope shall be evaluated by the geotechnical consultant.

7.2.4. Unless specifically recommended otherwise, compacted fill slopes shall be overbuilt and cut back to grade, exposing firm compacted fill. The actual amount of overbuilding may vary as field conditions dictate. If the desired results are not achieved, the existing slopes shall be overexcavated and reconstructed in accordance with the recommendations of the geotechnical consultant. The degree of overbuilding may be increased until the desired compacted slope face condition is achieved. Care shall be taken by the contractor to provide mechanical compaction as close to the outer edge of the overbuilt slope surface as practical.

7.2.5. If access restrictions, property line location, or other constraints prevent overbuilding and cutting back of the slope face, an alternative method for compaction of the slope face may be attempted by conventional construction procedures including backrolling at intervals of 4 feet or less in vertical slope height, or as dictated by the capability of the available equipment, whichever is less. Fill slopes shall be backrolled utilizing a conventional sheeps foot-type roller. Care shall be taken to maintain the desired moisture conditions and/or reestablish the same, as needed, prior to backrolling. Upon achieving final grade, the slope shall again be moisture conditioned and backrolled.

7.2.6. The placement, moisture conditioning and compaction of fill slope materials shall be done in accordance with the recommendations presented in Section 5. of these Guidelines.

7.2.7. The contractor shall be ultimately responsible for placing and compacting the soil out to the slope face to obtain a relative compaction in accordance with Section 5. The geotechnical consultant shall perform field moisture and density tests at intervals of one test for approximately every 10,000 square feet of slope.

7.2.8. Backdrains shall be provided in fill as recommended by the geotechnical consultant.

7.2.9. Fill shall be compacted prior to placement of survey stakes. This is particularly important on fill slopes. Slope stakes shall not be placed until the slope is compacted and tested. If a slope face fill does not meet the recommendations presented in this specification, it shall be recognized that stakes placed prior to completion of the recompaction effort will be removed and/or demolished at such time as the compaction procedures resume.

7.3. Top-of-Slope Drainage

7.3.1. For pad areas above slopes, positive drainage shall be established away from the top of slope. This may be accomplished utilizing a berm and pad gradient of 2 percent or steeper at the top-of-slope areas. Site runoff shall not be permitted to flow over the tops of slopes.

7.3.2. Gunite-lined brow ditches shall be placed at the top of cut slopes to redirect surface runoff away from the slope face where drainage devices are not otherwise provided.

7.4. Slope Maintenance

7.4.1. In order to enhance surficial slope stability, slope planting shall be accomplished at the completion of grading. Slope plants shall consist of deep-rooting, variable root depth, drought-tolerant vegetation. Native vegetation is generally desirable. Plants native to semiarid and arid areas may also be appropriate. Large-leafed ice plant should not be used on slopes. A landscape architect shall be consulted regarding the actual types of plants and planting configuration to be used.

7.4.2. Irrigation pipes shall be anchored to slope faces and not placed in trenches excavated into slope faces. Slope irrigation shall be maintained at a level just sufficient to support plant growth. Property owners shall be made aware that over watering of slopes is detrimental to slope stability. Slopes shall be monitored regularly and broken sprinkler heads and/or pipes shall be repaired immediately.

7.4.3. Periodic observation of landscaped slope areas shall be planned and appropriate measures taken to enhance growth of landscape plants.

7.4.4. Graded swales at the top of slopes and terrace drains shall be installed and the property owners notified that the drains shall be periodically checked so that they may be kept clear. Damage to drainage improvements shall be repaired

immediately. To reduce siltation, terrace drains shall be constructed at a gradient of 3 percent or steeper, in accordance with the recommendations of the project civil engineer.

7.4.5. If slope failures occur, the geotechnical consultant shall be contacted immediately for field review of site conditions and development of recommendations for evaluation and repair.

8. CUT-OFF BARRIER

The following sections provide recommendations for construction of the cut-off barriers.

8.1. The cut-off barrier shall be 12 or more inches wide and shall extend to depths of 13 or more feet below the ground surface, as shown on the plans.

8.2. The trench used for the barrier shall not be left open overnight.

8.3. The geotextile used in the cut-off barrier shall consist of a Contech C-80NW, Mirafi, Inc. 180N, or equivalent. The manufacture's specifications for these produces are shown below.

Properties of CONTECH Nonwoven Geotextiles

CONTECH CONSTRUCTION PRODUCTS INC.

PROPERTY	TEST METHOD	UNITS	ROLL VALUE	C-31NW	C35NW	C-38NW (See note 3)	C-40NW	C-45NW	C-45NW (See note 3)	C-50NW	C-60NW	C-65NW	C-70NW	C-80NW	C-100NW	C-120NW	C-160NW
MECHANICAL																	
Grab Tensile Strength	ASTM D4632	lbs.	MARV	80	95	90	115	120	101	150	160	170	180	205	250	300	380
Grab Elongation	ASTM D4632	%	MARV	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Puncture Strength	ASTM D4833	lbs.	MARV	50	55	90	65	65	95	85	85	110	100	105	130	175	240
Mullen Burst	ASTM D3786	psi	MARV	150	185	210	210	230	220	280	280	330	300	350	460	580	750
Trapezoidal Tear	ASTM D4533	lbs.	MARV	30	40	40	50	50	45	60	60	70	75	85	100	115	145
HYDRAULIC																	
Apparent Opening Size (AOS)	ASTM D4751	US Sieve (mm)	MARV	70/0.212	70/0.212	n/a	70/0.212	70/0.212	n/a	70/0.212	70/0.212	70/0.212	70/0.212	80/0.180	100/0.150	100/0.150	100/0.150
Permittivity, ψ	ASTM D4491	sec^{-1}	MARV	2.00	2.00	n/a	2.00	1.50	n/a	1.40	1.30	1.30	1.50	1.50	1.20	1.00	0.70
Permeability, $k = \psi t$	ASTM D4491	cm/sec	MARV	0.22	0.25	n/a	0.22	0.22	n/a	0.23	0.24	0.24	0.34	0.38	0.30	0.29	0.27
Water Flow Rate	ASTM D4491	gpm/ft^2	MARV	110	110	n/a	140	120	n/a	115	110	110	110	110	85	75	50
PHYSICAL																	
Mass	ASTM D4533	oz/yd^2	Nominal	3.0	3.5	3.5	4.0	4.5	4.0	5.0	6.0	6.5	7.0	8.0	10.0	12.0	16.0
Thickness, t	ASTM D5199	mils	MARV	30	40	30	50	45	35	55	60	65	70	70	100	105	145
ENDURANCE																	
UV Resistance	ASTM D4355 Xenon Arc	% Retained @ 500 hrs.	MARV	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Melting Point	ASTM D276	degrees F	MARV	n/a	n/a	>300	n/a	n/a	>300	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Asphalt Retention	Task Force 25 Method B	gal/sy	MARV	n/a	n/a	0.20	n/a	n/a	0.20	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
STANDARD PACKAGING																	
Roll Width	Measured	feet	Nominal	12.5/15.0	12.5/15.0	12.5	12.5/15.0	12.5/15.0	12.5	12.5/15.0	12.5/15.0	15.0	12.5/15.0	15.0	15.0	15.0	15.0
Roll Length	Measured	feet	Nominal	360	360	360	360	360	360	360	300	300	300	300	300	300	300
Roll Area	Calculated	sy	Nominal	500/600	500/600	500	500/600	500/600	500	500/600	417/500	500	417/500	500	500	500	500

Notes: *1. Values are reported for the weaker principle direction.*
2. "MARV" INDICATES minimum average roll values, which is calculated as the mean minus two standard deviations, yielding a 97.5% confidence level.
3. C-38NW and C-46NW are for use in asphalt pavement overlay applications. Due to the relevancy of mass per unit area in paving applications, as acceptance/rejection criteria, the mass units are for C-38NW and C-46NW are reported as MARV.

This data sheet supercedes all previous data sheets for these styles of CONTECH Nonwoven Geotextiles and is subject to change without notice. Your CONTECH Regional office can advise if any values listed herein have changed since this data sheet was issued.

CP1500-NWP-1 (4/09) SM AP

SPECIFICATIONS

Mirafi Construction Products: Typical Property Values
The product specifications are average values. For minimum certifiable values contact your local Mirafi Representative or the Mirafi Technical Department at 1-800-234-0484.

SR = SOIL REINFORCEMENT SC = SEDIMENTATION CONTROL EC = EROSION CONTROL
D = DRAINAGE L = LANDSCAPING PU = POND UNDERLINING

Property	Unit	Test Method	Mira-drain 6000 (D)	Mira-grid (SR)	Miramat 2400 (EC)	160X (SC)	140NBL (D,EC)	140NL (D,EC)	140NS (D,EC)	140N (D,EC)	500X (SR)	600X (SR,EC)	700X (D,EC)	1200HP (SR,EC)	2120HP (SR)	160NS (PU,CC)	180N (PU,EC)
Weight	oz/sy	ASTM D-3776-79		6	24	3.0	3.5	3.5	4.1	4.5	4.0	6.0	6.5	12.0	14.0	6.0	8.0
Grab Strength	lbs	ASTM D-4632-86		2000 x 1700[5]	18 x 6[4]	120	140	100	145	120	200	300	425 x 250	600	1000 x 550	240	230
Grab Elongation	%	ASTM D-4632-86		21 x 26[5]	150 x 100	30 (min)	70	55	70	55	30 (max)	35 (max)	30	30 x 30	25 x 15	70	60
Trapezoid Tear Strength	lbs	ASTM D-4533-85				65	90	30	75	45	115	120	110 x 65	250 x 250	400 x 275	90	80
Mullen Burst Strength	psi	ASTM D-3786-87				200	150	230	180	270	450	600	525	1200+	1200+	270	495
Puncture Strength	lbs	ASTM D-3787-80[3]					40	65	50	80	85	130	150	350	75 x 150	75	150
Wide Width Strip Tensile	lbs/in	ASTM D-4595-86		220 x 134							150 x 150	200 x 180	250 x 160	400 x 400	1000 x 500		
Wide Width Strip Elongation	%	ASTM D-4595-86		15 x 20							20 x 20	20 x 15	20 x 16	20 x 20	18 x 20		
Thickness	mils	ASTM D-1777-64			260	17		45		55	23	30	19	50	40		110
Permittivity	sec^{-1}	ASTM D-4491-85[5]				.5	1.3	2.0	0.8	2.0	.2	.2	.2	.2	1.0	.3	1.5
Water Flow Rate	gal/min/sf	ASTM D-4491-85[5]				35	85	190	50	190	25	25	50	40	50	25	150
Apparent																	
Opening Size (AOS)	U.S. Std Sieve	ASTM D-4751-87				30-50	50-100	70-100	70-100	100+	30-50	30-50	70-100	30-50	40-70	100+	100+
Efficiency	%	VA DOH VTM-51				75											
Slurry Flow Rate	gal/min/sf	VA DOH VTM-51				85											
Ultraviolet																	
Stability	%	ASTM D-4355-84[2]				90					80	90	90	90	90		
Porosity	%	Calculated			85-90												
Flexibility	mg-cm	ASTM D-1388-64			2000												
Core Compressive	psi	ASTM D-1621															
Strength		(Modified)	15,000														
Water Flow Rate	gpm/ft width	ASTM D-4716-87[6]	15														
Core Amplitude	in.	Measured	30														

1. Torsion testing machine with ring clamp; steel ball replaced with a 5/16-inch diameter solid steel cylinder centered within the ring clamp. (I)
2. ASTM D 4632-86 after 250 cycles in an Xenon-arc Weatherometer (Type BH or C). One cycle consists of 102 minutes of light followed by 18 minutes of light with water spray.
3. Flow rate measured with the following parameters. i = 1.0 / 3600 psi confining pressure / 300 hrs.
4. Two-inch strip method. (lbs/in)
5. 5cm Constant Head
6. Modified for gauging using sample size 1 strand by 4 junctions with two junctions between jaws. Results reported in lbs/foot.

MIRAFI® INC

8.4. The geotextile shall be secured with 12 inch; 6-gauge soil nails, with washers, spaces every 25 lineal feet or less, in accordance with the manufacture's specifications. The manufacture's representative shall provide design support and construction observations.

8.5. Native soils excavated from the cut-off barrier may be reused as engineered fill after the cut-off barrier is excavated and the geotextile is placed and secured. Mechanical processing shall be performed as needed to insure that no particle or soil clod, which is used to backfill the cut-off barrier, is greater than 1.5 inches in their greatest dimension.

8.6. The contractor shall place the backfill in a manner that will inhibit bridging or the creation of voids within the backfill matrix and avoid damage to the geotextile material.

8.7. The top segment of the cut-off barrier trench (extended from the ground surface to a depth of 12 or more inches) shall be capped with a low permeability soil, as shown on the plans.

9. TRENCH BACKFILL

The following sections provide recommendations for backfilling of trenches for utilities associated with the proejct. This section excludes the backfilling of the cut-off barrier trench.

9.1. Trench backfill shall consist of granular soils (bedding) extending from the trench bottom to 1 foot or more above the pipe. On-site or imported fill which has been evaluated by the geotechnical consultant may be used above the granular backfill. The cover soils directly in contact with the pipe shall be classified as having a very low expansion potential, in accordance with ASTM D 4829-95, and shall contain no rocks or chunks of hard soil larger than 1.5-inch in diameter.

9.2. Trench backfill shall, unless otherwise recommended, should be placed in loose lifts 8-inches thick or thinner, moisture conditioned, and compacted in accordance with the recommendations of Section 5. of these guidelines. The backfill shall be tested by the geotechnical consultant at vertical intervals of approximately 2 feet of backfill placed and at spacings along the trench of approximately 100 feet in the same lift.

9.3. Jetting of trench backfill materials is generally not a recommended method of densification, unless the on-site soils are sufficiently free-draining and provisions have been made for adequate dissipation of the water utilized in the jetting process. Jetting as a trench backfill method shall be approved by the owner and the geotechnical engineer prior to the start of work.

9.4. If it is decided that jetting may be utilized, granular material with a sand equivalent greater than 30 shall be used for backfilling in the areas to be jetted. Jetting shall generally be considered for trenches 2 feet or narrower in width and 4 feet or shallower in depth. Following jetting operations, trench backfill shall be mechanically compacted to the specified compaction to finish grade.

9.5. Trench backfill which underlies the zone of influence of foundations shall be mechanically compacted in accordance with the recommendations of Section 5. The zone of influence of the foundations is generally defined as the roughly triangular area within the limits of a 1:1 projection from the inner and outer edges of the foundation, projected down and out from both edges.

9.6. Trench backfill within slab areas shall be compacted in accordance with the recommendations of Section 5. For minor interior trenches, density testing may be omitted or spot testing may be performed, as deemed appropriate by the geotechnical consultant.

9.7. When compacting soil in close proximity to utilities, care shall be taken by the grading contractor so that mechanical methods used to compact the soils do not damage the utilities. If the utility contractors indicate that it is undesirable to use

compaction equipment in close proximity to a buried conduit, then the grading contractor may elect to use light mechanical compaction equipment or, with the approval of the geotechnical consultant, cover the conduit with clean granular material. These granular materials shall be jetted in place to the top of the conduit in accordance with the recommendations of Section 8.4 prior to initiating mechanical compaction procedures. Other methods of utility trench compaction may also be appropriate, upon review by the geotechnical consultant and the utility contractor, at the time of construction.

9.8. Clean granular backfill and/or bedding materials are not recommended for use in slope areas unless provisions are made for a drainage system to mitigate the potential for buildup of seepage forces or piping of backfill materials.

9.9. The contractor shall exercise the necessary and required safety precautions, in accordance with OSHA Trench Safety Regulations, while conducting trenching operations. Such precautions include shoring or laying back trench excavations at 1.5:1 or flatter, depending on material type, for trenches in excess of 5 feet in depth. The geotechnical consultant is not responsible for the safety of trench operations or stability of the trenches.

10. DRAINAGE

The following sections provide recommendations pertaining to site drainage.

10.1. Roof, pad, and slope drainage shall be directed away from slopes and structures to suitable discharge areas by nonerodible devices (e.g., gutters, downspouts, concrete swales, etc.).

10.2. Positive drainage adjacent to structures shall be established and maintained. Positive drainage may be accomplished by providing drainage away from the foundations of the structure at a gradient of 2 percent or steeper for a distance of 5 feet or more outside the building perimeter, further maintained by a graded swale leading to an appropriate outlet, in accordance with the recommendations of the project civil engineer and/or landscape architect.

10.3. Surface drainage on the site shall be provided so that water is not permitted to pond. A gradient of 2 percent or steeper shall be maintained over the pad area and drainage patterns shall be established to direct and remove water from the site to an appropriate outlet.

10.4. Care shall be taken by the contractor during final grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices of a permanent nature on or adjacent to the property. Drainage patterns established at the time of final grading shall be maintained for the life of the project. Property owners shall be made

very clearly aware that altering drainage patterns may be detrimental to slope stability and foundation performance.

11. SITE PROTECTION

The site shall be protected as outlined in the following sections.

11.1. Protection of the site during the period of grading shall be the responsibility of the contractor unless other provisions are made in writing and agreed upon among the concerned parties. Completion of a portion of the project shall not be considered to preclude that portion or adjacent areas from the need for site protection, until such time as the project is complete as agreed upon by the geotechnical consultant, the client, and the regulatory agency.

11.2. The contractor is responsible for the stability of temporary excavations. Recommendations by the geotechnical consultant pertaining to temporary excavations are made in consideration of stability of the completed project and, therefore, shall not be considered to preclude the responsibilities of the contractor. Recommendations by the geotechnical consultant shall also not be considered to preclude more restrictive requirements by the applicable regulatory agencies.

11.3. Precautions shall be taken during the performance of site clearing, excavation, and grading to protect the site from flooding, ponding, or inundation by surface runoff. Temporary provisions shall be made during the rainy season to adequately direct surface runoff away from and off the working site. Where low areas cannot be avoided, pumps shall be provided to remove water as needed during periods of rainfall.

11.4. During periods of rainfall, plastic sheeting shall be used as needed to reduce the potential for unprotected slopes to become saturated. Where needed, the contractor shall install check dams, desilting basins, riprap, sandbags or other appropriate devices or methods to reduce erosion and provide safe conditions during inclement weather.

11.5. During periods of rainfall, the geotechnical consultant shall be kept informed by the contractor of the nature of remedial or precautionary work being performed on site (e.g., pumping, placement of sandbags or plastic sheeting, other labor, dozing, etc.).

11.6. Following periods of rainfall, the contractor shall contact the geotechnical consultant and arrange a walk-over of the site in order to visually assess rain-related damage. The geotechnical consultant may also recommend excavation and testing in order to aid in the evaluation. At the request of the geotechnical consultant, the contractor shall make excavations in order to aid in evaluation of the extent of rain-related damage.

11.7. Rain- or irrigation-related damage shall be considered to include, but may not be limited to, erosion, silting, saturation, swelling, structural distress, and other adverse conditions noted by the geotechnical consultant. Soil adversely affected shall be classified as "Unsuitable Material" and shall be subject to overexcavation and replacement with compacted fill or to other remedial grading as recommended by the geotechnical consultant.

11.8. Relatively level areas where saturated soils and/or erosion gullies exist to depths greater than 1 foot shall be overexcavated to competent materials as evaluated by the geotechnical consultant. Where adverse conditions extend to less than 1 foot in depth, saturated and/or eroded materials may be processed in-place. Overexcavated or in-place processed materials shall be moisture conditioned and compacted in accordance with the recommendations provided in Section 5. If the desired results are not achieved, the affected materials shall be overexcavated, moisture conditioned, and compacted until the specifications are met.

11.9. Slope areas where saturated soil and/or erosion gullies exist to depths greater than 1 foot shall be overexcavated and replaced as compacted fill in accordance with the applicable specifications. Where adversely affected materials exist to depths of 1 foot or less below proposed finished grade, remedial grading by moisture conditioning in-place and compaction in accordance with the appropriate specifications may be attempted. If the desired results are not achieved, the affected materials shall be overexcavated, moisture conditioned, and compacted until the specifications are met. As conditions dictate, other slope repair procedures may also be recommended by the geotechnical consultant.

11.10. During construction, the contractor shall grade the site to provide positive drainage away from structures and to keep water from ponding adjacent to structures. Water shall not be allowed to damage adjacent properties. Positive drainage shall be maintained by the contractor until permanent drainage and erosion reducing devices are installed in accordance with project plans.

12. DEFINITIONS OF TERMS

ALLUVIUM:	Unconsolidated detrital deposits deposited by flowing water; includes sediments deposited in river beds, canyons, flood plains, lakes, fans at the foot of slopes, and in estuaries.
AS-GRADED (AS-BUILT):	The site conditions upon completion of grading.
BACKCUT:	A temporary construction slope at the rear of earth-retaining structures such as buttresses, shear keys, stabilization fills, or retaining walls.
BACKDRAIN:	Generally a pipe-and-gravel or similar drainage system placed behind earth-retaining structures such as buttresses, stabilization fills, and retaining walls.
BEDROCK:	Relatively undisturbed in-place rock, either at the surface or beneath surficial deposits of soil.
BENCH:	A relatively level step and near-vertical riser excavated into sloping ground on which fill is to be placed.
BORROW (IMPORT):	Any fill material hauled to the project site from off-site areas.
BUTTRESS FILL:	A fill mass, the configuration of which is designed by engineering calculations, to retain slopes containing adverse geologic features. A buttress is generally specified by minimum key width and depth and by maximum backcut angle. A buttress normally contains a back drainage system.
CIVIL ENGINEER:	The Registered Civil Engineer or consulting firm responsible for preparation of the grading plans and surveying, and verifying as-graded topographic conditions.
CLIENT:	The developer or a project-responsible authorized representative. The client has the responsibility of reviewing the findings and recommendations made by the geotechnical consultant and authorizing the contractor and/or other consultants to perform work and/or provide services.
COLLUVIUM:	Generally loose deposits, usually found on the face or near the base of slopes and brought there chiefly by gravity through slow continuous downhill creep (see also Slope Wash).
COMPACTION:	The densification of a fill by mechanical means.

CONTRACTOR:	A person or company under contract or otherwise retained by the client to perform demolition, grading, and other site improvements.
DEBRIS:	The products of clearing, grubbing, and/or demolition, or contaminated soil material unsuitable for reuse as compacted fill, and/or any other material so designated by the geotechnical consultant.
ENGINEERED FILL:	A fill which the geotechnical consultant or the consultant's representative has observed and/or tested during placement, enabling the consultant to conclude that the fill has been placed in substantial compliance with the recommendations of the geotechnical consultant and the governing agency requirements.
ENGINEERING GEOLOGIST:	A geologist certified by the state licensing agency who applies geologic knowledge and principles to the exploration and evaluation of naturally occurring rock and soil, as related to the design of civil works.
EROSION:	The wearing away of the ground surface as a result of the movement of wind, water, and/or ice.
EXCAVATION:	The mechanical removal of earth materials.
EXISTING GRADE:	The ground surface configuration prior to grading; original grade.
FILL:	Any deposit of soil, rock, soil-rock blends, or other similar materials placed by man.
FINISH GRADE:	The final as-graded ground surface elevation that conforms to the grading plan.
GEOFABRIC:	An engineering textile utilized in geotechnical applications such as subgrade stabilization and filtering.
GEOTECHNICAL CONSULTANT:	The geotechnical engineering and engineering geology consulting firm retained to provide technical services for the project. For the purpose of these specifications, observations by the geotechnical consultant include observations by the geotechnical engineer, engineering geologist and other persons employed by and responsible to the geotechnical consultant.

GEOTECHNICAL ENGINEER:	A licensed civil engineer and geotechnical engineer, approved by the state licensing agency, who applies scientific methods, engineering principles, and professional experience to the acquisition, interpretation, and use of knowledge of materials of the earth's crust to the resolution of engineering problems. Geotechnical engineering encompasses many of the engineering aspects of soil mechanics, rock mechanics, geology, geophysics, hydrology, and related sciences.
GRADING:	Any operation consisting of excavation, filling, or combinations thereof and associated operations.
LANDSLIDE DEPOSITS:	Material, often porous and of low density, produced from instability of natural or manmade slopes.
MAXIMUM DRY DENSITY:	Standard laboratory test for maximum dry unit weight. Unless otherwise specified, the maximum dry unit weight shall be evaluated in accordance with ASTM Test Method D698-00a.
OPTIMUM MOISTURE:	The moisture content at the maximum dry density.
RELATIVE COMPACTION:	The degree of compaction (expressed as a percentage) of a material as compared to the maximum dry density of the material.
ROUGH GRADE:	The ground surface configuration at which time the surface elevations approximately conform to the approved plan.
SHEAR KEY:	Similar to a subsurface buttress; however, it is generally constructed by excavating a slot within a natural slope in order to stabilize the upper portion of the slope without encroaching into the lower portion of the slope.
SITE:	The particular parcel of land where grading is being performed.
SLOPE:	An inclined ground surface, the steepness of which is generally specified as a ratio of horizontal units to vertical units.
SLOPE WASH:	Soil and/or rock material that has been transported down a slope by gravity assisted by the action of water not confined to channels (see also Colluvium).
SLOUGH:	Loose, uncompacted fill material generated during grading operations.

SOIL:	Naturally occurring deposits of sand, silt, clay, etc., or combinations thereof.
STABILIZATION FILL:	A fill mass, the configuration of which is typically related to slope height and is specified by the standards of practice for enhancing the stability of locally adverse conditions. A minimum stabilization fill is normally specified by minimum key width and depth and by maximum backcut angle. A stabilization fill may or may not have a back drainage system specified.
SUBDRAIN:	Generally a pipe-and-gravel or similar drainage system placed beneath a fill along the alignment of buried canyons or former drainage channels.
TAILINGS:	Non-engineered fill which accumulates on or adjacent to equipment haul roads.
TERRACE:	A relatively level bench constructed on the face of a graded slope surface for drainage control and maintenance purposes.
TOPSOIL:	The upper zone of soil or bedrock materials, which is usually dark in color, loose, and contains organic materials.
WINDROW:	A row of large rocks buried within engineered fill in accordance with guidelines set forth by the geotechnical consultant.