INITIAL GEOTECHNICAL EVALUATION
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PREPARED FOR:

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Ninyo & Moore
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Mr. Barry Ling, P.E.
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Phoenix, Arizona 85021

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

Dear Mr. Ling:

In accordance with our proposal dated May 7, 2001 and your authorization to proceed dated June 7, 2001, Ninyo & Moore has performed an Initial 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

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1. INTRODUCTION

In accordance with our proposal dated May 7, 2001 and your authorization to proceed dated June 7, 2001, 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 locations and notifying Arizona Blue Stake of the boring locations prior to drilling.
- Drilling, logging, and sampling 17 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 three 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, in general accordance with the City of Chandler method. 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 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 initial report that presents our findings, conclusions, and recommendations regarding the design and construction of the new basin.

3. SITE DESCRIPTION

Much 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 covers 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. Farming apparently 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. In addition, several unpaved roads crossed the site indiscriminately, except for an unpaved road that appeared to coincide with the alignment of Pecos Road in the southern portion of the project site. Some scattered piles of soil were also 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, it appears 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 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 roughly match the depth of the EMF, which is situated at about elevation 1,310 feet above MSL. Consequently, the excavation needed to create the basin area will extend about 10 to 20 feet bgs.

A 1,500-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 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 2,100 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 you 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 to existing ground surface.

The 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 small portion of the site located on the west side of Power Road, about 2,600 feet south of the Power Road intersection with the EMF, will not be excavated. This area is reserved for future golf course operations.

5. FIELD EXPLORATION

5.1. Soil Borings

Ninyo & Moore conducted a subsurface evaluation consisting of soil boring excavations from July 5 through 16, 2001 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 17 small-diameter borings. The borings were drilled using a CME-75 truck-mounted drill rig. Of these borings, five were drilled along the EMF perimeter (denoted as RH-1 through RH-5), one was drilled adjacent to the Kinder Morgan property (denoted as RH-6), two were drilled along the Rittenhouse Channel perimeter (denoted as RH-7 and RH-8), five were drilled along the Power Road perimeter (denoted as RH-9 through RH-13), and four were drilled within the new basin area (denoted as 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 boring 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 of each boring location are presented on the logs. The general locations of the borings are denoted on the Soil Boring Location Map (Figure 2).

5.2. Test Pits

Ninyo & Moore conducted a supplemental subsurface evaluation consisting of the excavation of three test pits from November 26 through 27, 2001 in order to further evaluate the existing subsurface conditions. The test pits were excavated along the EMF perimeter using a Ford 555E backhoe. Detailed descriptions of the soils encountered are presented in the boring 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 event occurred during our study period and no meaningful readings were taken; however, the wells were left in-place. Consequently, if a heavy rain event occurs during the final design phase, the piezometers may be read and the information could be useful.

5.4. Field Percolation Tests

In order to provide a preliminary evaluation 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. These tests were performed near the central portion of the site, adjacent to borings RH-14, RH-15, RH-16, and RH-17. The procedures used consisted of the insertion of a 12-inch diameter impermeable 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 volatile organic compounds (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 por-

tion of each collected soil sample, sealed, and allowed to volatilize for 10 minutes. The tip of the PID was then inserted into the headspace 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 drilling 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%	20%	16%	64%

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%	53%	12%	35%

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 1,299 to 1,320 feet MSL. Localized variations are largely attributable to erosion of the Late Pleistocene surface.

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 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 pro-

posed project, as appropriate. Based on this initial study, 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. As a result, one of the major findings revealed was that a crack-stopper barrier (located within the levee between the basin and the EMF and Rittenhouse Channel) would alleviate 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 to older Pleistocene deposits. Based on our field work, we estimate that the contact between the Holocene and Pleistocene deposits range from about elevation 1,299 to 1,320 feet MSL at the boring locations.
- 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 preliminary geotechnical recommendations for the proposed basin construction. We anticipate that more detailed recommendations will result from an additional design-phase geotechnical evaluation.

9.1. Earthwork

The following sections provide our earthwork recommendations.

9.1.1. Excavation Characteristics

Our evaluation of the excavation characteristics of the on-site materials is based on the results of 17 widely-spaced exploratory borings, three 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 the borings, which may be somewhat more time-consuming to excavate. This cementation predominates in the older Pleistocene deposits, which were encountered below roughly elevation 1,299 to 1,320 feet MSL.

We recommend that trenches and excavations be designed and constructed in accordance with 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.

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 698-91 at a moisture content within two percent of its above optimum.

Based on the laboratory tests we performed, it appears that 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 logs, because much of this site was used for farming, the top 6 to 12 inches may contain some organics. This layer may need to be segregated during construction and could be reused in non-structural area of the site.

9.1.3. Reuse of Excavated Material as Borrow

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. Please 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 722, 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 the average value for the site, 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 proposed construction of the new basin will 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 in a controlled 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.

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 limited 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.

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.

9.2.1. Side Slope Stability

Based on our conversations with your office and the conceptual plans we were given, we understand that the preliminary design of the side slopes around the perimeter of the basin calls for a 4 (horizontal) to 1 (vertical) slope. We performed preliminary 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 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 safe from a geotechnical standpoint. A graphical representation of this slope stability analysis is given in Figure 3.

9.2.2. Piping and Seepage

Because these natural levees will be constructed of native soils that are highly heterogeneous and not placed in a controlled 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.

The outcome of this FMA will be summarized in a Failure Mode Report, which will be prepared by Kirkham Michael Consulting Engineers. One of the major findings revealed in this process was that a crack-stopper barrier (located within the levee between the basin and the EMF and Rittenhouse Channel) would alleviate several of the potential failure modes discussed, particularly those associated with differential settlement, cracking, piping and seepage. Detailed discussions and recommendations for crack-stopper barrier construction, including cost analysis and comparisons, will be provided in the final geotechnical report.

9.2.3. Self-Weight Settlement of Levee and Basin Floor

As mentioned earlier, the project site is generally underlined with a Holocene "apron" overlying an older Late Pleistocene deposit. The Holocene deposits are typically of lower density and are relatively susceptible to collapse, under their own self-weight, upon wetting. If this settlement occurs under or within the levee, cracks may develop. As with the piping and seepage concerns discussed in the previous section, defensive measures like a crack-stopper barrier may alleviate this situation as well.

In addition, self-weight settlement within the basin may also occur, with the cracks that develop generally limited to the basin floor. As a result, a low spot could be created and the capacity of the basin may be locally affected. However, the overall performance of the basin as a result of this potential localized settlement will most likely not be compromised.

9.2.4. 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.

9.3. Side Weir and Outlet Works

As mentioned earlier, we understand that a 1,500-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 2,100 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. A plunge pool, extending 4 feet below the bottom of the basin, will be provided near the toe of the weir on the basin side. The plunge pool will be lined with rip-rap to mitigate erosion.

The conceptual drawings that we received also show two cut-off walls, located on either side of the weir and extending 6 feet below the bottom of the basin. We understand that these walls are proposed to discourage undermining of the side weir by water flow, but will also act in some capacity as piping and seepage control.

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 position 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 ranges from about elevation 1,299 to 1,320 feet MSL. Localized variations are largely attributable to erosion of the Late Pleistocene surface.

Relevant geologic information was provided during the FMA workshop. As a result, the presence of Holocene soils below the weir and the potential collapse of these soils was considered a potential failure mode and also a major finding. Consequently, it was recommended that the Holocene soils located below the weir should be removed and replaced with compacted, engineered fill.

As mentioned earlier, the thickness of the Holocene apron varies considerably across the project site. Therefore, the anticipated depth of removal for the construction of the weir should be further evaluated during the design phase of this project. This further evaluation should consist of more closely-spaced borings and/or test pits and additional laboratory testing.

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 698-91 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 breech 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 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 believe 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 action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

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

11. SELECTED REFERENCES

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N

1.0 0 1.0 2.0

Approximate Scale in Miles

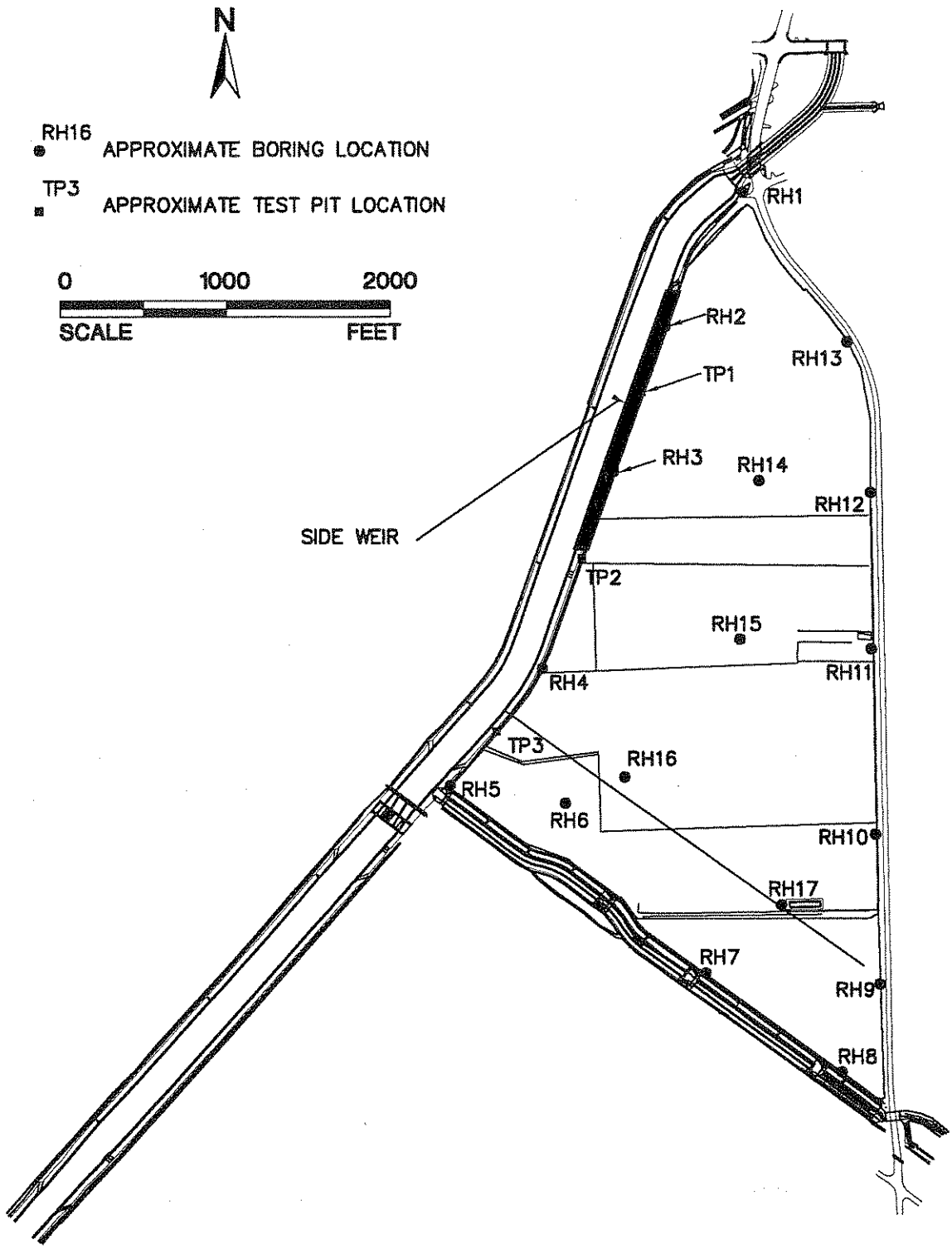
Reference: Microsoft Streets98, 1998.

Ninyo & Moore

SITE LOCATION MAP

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	1



Ninyo & Moore

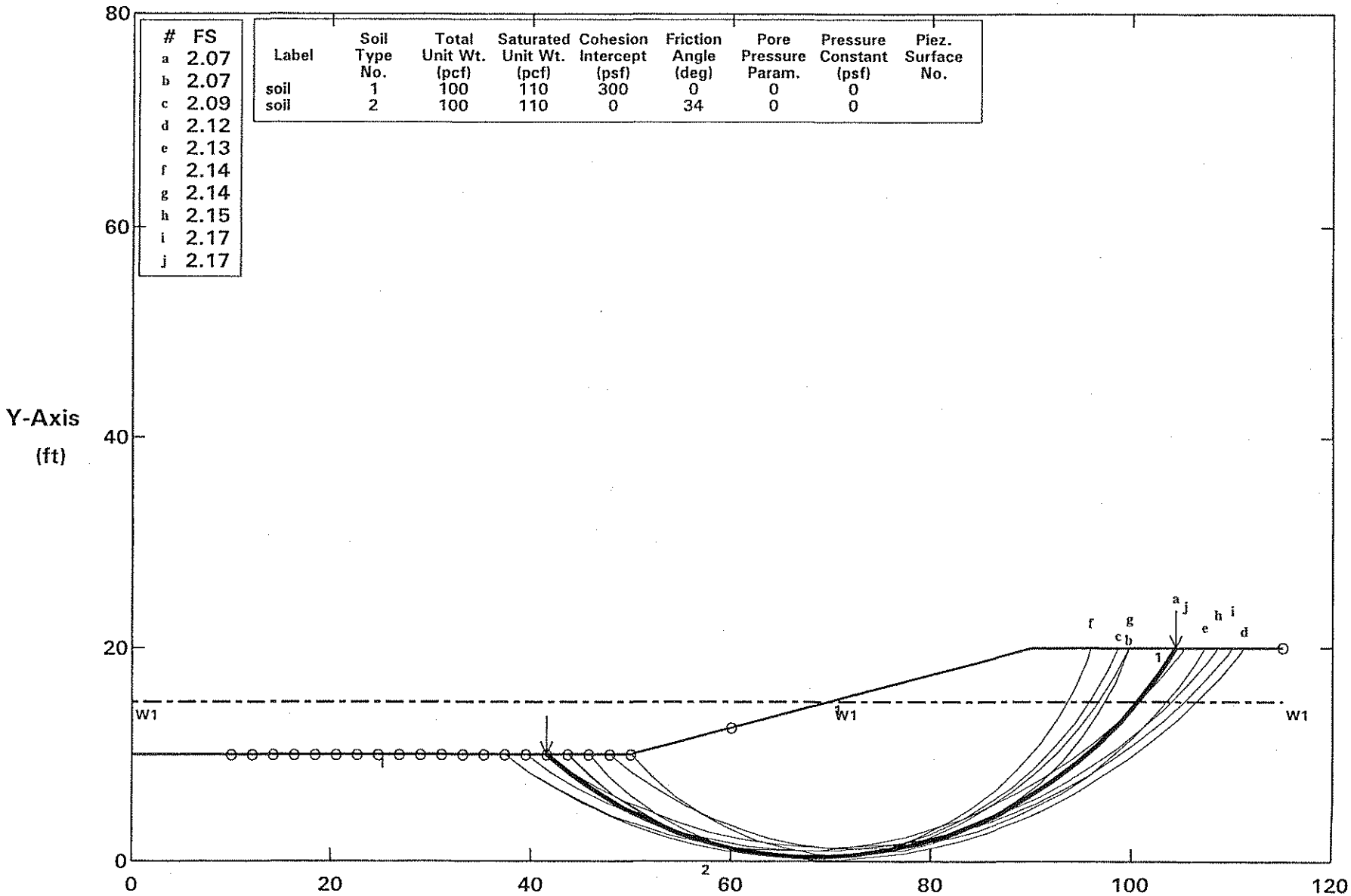
BORING/TEST PIT LOCATION MAP

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	2

Figure 3: Slope Stability Analysis of Typical Embankment

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



Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
soil	1	100	110	300	0	0	0	
soil	2	100	110	0	34	0	0	

STABL6H FSmin = 2.07 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

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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.

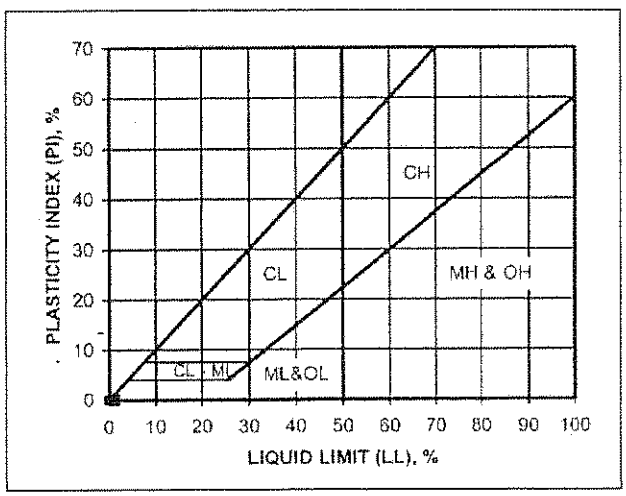
U.S.C.S. METHOD OF SOIL CLASSIFICATION

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

CLASSIFICATION CHART (Unified Soil Classification System)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No.4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.074
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART

Ninyo & Moore

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

DATE DRILLED _____ BORING NO. PATTERNS

GROUND ELEVATION _____ SHEET 1 OF 2

METHOD OF DRILLING _____

DRIVE WEIGHT _____ DROP _____

SAMPLED BY _____ LOGGED BY _____ REVIEWED BY _____

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								SOILS
							GW	(GW:G3N) = well graded GRAVEL
							GP	(GP:G) = poorly graded GRAVEL, sandy gravel, aggregate base
							GM	(GM:GZ) = silty GRAVEL
							GC	(GC:OG) = clayey GRAVEL
							SW	(SW:D) = well graded SAND
							SP	(SP:S) = poorly graded SAND
5							SM	(NZ) = silty SAND
							SC	(NO) = clayey SAND
							CL	(O) = low plasticity CLAY or just CLAY
							ML	(Z) = silt
							OL	(4) = low plasticity organic SILT
							CH	(C) = high plasticity CLAY
							MH	(M) = plastic SILT
10							OH	(5) = high plasticity organic CLAY
							PT	(Q) = peat
								ROCKS AND CONCRETE
								(I) = SILTSTONE (clayey SILTSTONE, sandy SILTSTONE, etc.)
								(1) = SANDSTONE (silty SANDSTONE, clayey SANDSTONE, etc.)
								(H) = CLAYSTONE (sandy CLAYSTONE, silty CLAYSTONE, etc.)
								(O12) = BRECCIA rock with angular and/or gravel- or cobble-sized clasts
15								(B) + (1) = CONGLOMERATE
								(>) = SHALE or SLATE
								(/) = GRANITIC ROCK or BONSALL TONALITE
								(2) = METAVOLCANIC (or VOLCANIC) ROCK
								(2+I) = VOLCANIC TUFF
								(V) = GABBROIC ROCK or other intrusive igneous rock
								(P) = ASPHALT CONCRETE
20								(9) = CONCRETE

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BORING LOG

LEGEND FOR BORING LOGS

PROJECT NO.	DATE	FIGURE
PATTERNS	REV. 5/99	Legend-1

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								(WATER) Water table during drilling.
								(FWATER) Water table at boring completion.
								(%) = CALICHE
								(.) = GYPSUM
								($) = SCHIST
								(7) = Mudstone
								(() Dolomite
25								
30								
35								
40								

DATE DRILLED _____ BORING NO. PATTERNS

GROUND ELEVATION _____ SHEET 2 OF 2

METHOD OF DRILLING _____

DRIVE WEIGHT _____ DROP _____

SAMPLED BY _____ LOGGED BY _____ REVIEWED BY _____

Ninyo & Moore

BORING LOG

LEGEND FOR BORING LOGS

PROJECT NO.	DATE	FIGURE
PATTERNS	REV. 5/99	Legend-2

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								Solid line denotes unit change.
								Dashed line denotes material change.
		■						Modified split-barrel drive sampler.
		╳						No recovery with modified split-barrel drive sampler.
5				♀				Seepage.
				▽				Groundwater encountered during drilling.
				▼				Groundwater measured after drilling.
		◥						Standard Penetration Test (SPT).
10		◺						No recovery with a SPT.
			XX/ XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
		◺						No recovery with Shelby tube sampler.
15	■							Bulk sample.
		▤						Continuous Push Sample.
20								The total depth line is a solid line that is drawn at the bottom of the boring.

DATE DRILLED _____ BORING NO. SYMBOL SAMPLES

GROUND ELEVATION _____ SHEET 1 OF 1

METHOD OF DRILLING _____

DRIVE WEIGHT _____ DROP _____

SAMPLED BY _____ LOGGED BY _____ REVIEWED BY _____

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BORING LOG

EXPLANATION OF BORING LOG SYMBOLS

PROJECT NO.	DATE	FIGURE
SYMSAMP	Rev. 5/99	Legend-3

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

GROUND ELEVATION 1324' 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.
10		30	6.9	99.4		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.
		43					Very dense.
15		85/11"	5.2				
		44					
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-1

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

GROUND ELEVATION 1324' 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			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								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-2

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

GROUND ELEVATION 1320' 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.
10						SC-SM	Reddish brown (5 YR 5/4), damp, dense, silty, clayey SAND.
		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
600198001	12/01	A-3

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

GROUND ELEVATION 1320' 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								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-4

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

GROUND ELEVATION 1320' 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.
	Driven	31	8.3	89.9			
5	Driven	74/10"	9.9	93.8			Very dense.
	Driven	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	Driven	64					
	Driven	54					
15	Driven	90/10"	8.4	86.0			
	Driven	81	6.2				
20							

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-5

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

GROUND ELEVATION 1320' 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		■	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								
40								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-6

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

GROUND ELEVATION 1319' 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	SAMPLES 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'.
20								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-7

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

GROUND ELEVATION 1319' 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
600198001	12/01	A-8

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

GROUND ELEVATION 1320' 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	SAMPLES 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								

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-9

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								

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

GROUND ELEVATION 1320' 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

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-10

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

GROUND ELEVATION 1322' 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				
							Brown (7.5 YR 5/4).
		68/11"					
10		31	10.6	79.3			
		42	10.1				
							Light to pale brown (7.5 YR 6/4 to 10 YR 6/3).
15		52	7.0	106.3			
		29	6.8			SM	Light brown (7.5 YR 6/3), dry, dense, silty SAND. Stage II cementation, scattered caliche coatings.
20							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-11

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

GROUND ELEVATION 1322' 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		■	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
600198001	12/01	A-12

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

GROUND ELEVATION 1325' 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							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-13

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

GROUND ELEVATION 1325' 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
600198001	12/01	A-14

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

GROUND ELEVATION 1329' 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							

Ninyo & Moore

BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-15

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

GROUND ELEVATION 1329' 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							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
600198001	12/01	A-16

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

GROUND ELEVATION 1329' 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.
		82					
5		55	7.9	109.0		CL	Pale brown (10 YR 6/3), dry to damp, hard, silty CLAY. Stage I cementation, weakly cemented.
		48	9.4				
10		84					
		34	18.8				
15		32	18.2	103.3			
		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
600198001	12/0101	A-17

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

GROUND ELEVATION 1329' 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			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
600198001	12/0101	A-18

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

GROUND ELEVATION 1327' 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				
20							Total Depth = 16.5 Groundwater not encountered. Backfilled on 7/9/01.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-19

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

GROUND ELEVATION 1325' 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	SAMPLES 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
600198001	12/01	A-20

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

GROUND ELEVATION 1325' 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		■	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
600198001	12/01	A-21

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

GROUND ELEVATION 1322' 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
600198001	12/01	A-22

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

GROUND ELEVATION 1322' 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
600198001	12/01	A-23

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

GROUND ELEVATION 1324' 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
600198001	12/01	A-24

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

GROUND ELEVATION 1324' 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		■	60	8.4	97.6		ML	Stage II cementation, weakly cemented, scattered nodules.
								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
600198001	12/01	A-25

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

GROUND ELEVATION 1323' 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	SAMPLES 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
600198001	12/01	A-26

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

GROUND ELEVATION 1322' 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.
	Driven	44	9.6	86.7			
5	Driven	70/11"	10.4	96.5			Weakly to moderately cemented by caliche.
	Driven	22	15.5				
10	Driven	45	15.4	101.7		CL	Brown (7.5 YR 5/4), damp, hard, silty CLAY. Stage II cementation, scattered caliche filaments and nodules.
15	Driven	20	5.7			SC	Brown (7.5 YR 5/4), damp, medium dense to dense, clayey fine to medium SAND. Stage II cementation, scattered nodules.
20							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/5/01.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-27

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

GROUND ELEVATION 1322' 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.
20							Total Depth = 16.5' Groundwater not encountered. Backfilled on 7/5/01.

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BORING LOG

East Maricopa Floodway
Rittenhouse Detention Basin

PROJECT NO.	DATE	FIGURE
600198001	12/01	A-28

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

GROUND ELEVATION 1327' 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
600198001	12/01	A-29

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TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

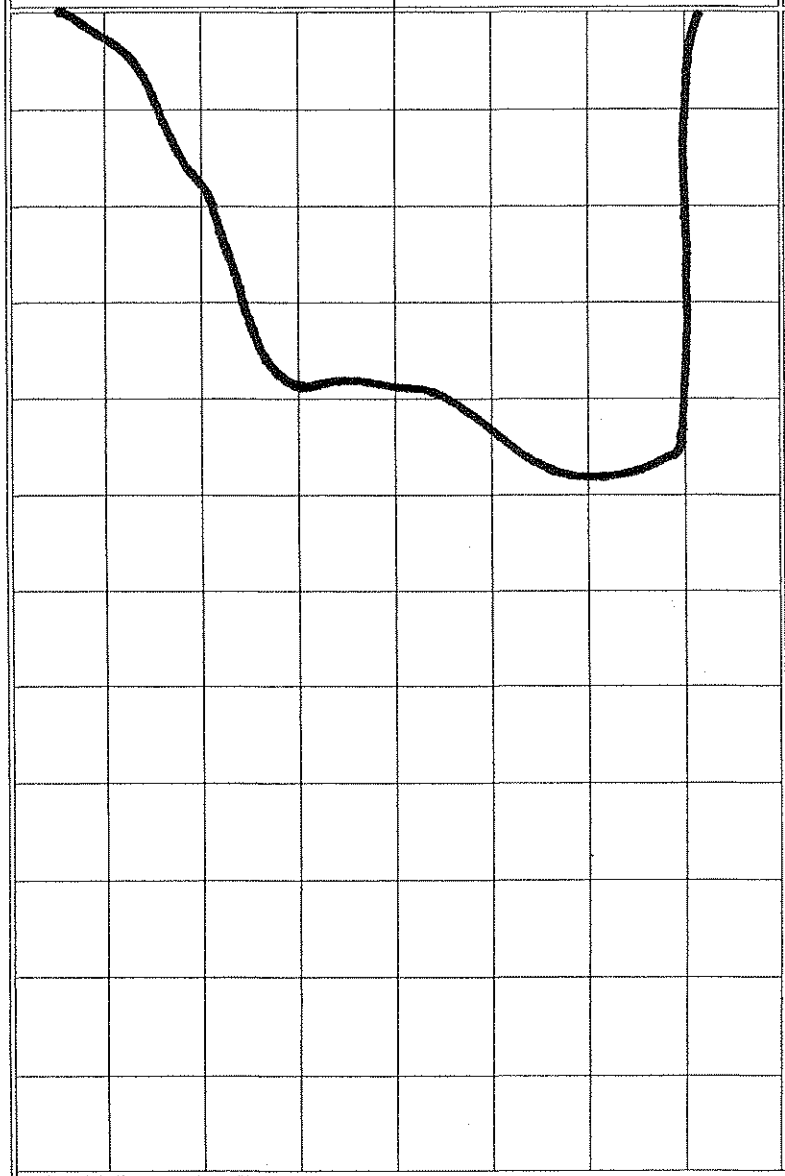
PROJECT NO.	DATE
600198001	12/01

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



SCALE = 1 in./5 ft.

DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0	■					SM	FILL:
						CL	Brown (7.5 YR 5/4), dry to damp, loose, silty fine to medium sand, scattered fine GRAVEL.
						ML	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).
5							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).
10	■						@ 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.
15							@ 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.
20							Total Depth = 12 feet. Groundwater not encountered during drilling. Backfilled on 11/26/01. Excavation Bearing: 201°
25							

FIGURE A-30

Ninyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

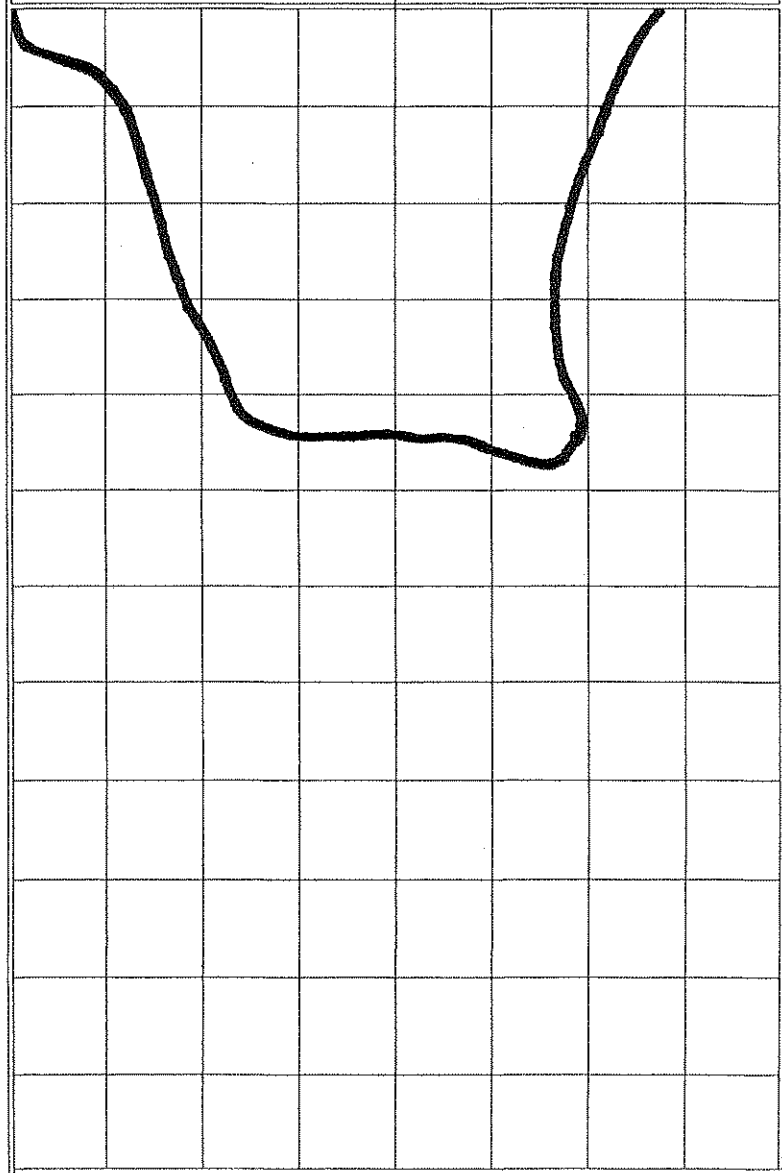
PROJECT NO.	DATE
600198001	12/01

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'.



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0	■					CL	ALLUVIUM: Strong brown (7.5 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.
5	■						
						SM	@ 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.
10	■					ML	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.
15							Brown (7.5 YR 4/4), damp, medium dense, sandy SILT.
20							
25							

Total Depth = 12 feet.
Groundwater not encountered during drilling.
Backfilled on 11/27/01.

Excavation Bearing: 200°

SCALE = 1 in./5 ft.

FIGURE A-31

Ninyo & Moore

TEST PIT LOG

East Maricopa Floodway
Rittenhouse Detention Basin

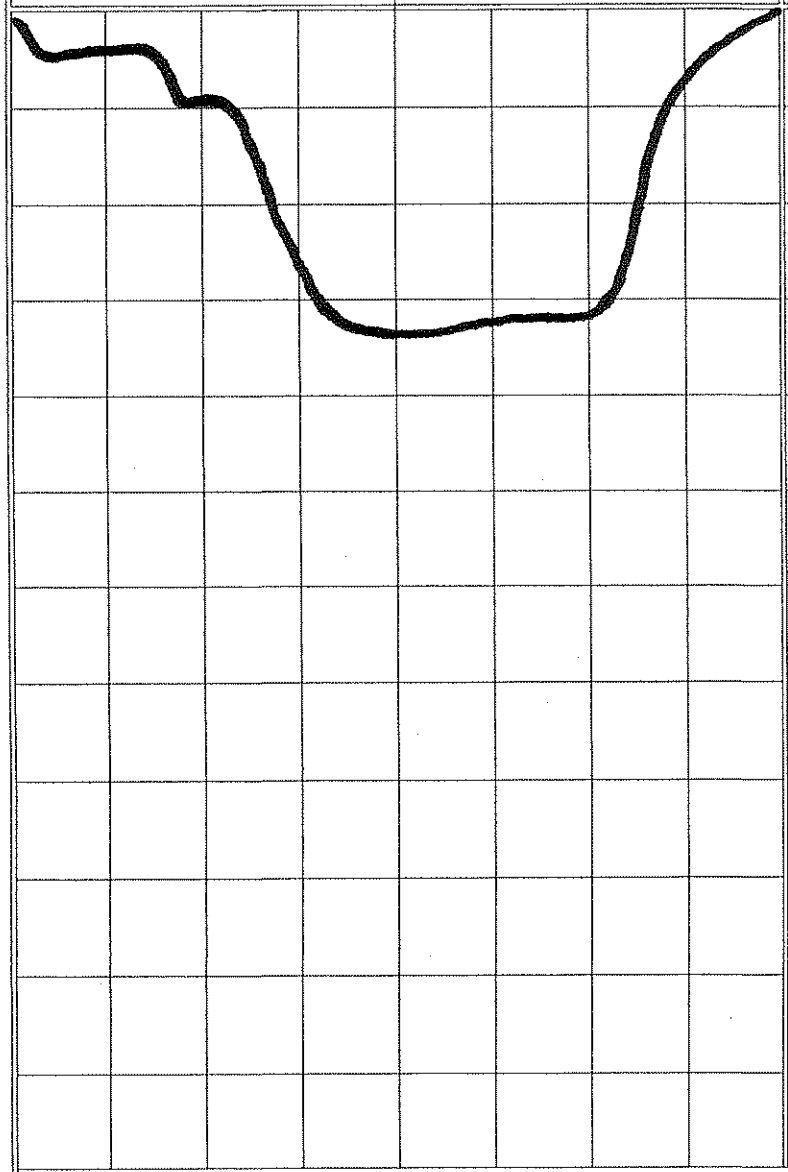
PROJECT NO.	DATE
600198001	12/01

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'.



DEPTH (FEET)	SAMPLES: Bulk	SAMPLES: Driven	SAMPLES: Sand Cone	MOISTURE (%)	DRY DENSITY (PCF)	CLASSIFICATION U.S.C.S.	DESCRIPTION
0	■					SM	FILL: Brown (7.5 YR 5/4), dry to damp, loose, silty fine -to medium SAND; scattered fine gravel.
						CL / ML	ALLUVIUM: Dark brown (7.5 YR 3/3), damp, stiff to very stiff, silty CLAY; scattered rootlets. Stage I cementation, weakly to non-cemented.
5							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.
						SM	@ 6 feet bgs, becomes hard with higher degree of cementation.
10							@ 7 feet bgs, (10 YR 6/6), changes to fine sandy scattered pockets of silt, higher porosity. Stage I cementation, abundant filaments.
							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.
15							Total Depth = 8.5 feet. Groundwater not encountered during drilling. Backfilled on 11/26/01.
20							Excavation Bearing: 215°
25							

SCALE = 1 in./5 ft.

FIGURE A-32

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-33. 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 4318-98. 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-34 through B-37.

Consolidation Tests

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435-90. 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-38 through B-40.

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 1557-91. The results of these tests are summarized on Figures B-41 through B-43.

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-44.

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 722. The sulfate content of selected samples was evaluated in general accordance with Arizona Test 733. The test results are presented on Figure B-45.

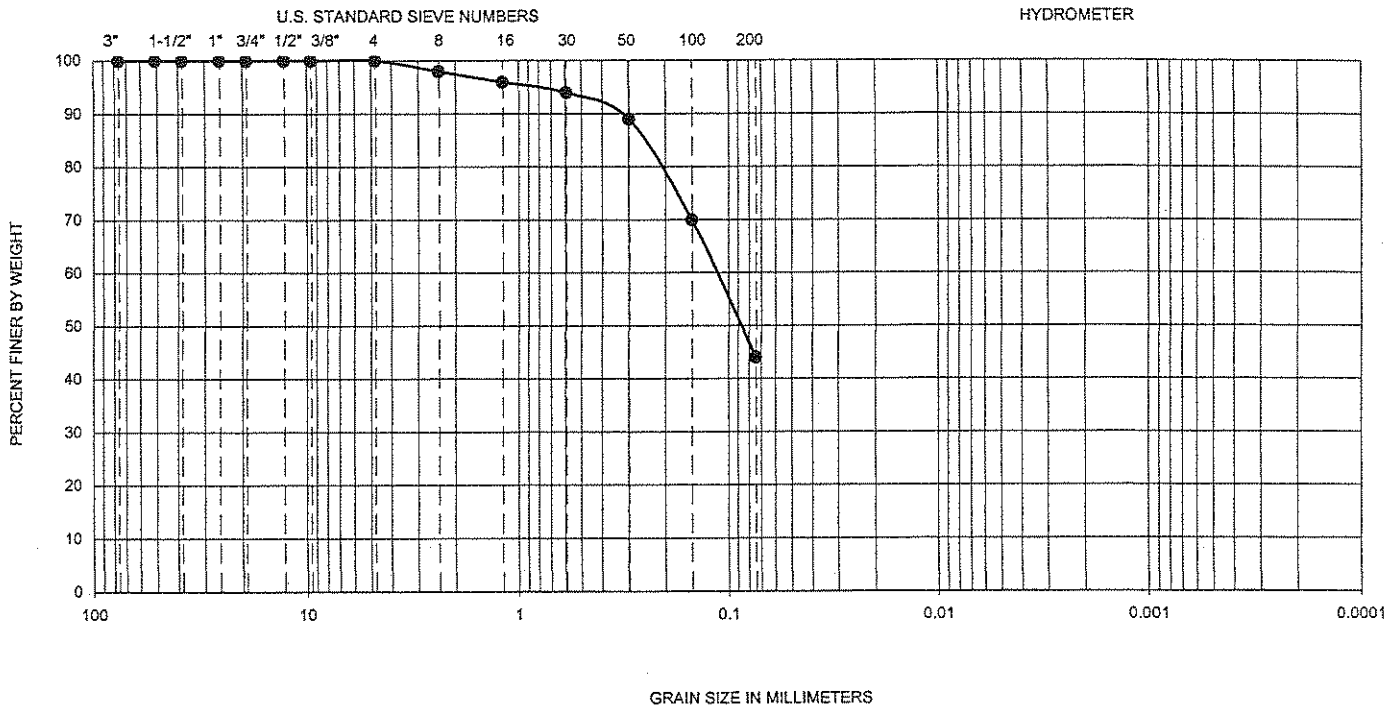
Permeability Tests

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-46.

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-47 and B-49.

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

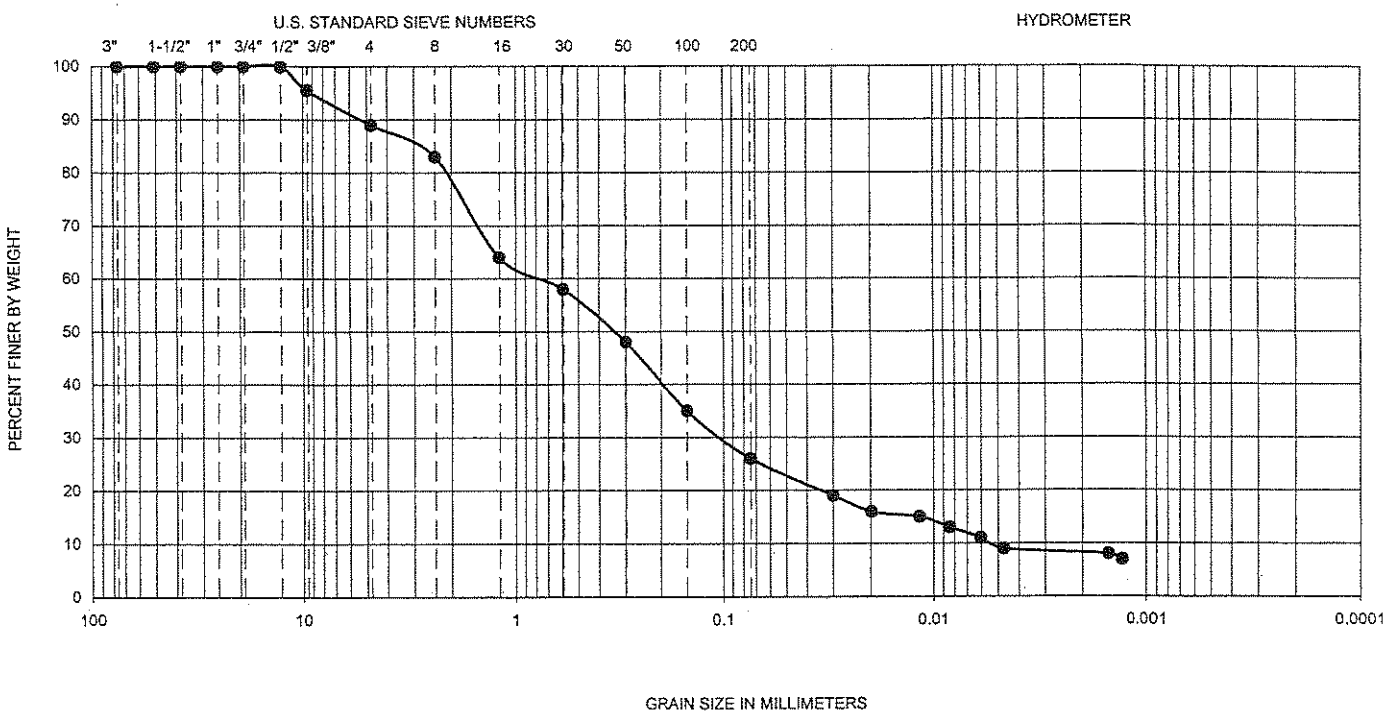
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-1

SIEVE RH-01@10.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-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

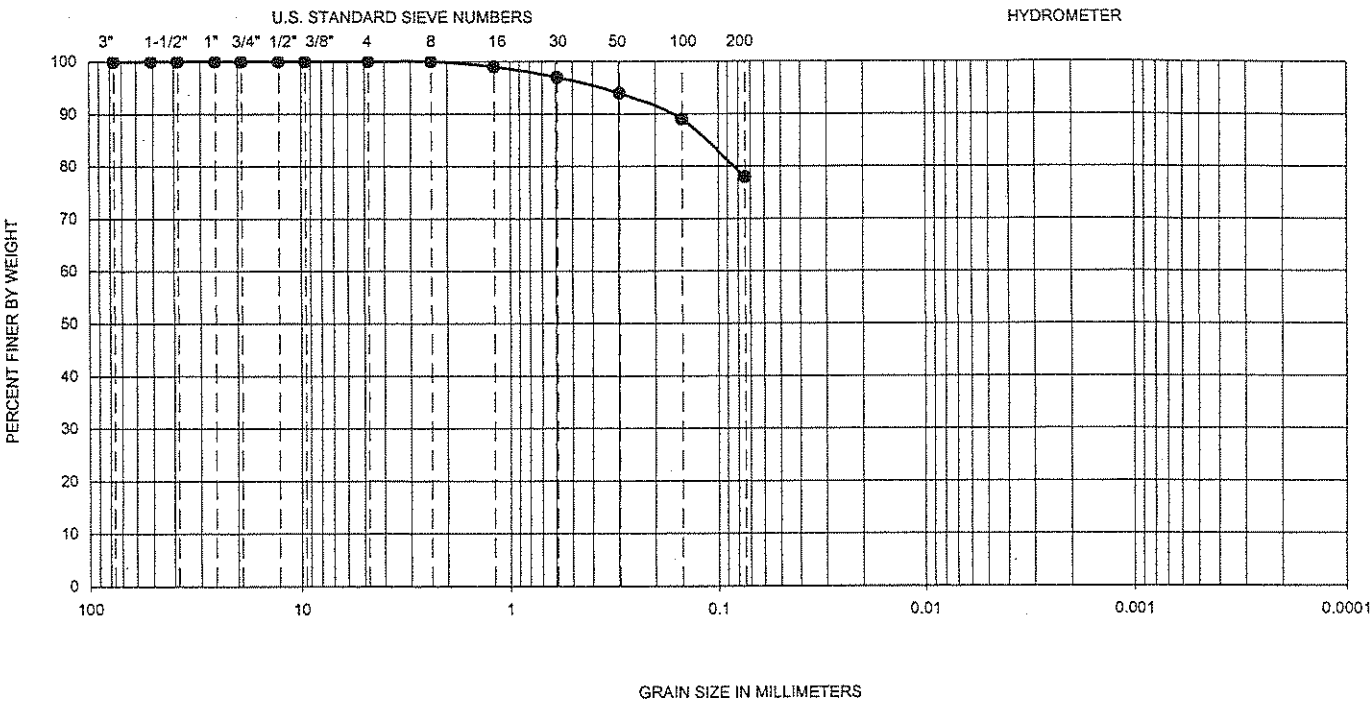
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-2

RH-1 25 TO 26.5 SIEVE+HYDRO1.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-2	2.5-4	34	8	26	--	--	--	--	--	78	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

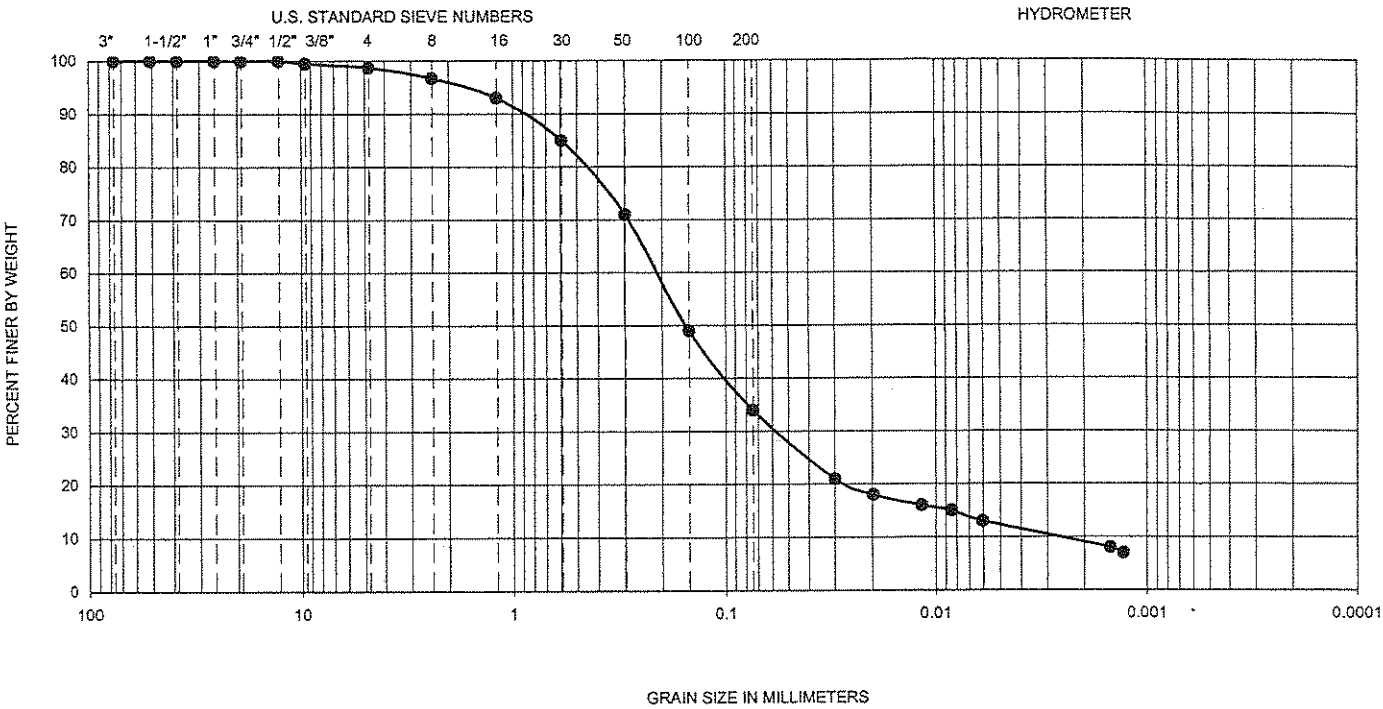
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-3

SIEVE RH-02@2.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-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

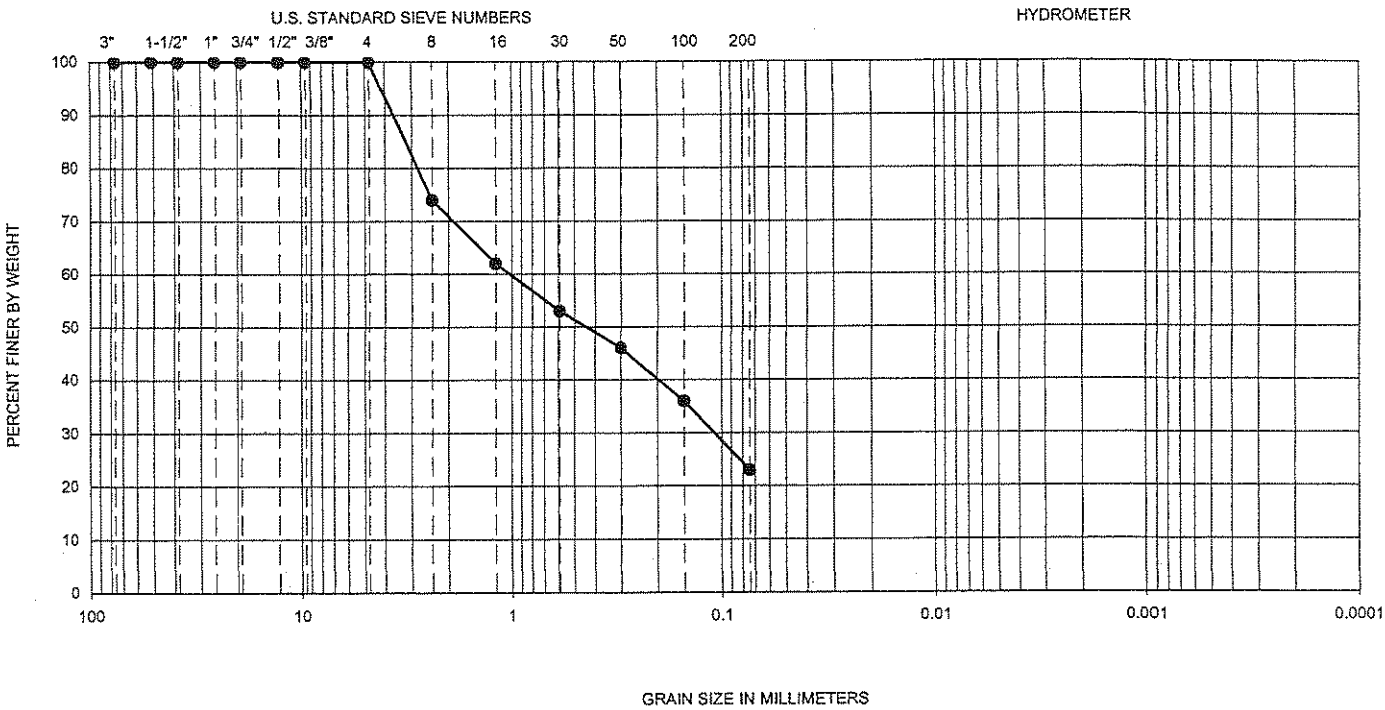
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-4

RH-2 12.5 TO 14 SIEVE+HYDRO1.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-3	5-6.5	28	24	4	--	--	--	--	--	23	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

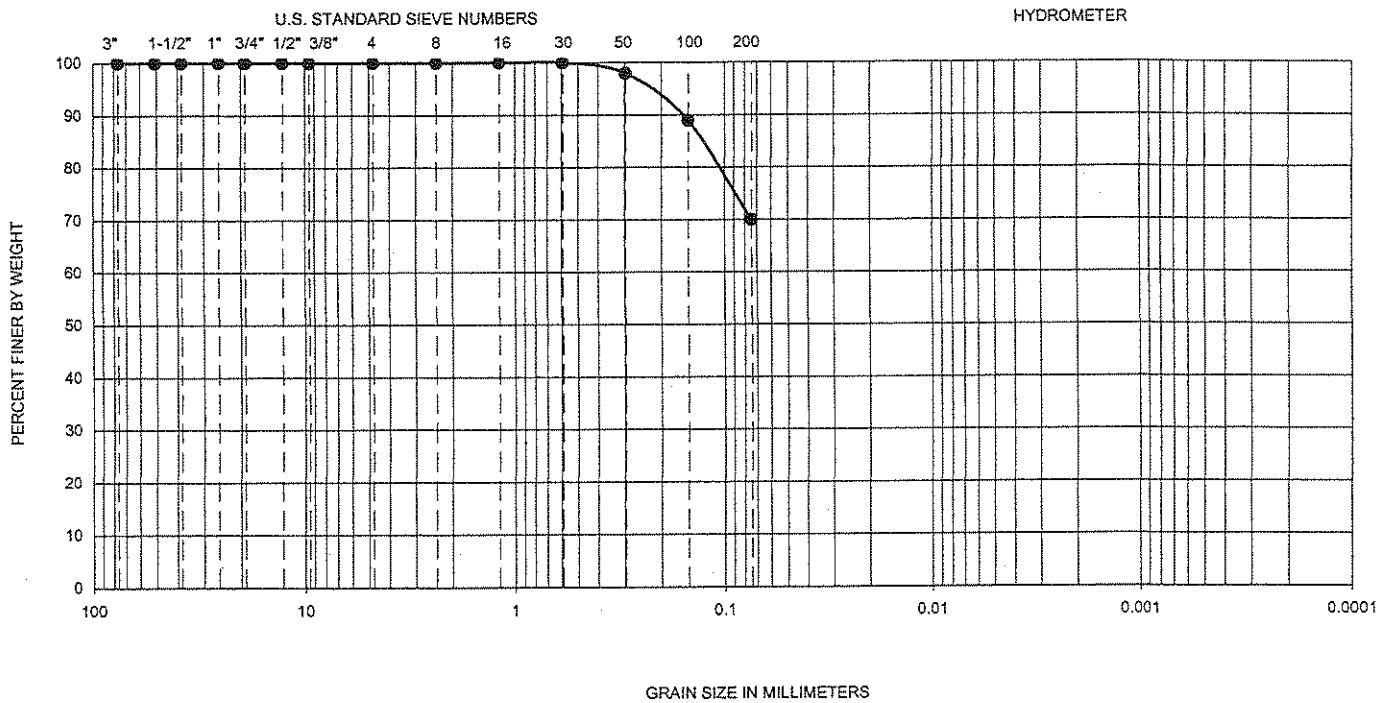
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-5

SIEVE RH-03@5.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-4	5-6.5	27	15	12	--	--	--	--	--	70	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

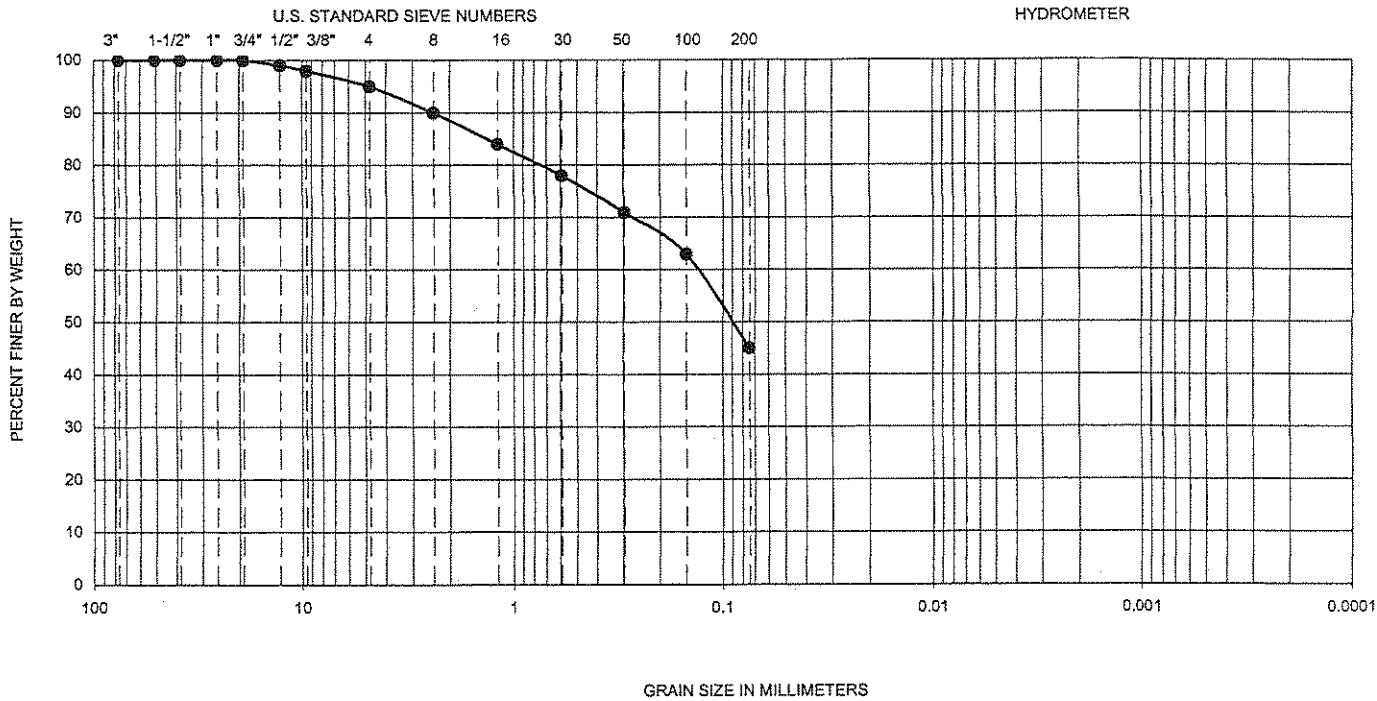
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-6

SIEVE RH-04@5.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-4	15-16.5	29	16	13	--	--	--	--	--	45	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

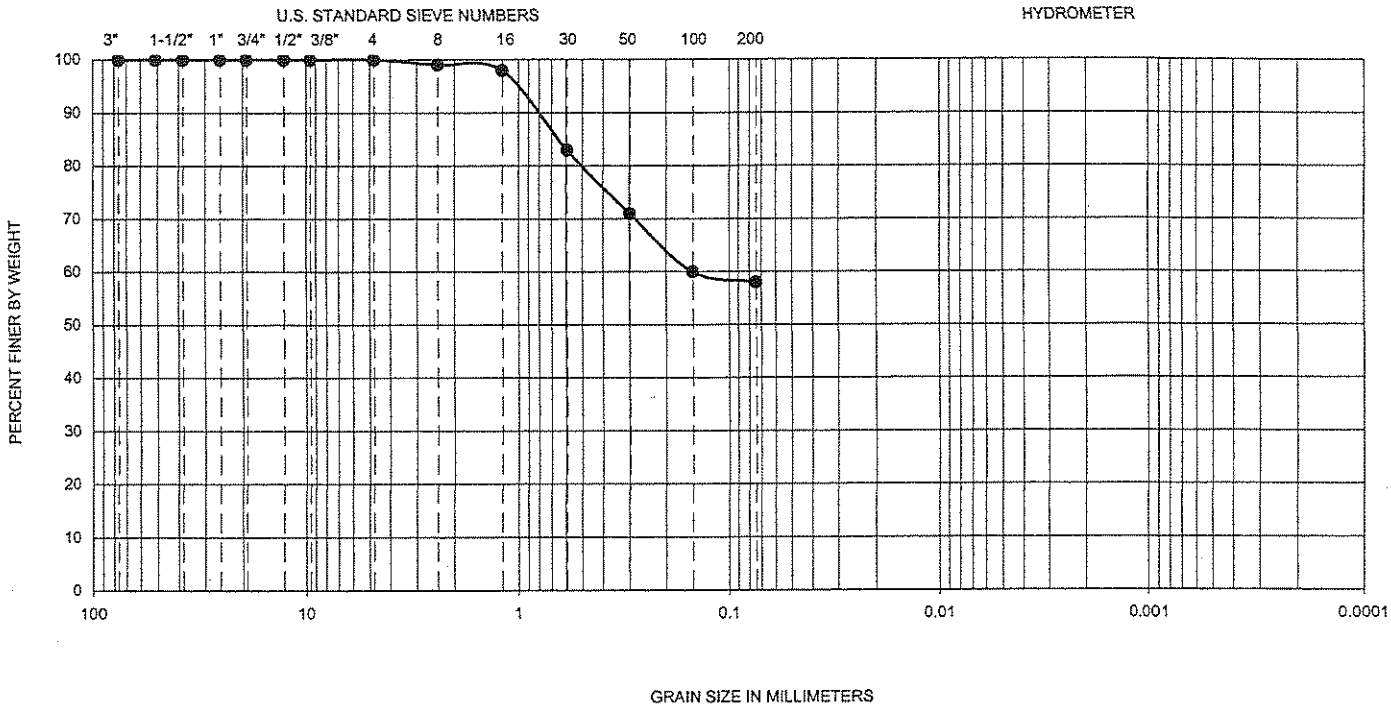
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-7

SIEVE RH-04@15.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-5	5-6.5	25	20	5	--	--	--	--	--	58	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

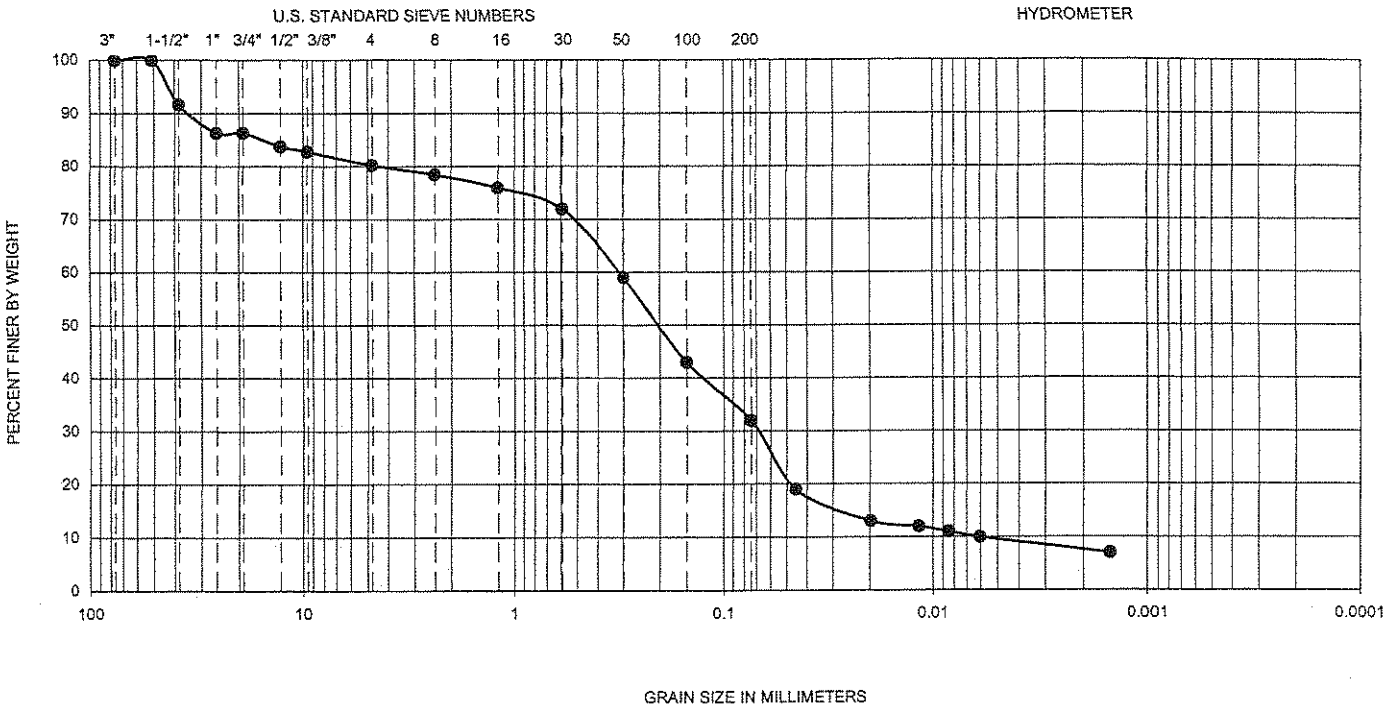
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-8

SIEVE RH-05@5.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-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

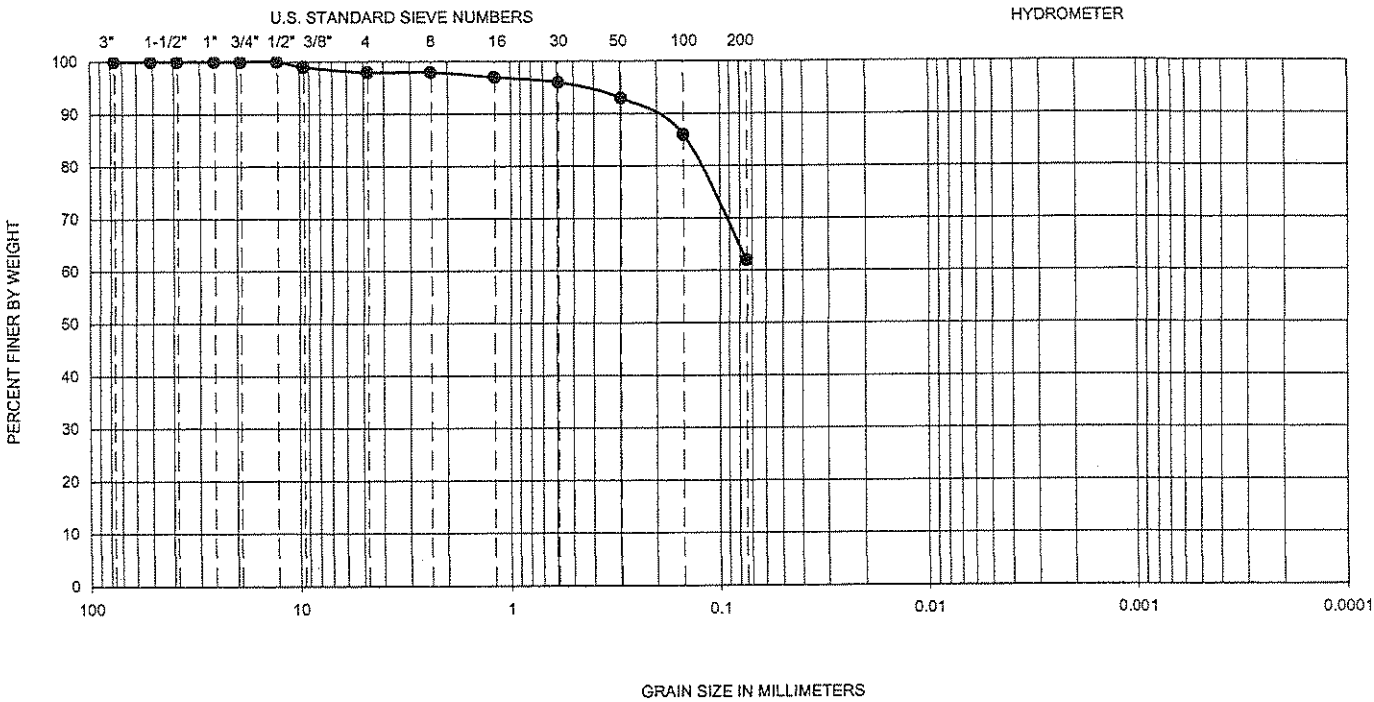
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-9

RH-5 20.0 TO 21.5 SIEVE+HYDRO1.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-6	10-11.5	28	19	9	--	--	--	--	--	62	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

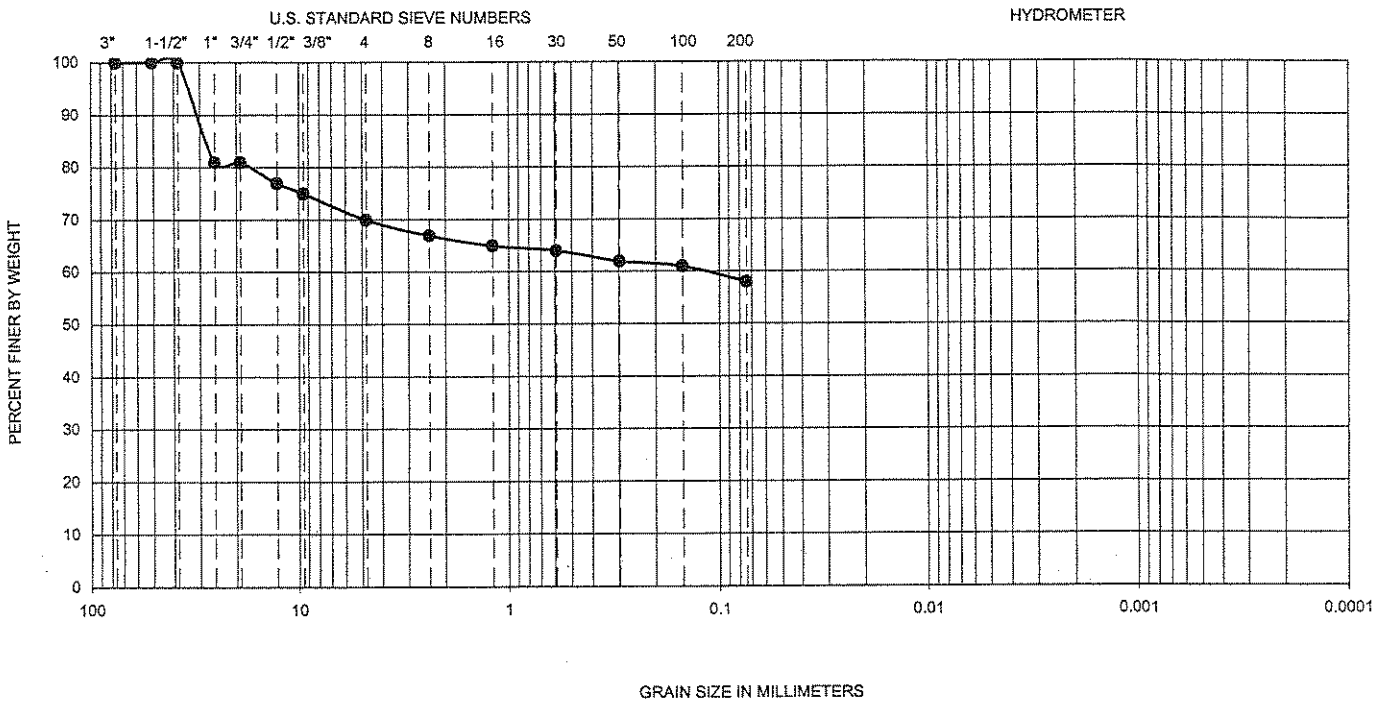
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-10

SIEVE RH-06@10.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-6	15-16.5	32	19	13	--	--	--	--	--	58	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

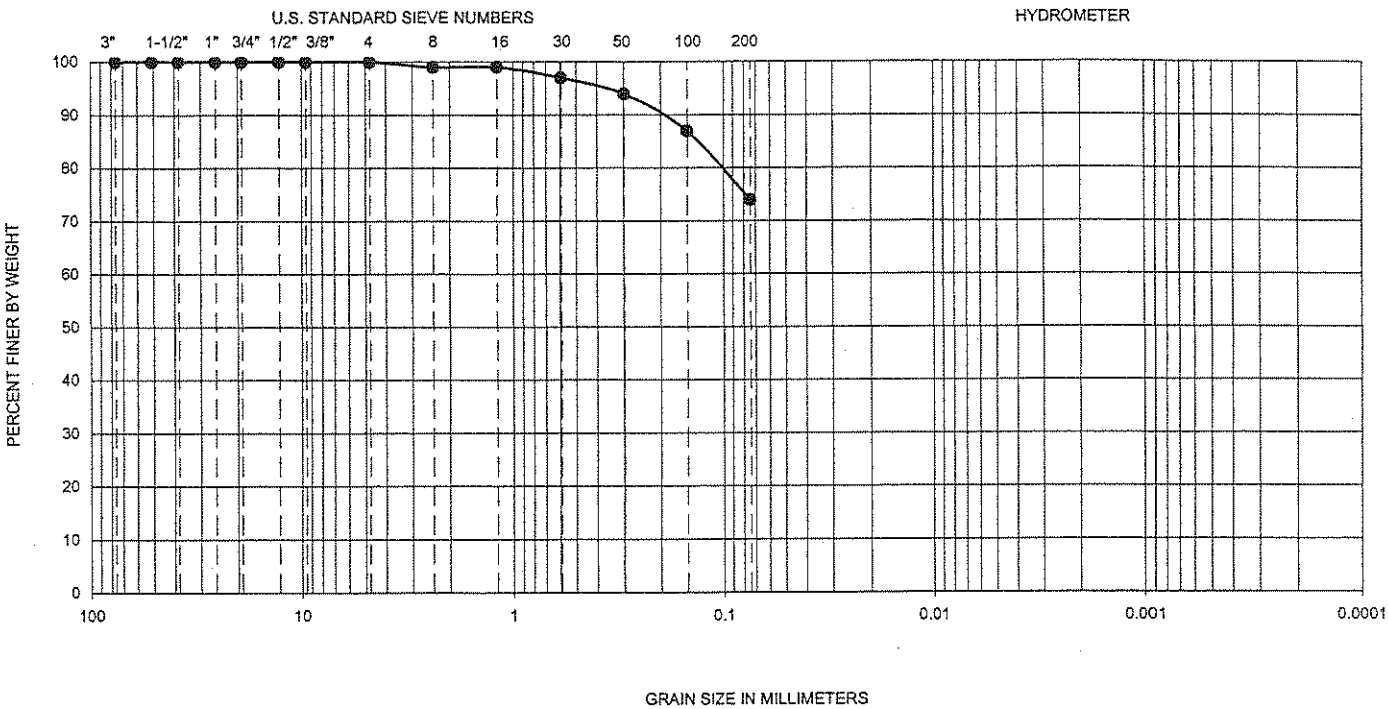
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-11

SIEVE RH-06@15.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-7	2.5-4	30	16	14	--	--	--	--	--	74	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

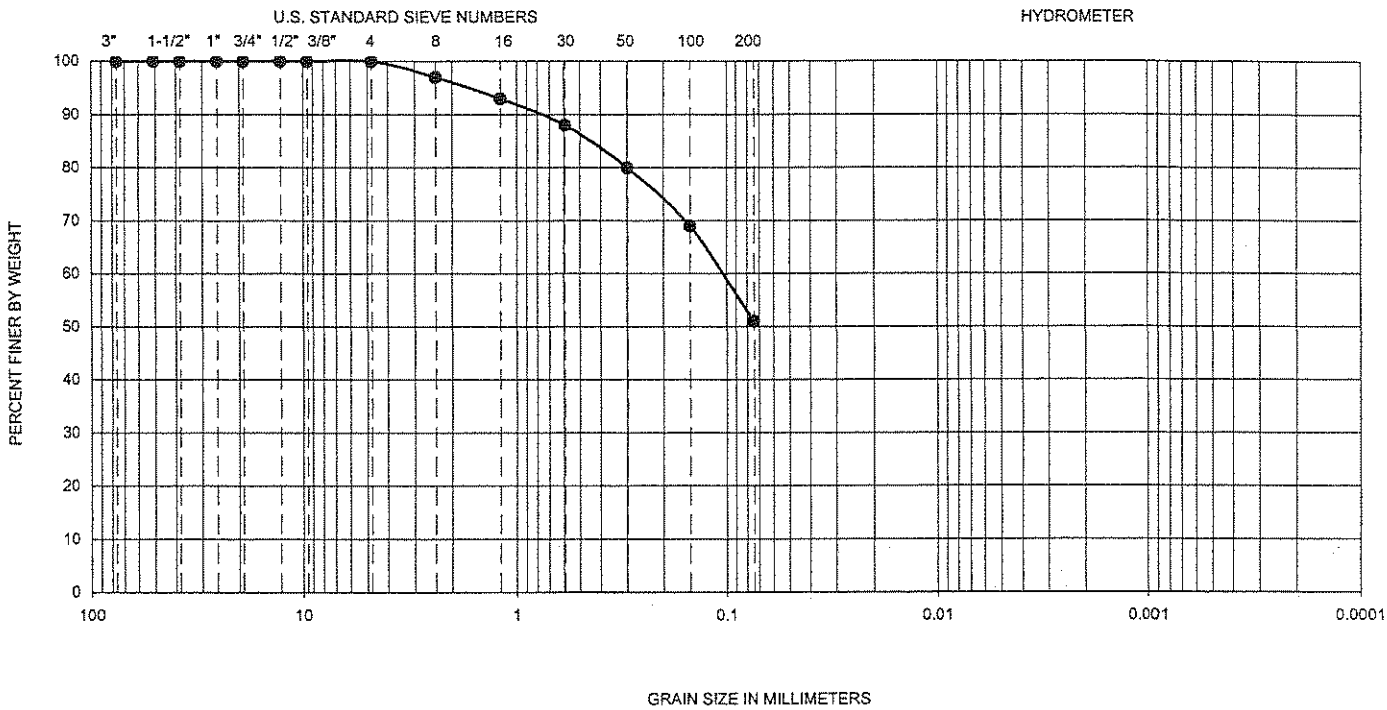
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-12

SIEVE RH-07@2.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-7	17.5-18.5	32	19	13	--	--	--	--	--	51	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

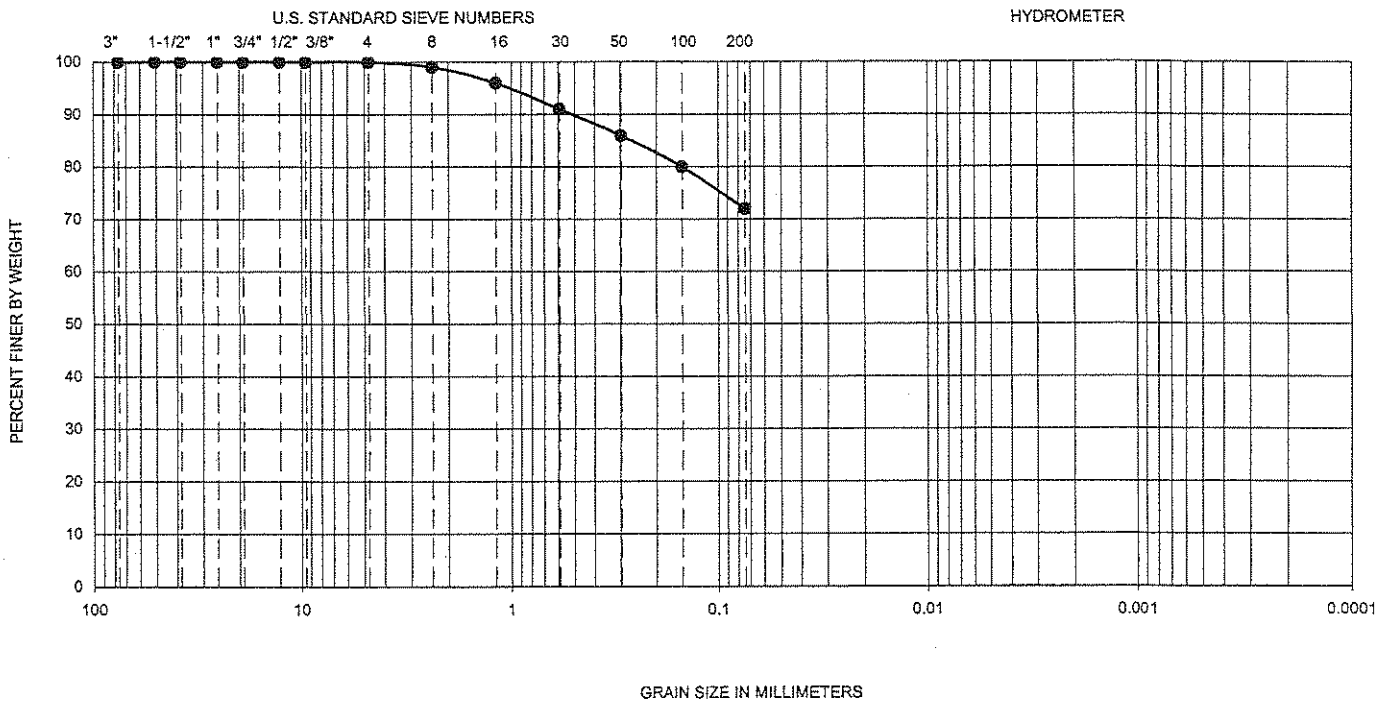
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-13

SIEVE RH-07@17.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	7.5-8.9	32	21	11	--	--	--	--	--	72	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

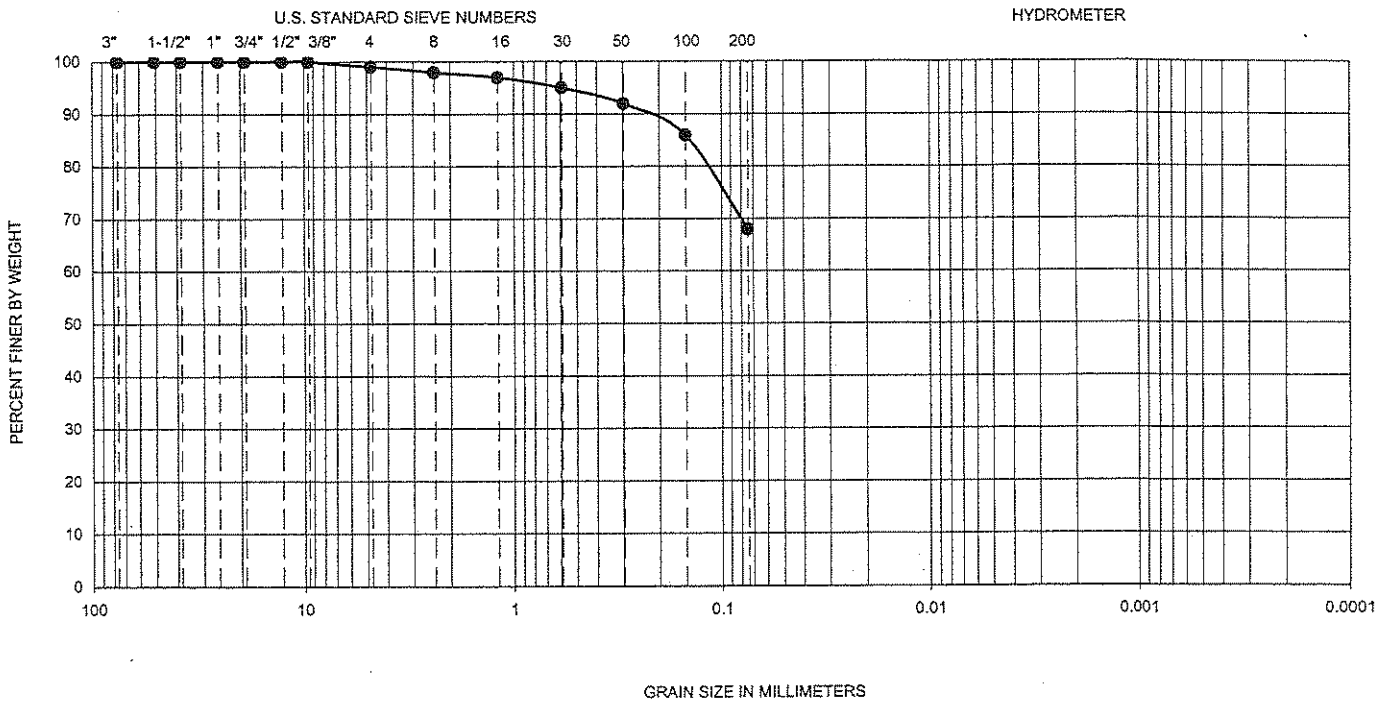
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	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

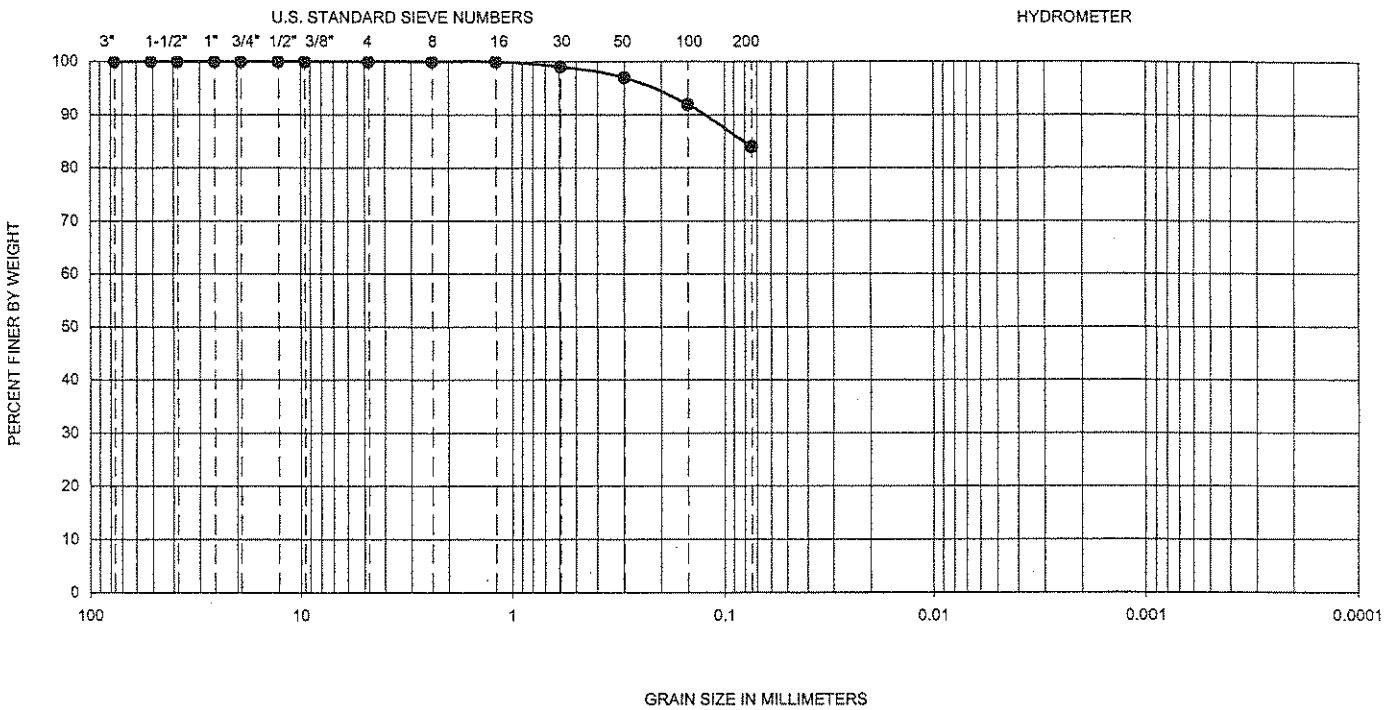
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-15

SIEVE RH-08@17.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-9	5-6.5	28	17	11	--	--	--	--	--	84	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

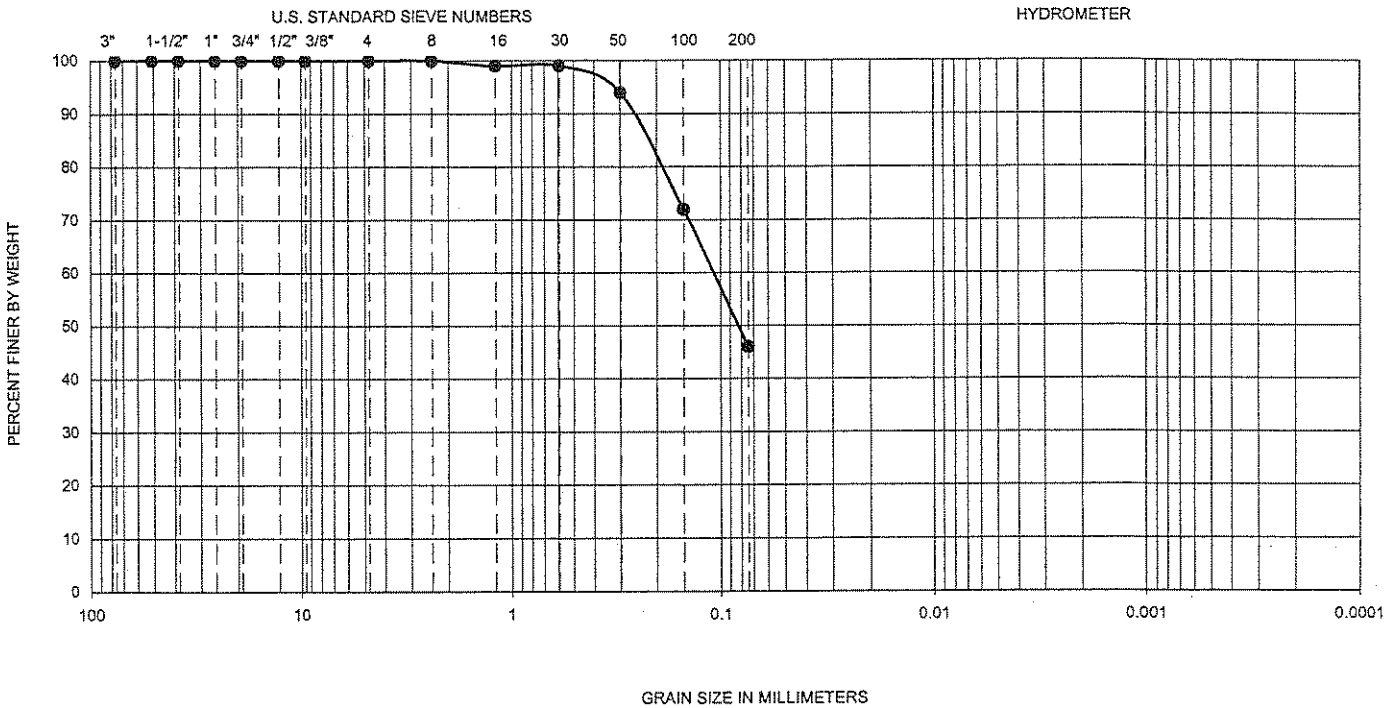
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-16

SIEVE RH-09@5.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-9	20-21.5	--	--	NP	--	--	--	--	--	46	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

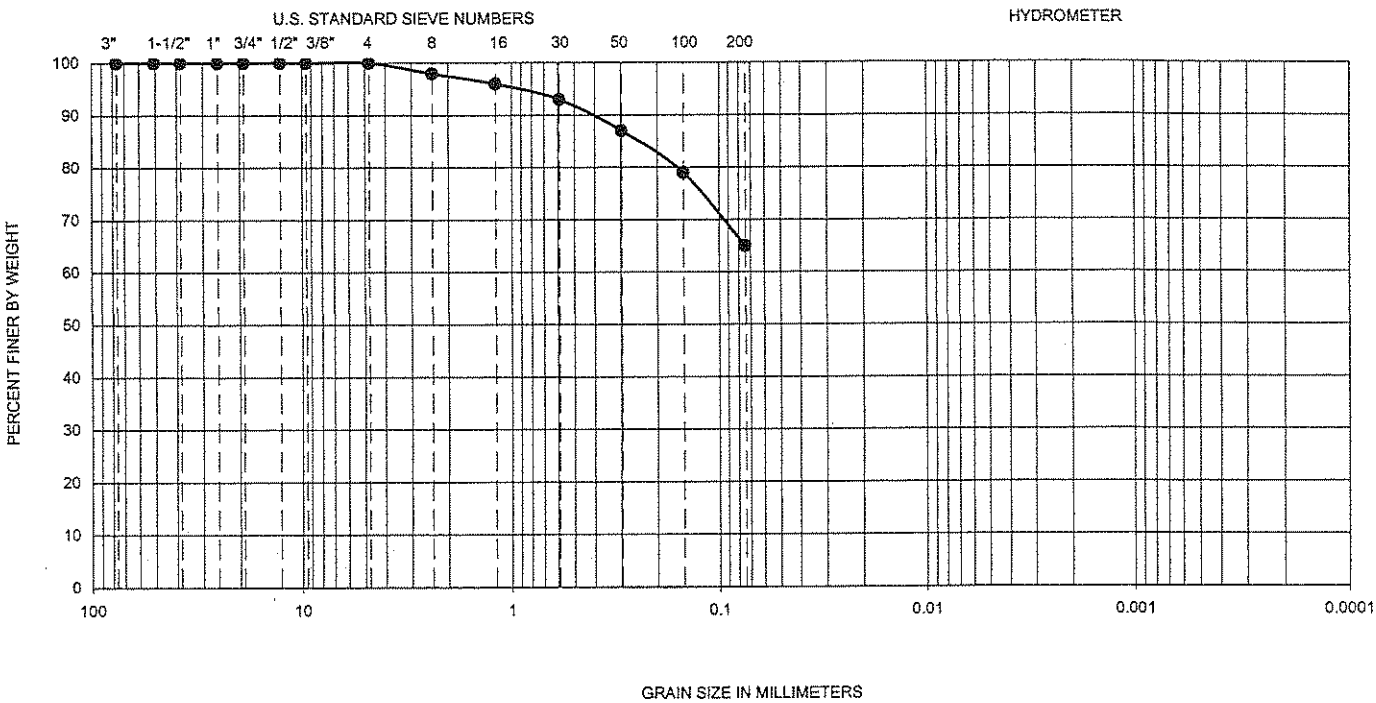
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-17

SIEVE RH-09@20.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-10	12.5-14	30	23	7	--	--	--	--	--	65	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

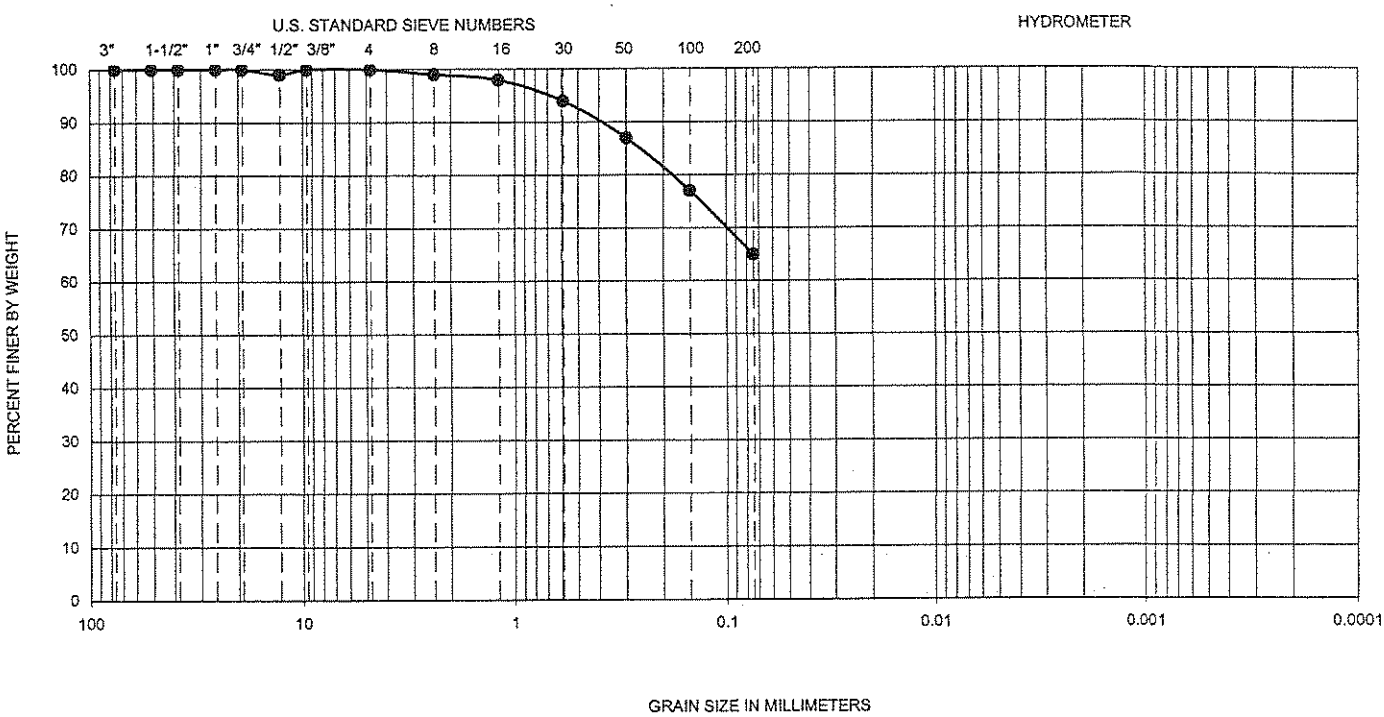
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-18

SIEVE RH-10@12.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-11	10-11.5	36	19	17	--	--	--	--	--	65	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

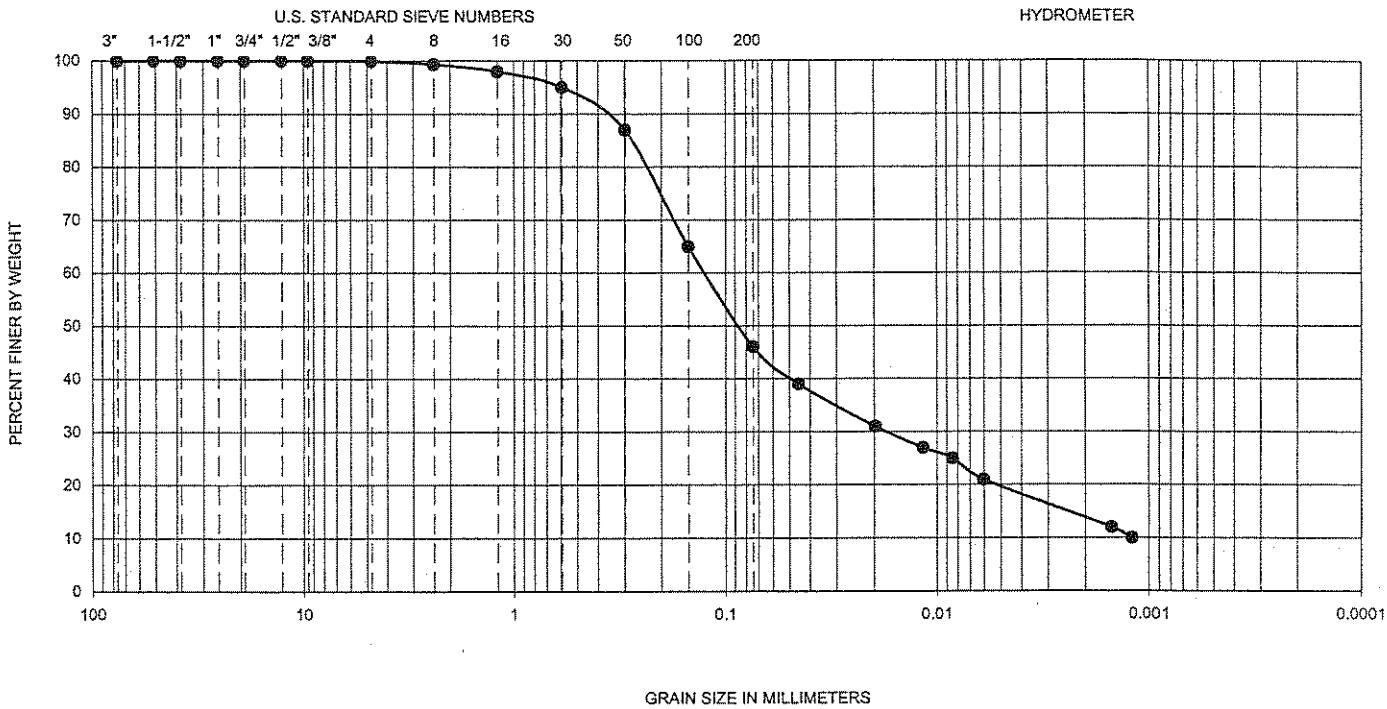
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-19

SIEVE RH-11@10.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-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

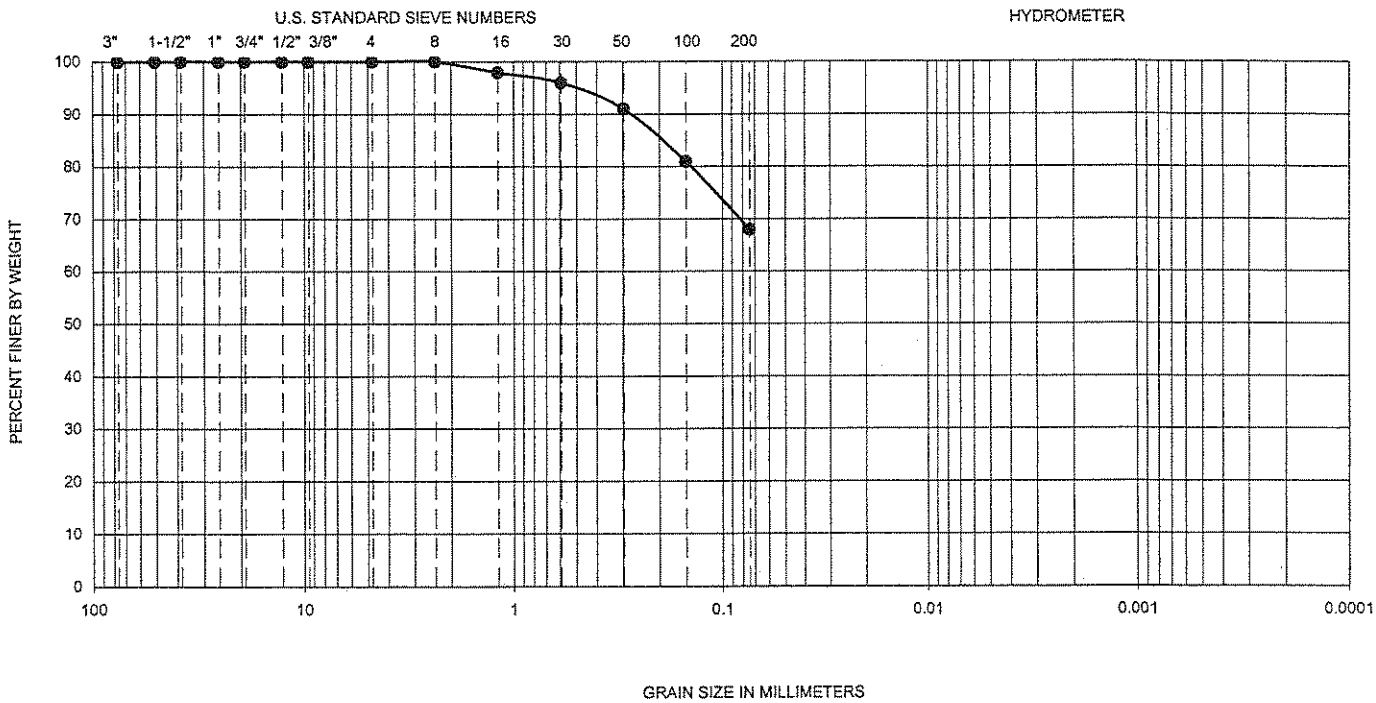
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-20

RH-11 17.5 TO 19.0 SIEVE+HYDRO1.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-12	5-5.5	--	--	NP	--	--	--	--	--	68	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

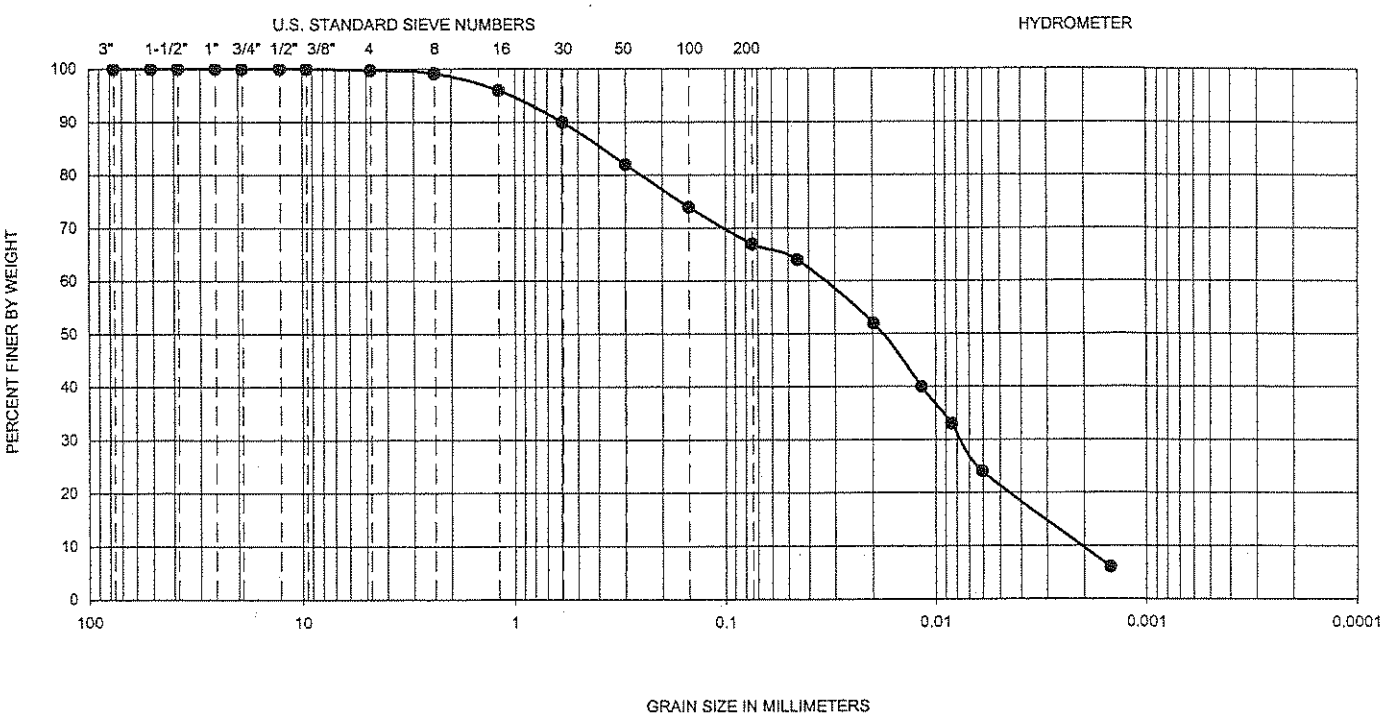
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-21

SIEVE RH-12@5.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-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

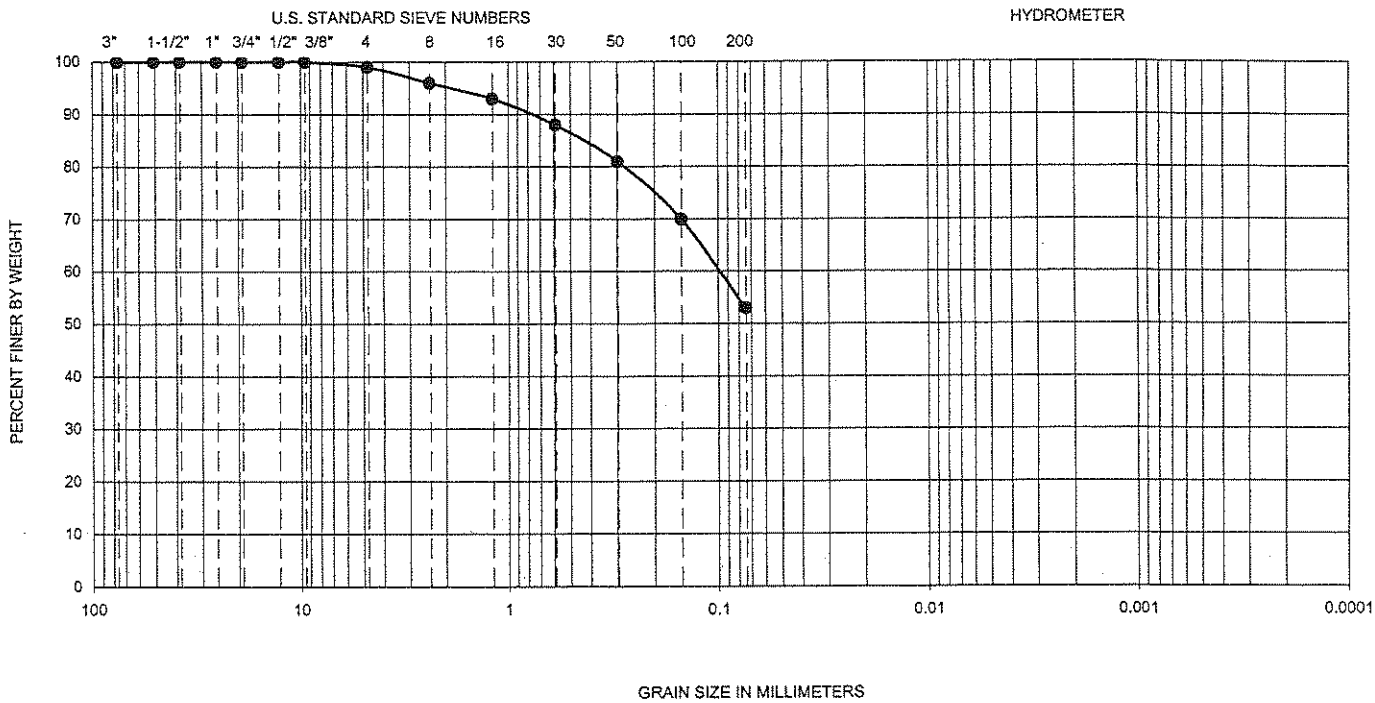
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-22

RH-12 10.0 TO 11.5 SIEVE+HYDRO1.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-12	15-15.4	26	18	8	--	--	--	--	--	53	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

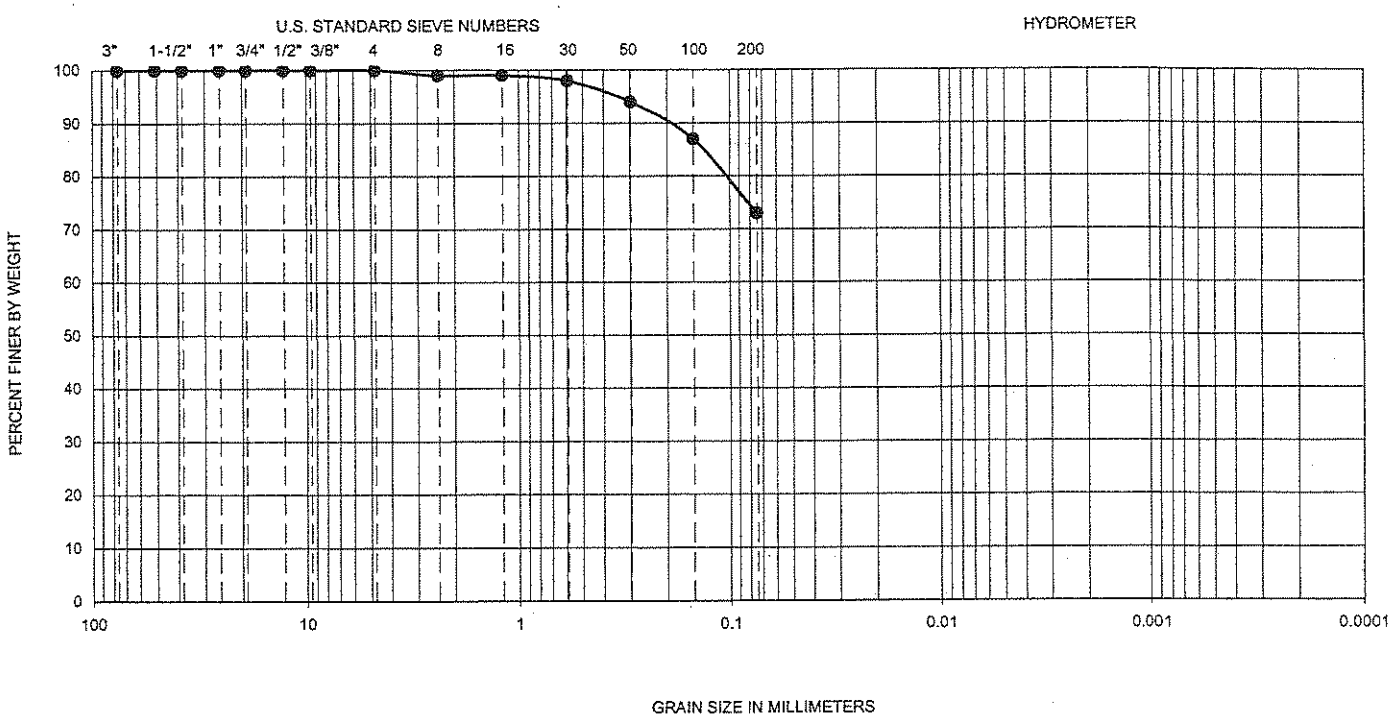
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-23

SIEVE RH-12@15.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-13	5-6.5	43	17	26	--	--	--	--	--	73	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

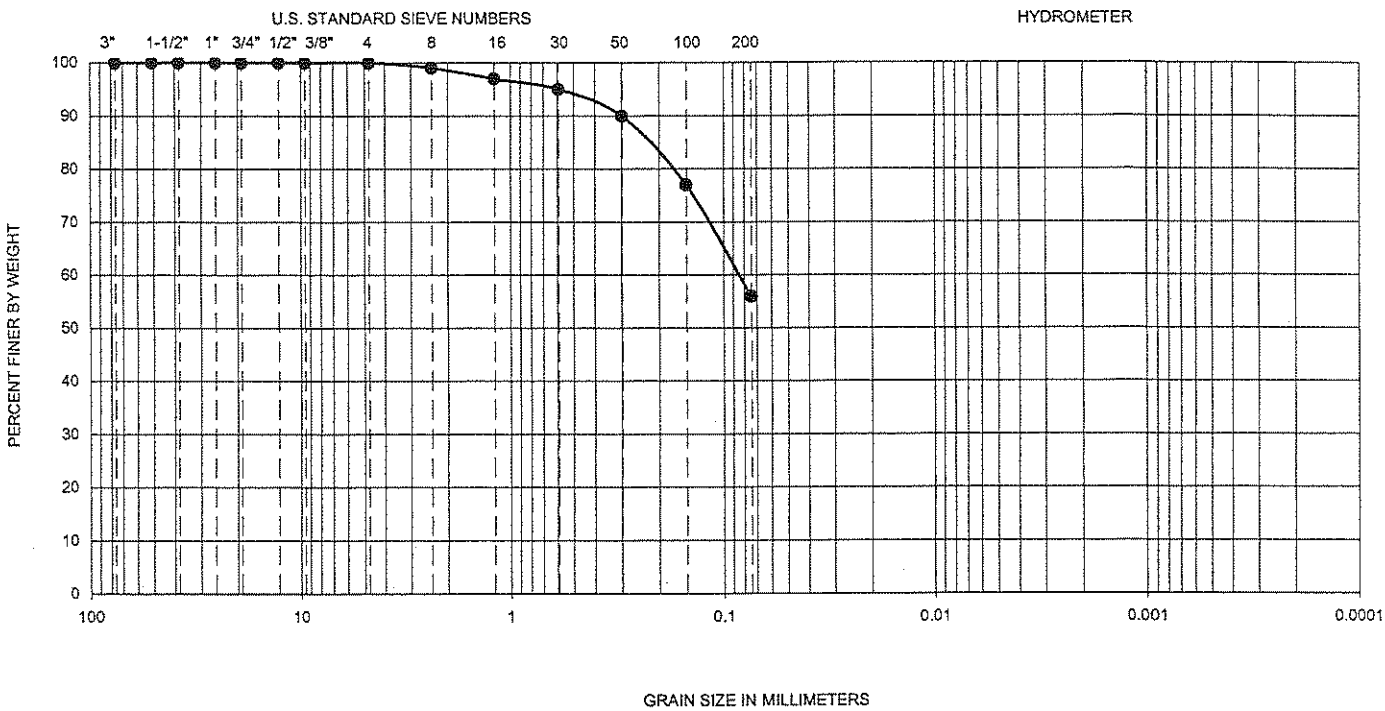
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-24

SIEVE RH-13@5.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-13	20-21.5	--	--	NP	--	--	--	--	--	56	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

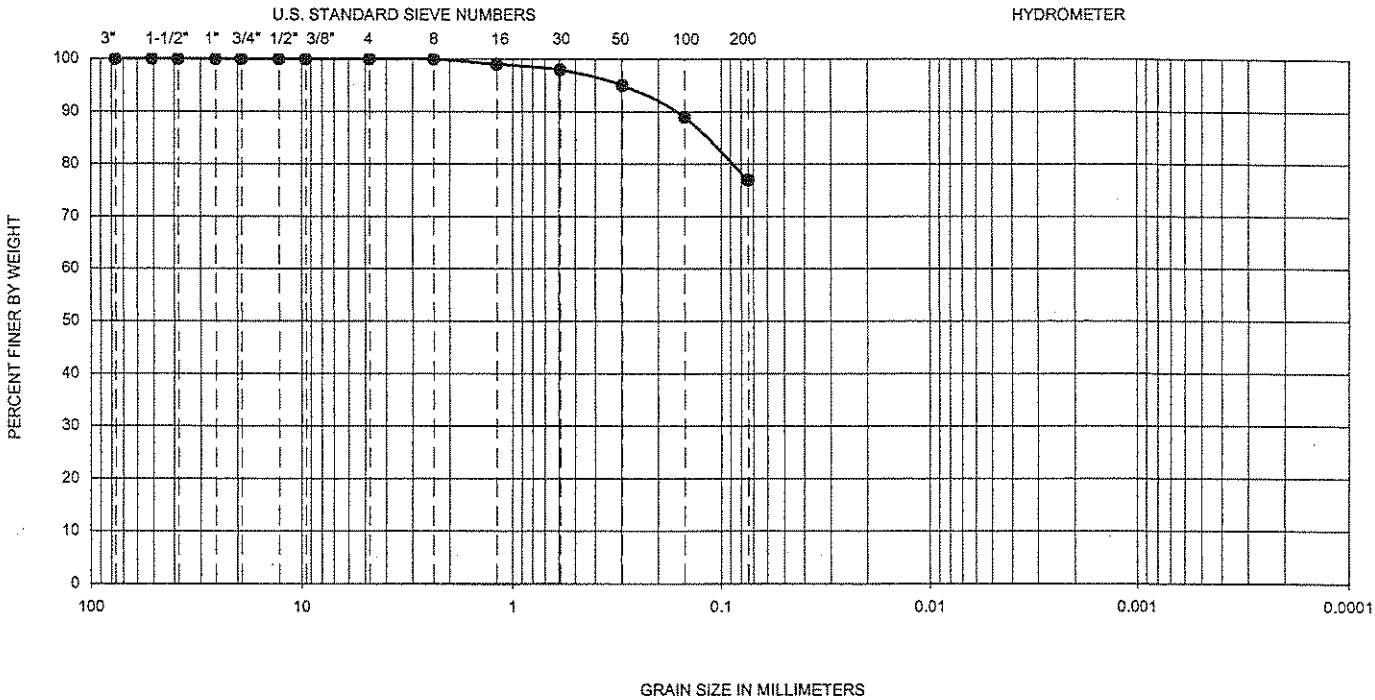
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-25

SIEVE RH-13@20.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-14	2.5-3.5	29	16	13	--	--	--	--	--	77	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

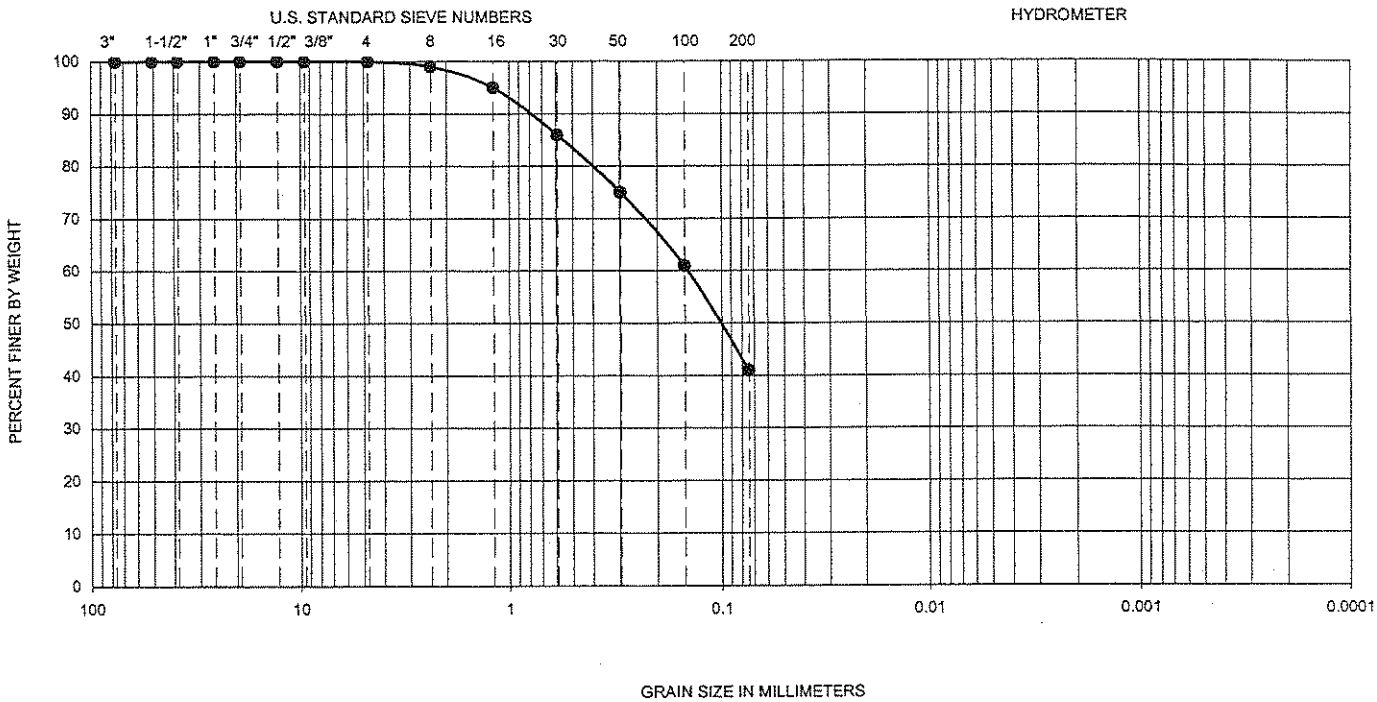
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-26

SIEVE RH-14@2.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-14	15-15.8	30	18	12	--	--	--	--	--	41	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

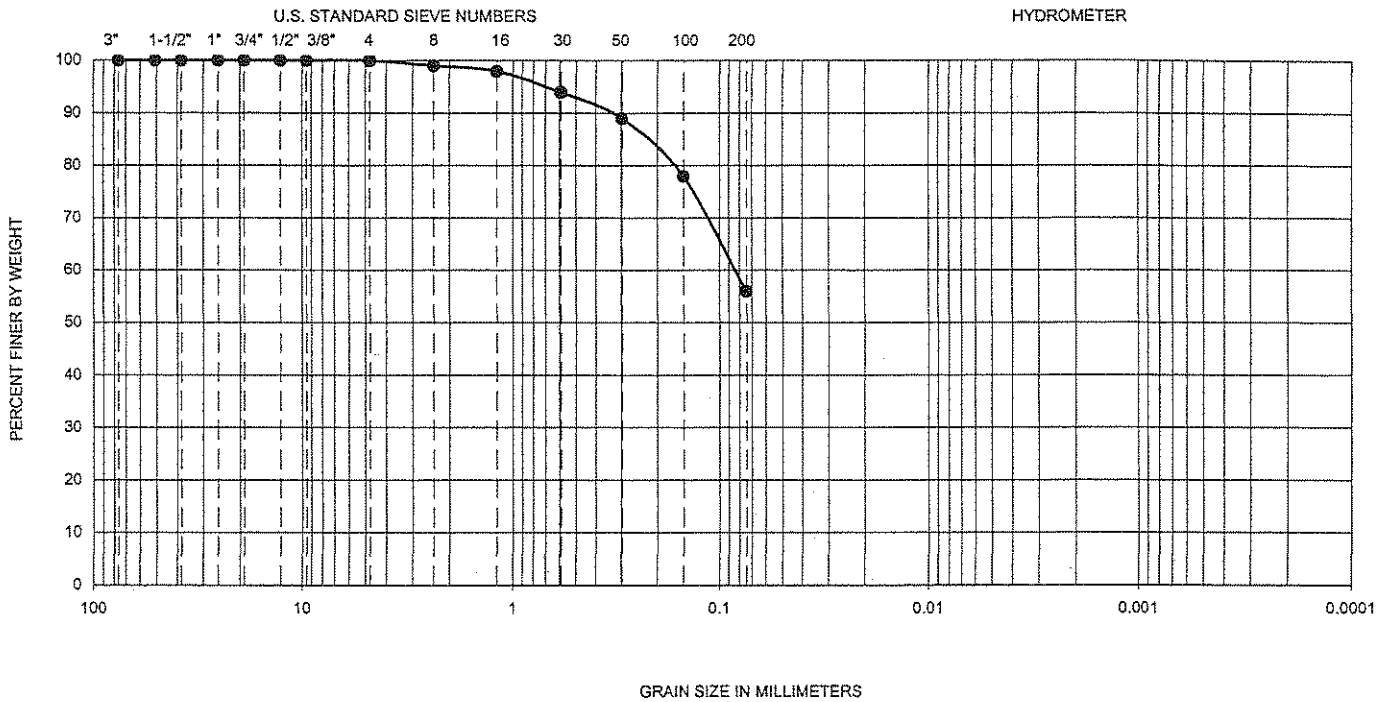
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-27

SIEVE RH-14@15.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-15	5-5.9	--	--	NP	--	--	--	--	--	56	ML

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

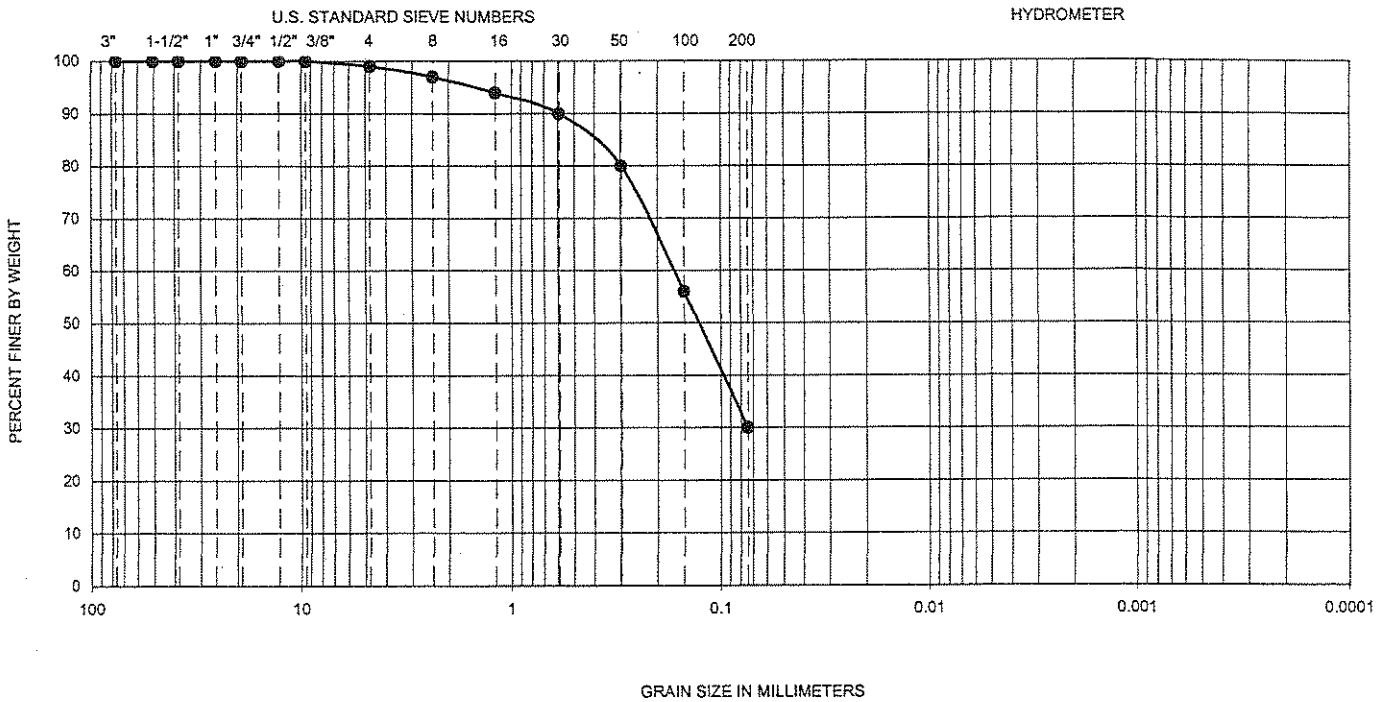
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-28

SIEVE RH-15@5.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-15	15-16.5	--	--	NP	--	--	--	--	--	30	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

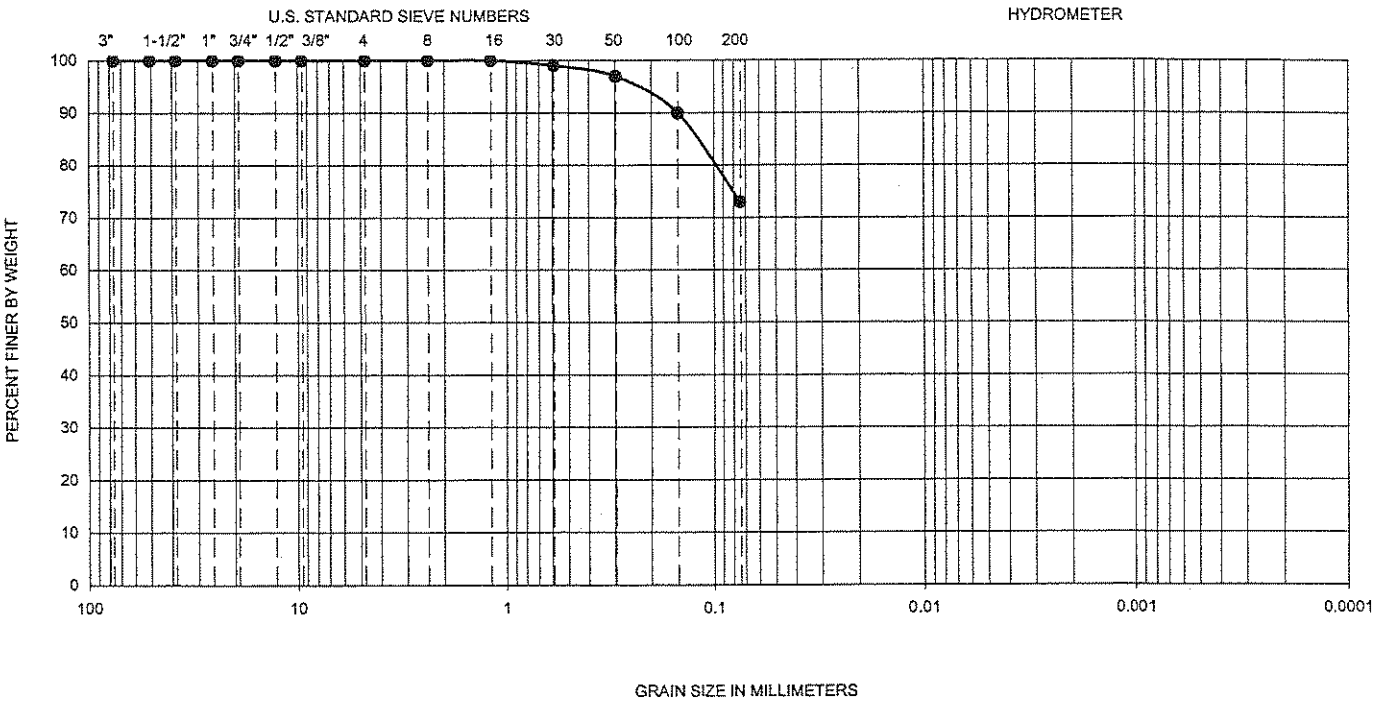
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-29

SIEVE RH-15@15.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-16	2.5-4	27	16	11	--	--	--	--	--	73	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

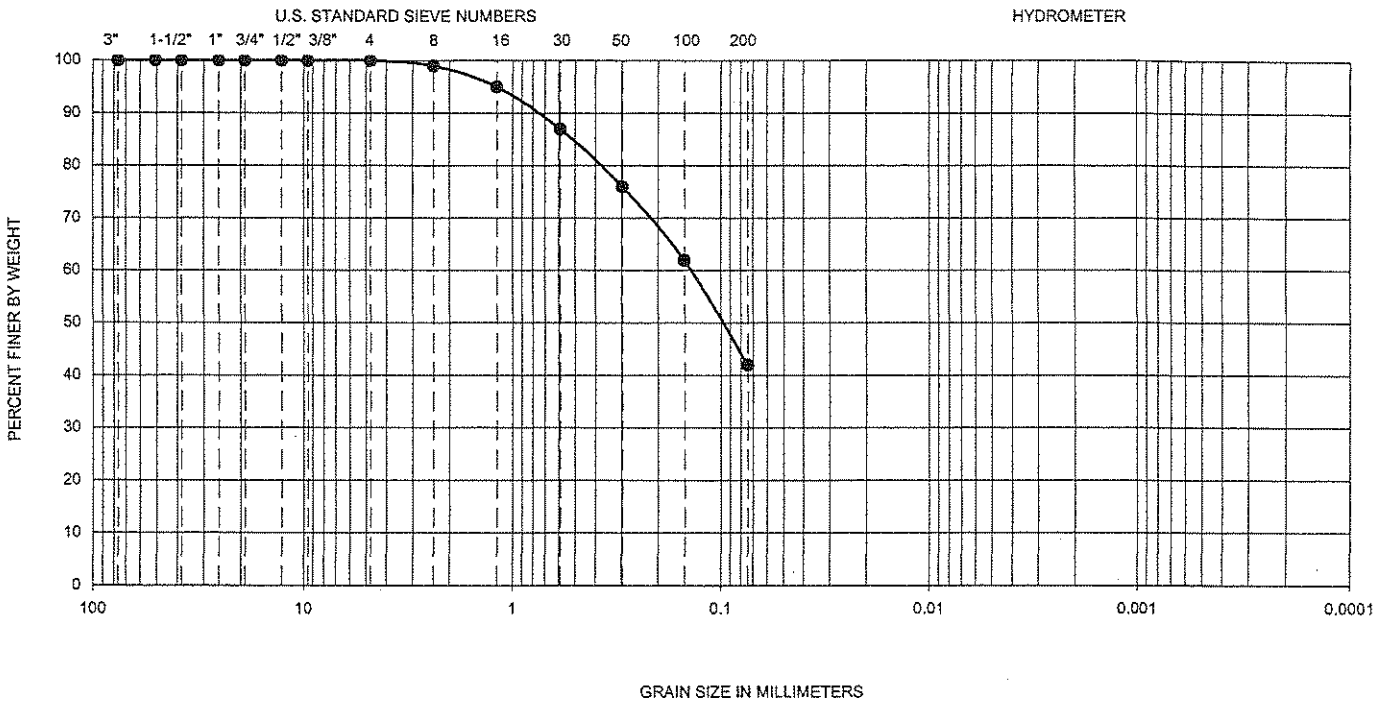
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-30

SIEVE RH-16@2.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-16	7.5-8.8	--	--	NP	--	--	--	--	--	42	SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

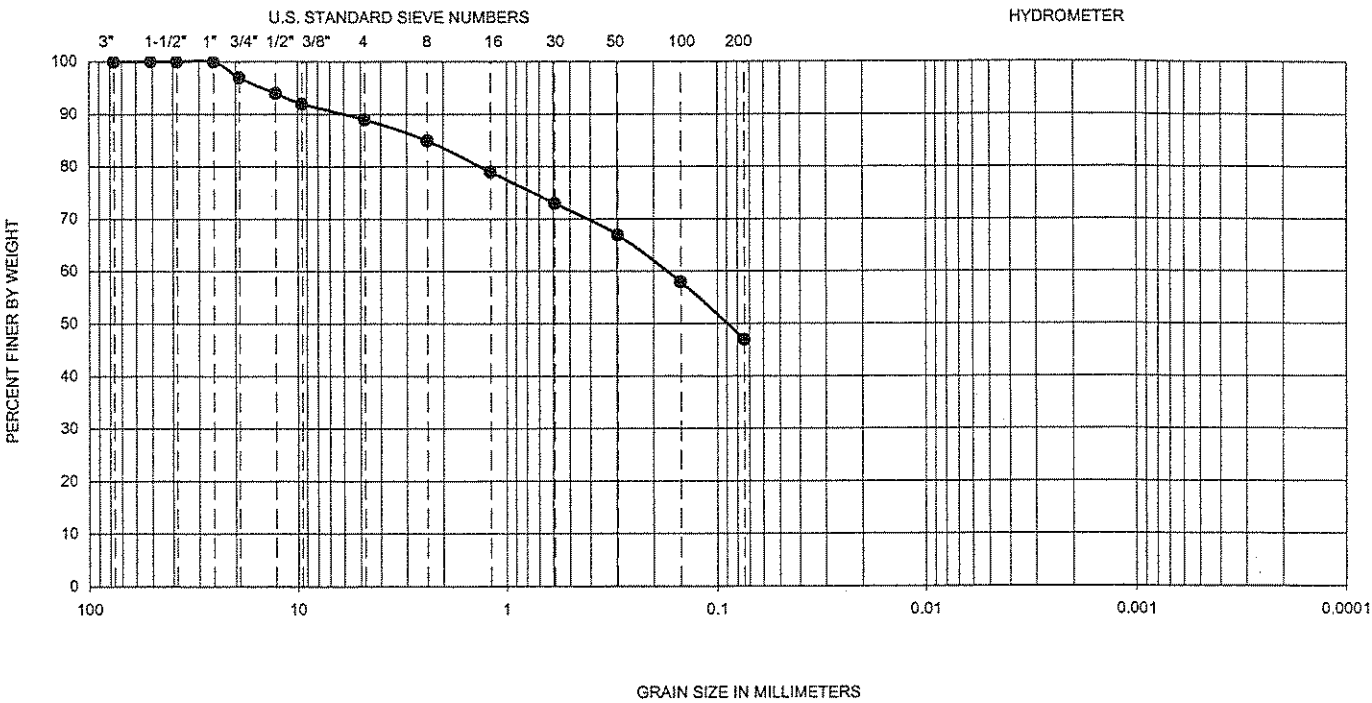
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-31

SIEVE RH-16@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-17	2.5-4	22	15	7	--	--	--	--	--	47	SC

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422-63

Ninyo & Moore

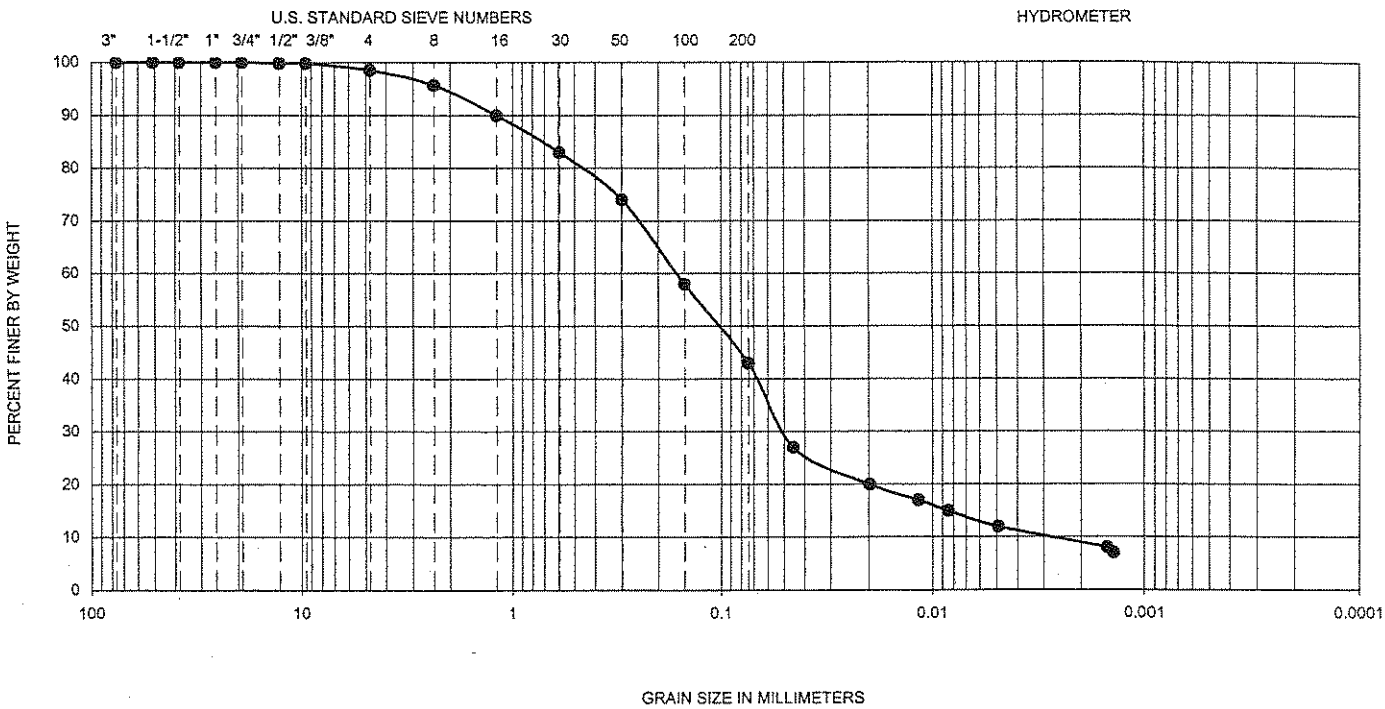
GRADATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-32

SIEVE RH-17@2.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-12	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

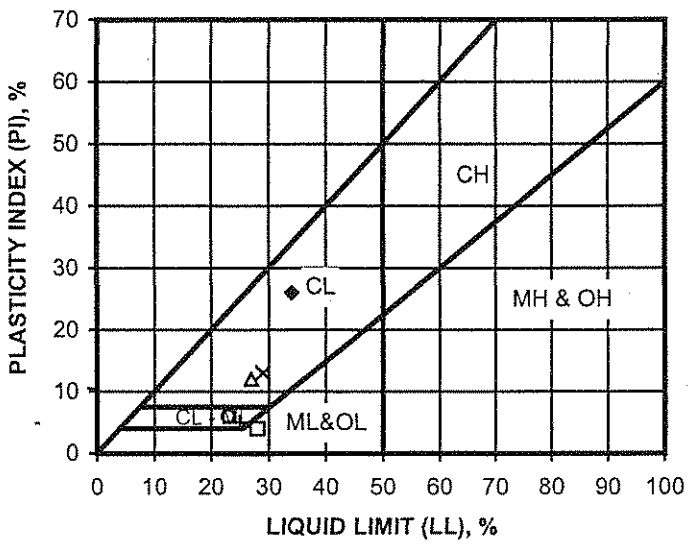
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-33

RH-17 10.0 TO 11.0 SIEVE+HYDRO1.xls

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
○	RH-2	12.5-14	23	17	6	CL-ML	SC-SM
□	RH-3	5-6.5	28	24	4	ML	SM
△	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 4318-98

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

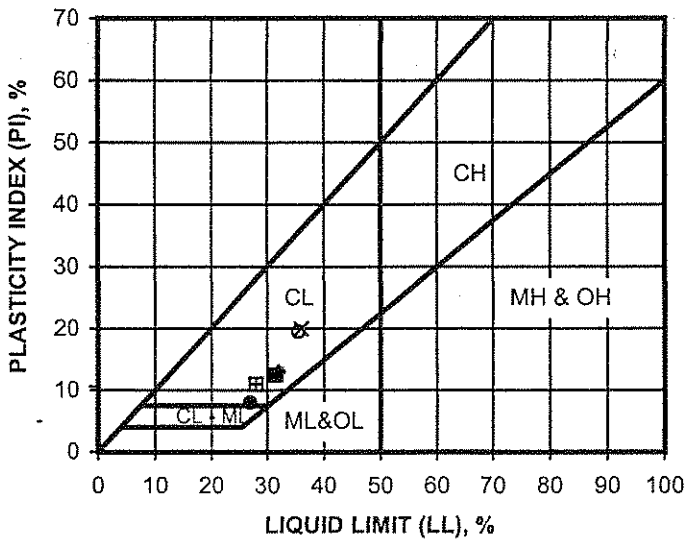
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-34

RH ATTERBERG 1.xls

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
○	RH-7	2.5-4	36	16	20	CL	CL
□	RH-7	17.5-19	28	17	11	CL	CL
△	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 4318-98

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

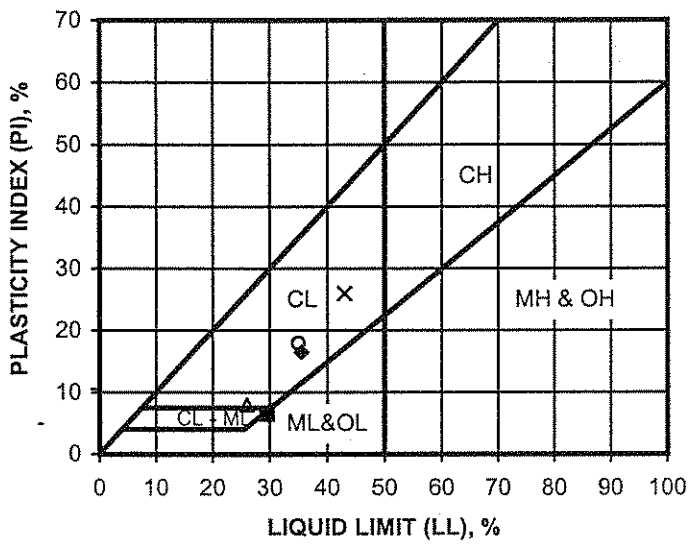
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-35

RH ATTERBERG 2.xls

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
○	RH-11	17.5-19	35	17	18	CL	SC
□	RH-12	5-6.5	-	-	NP	ML	ML
△	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 4318-98

Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

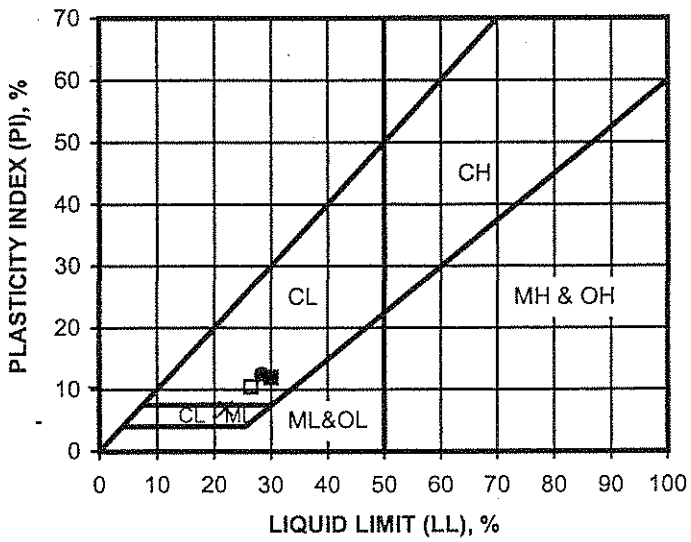
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-36

RH ATTERBERG 3.xls

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
○	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 4318-98

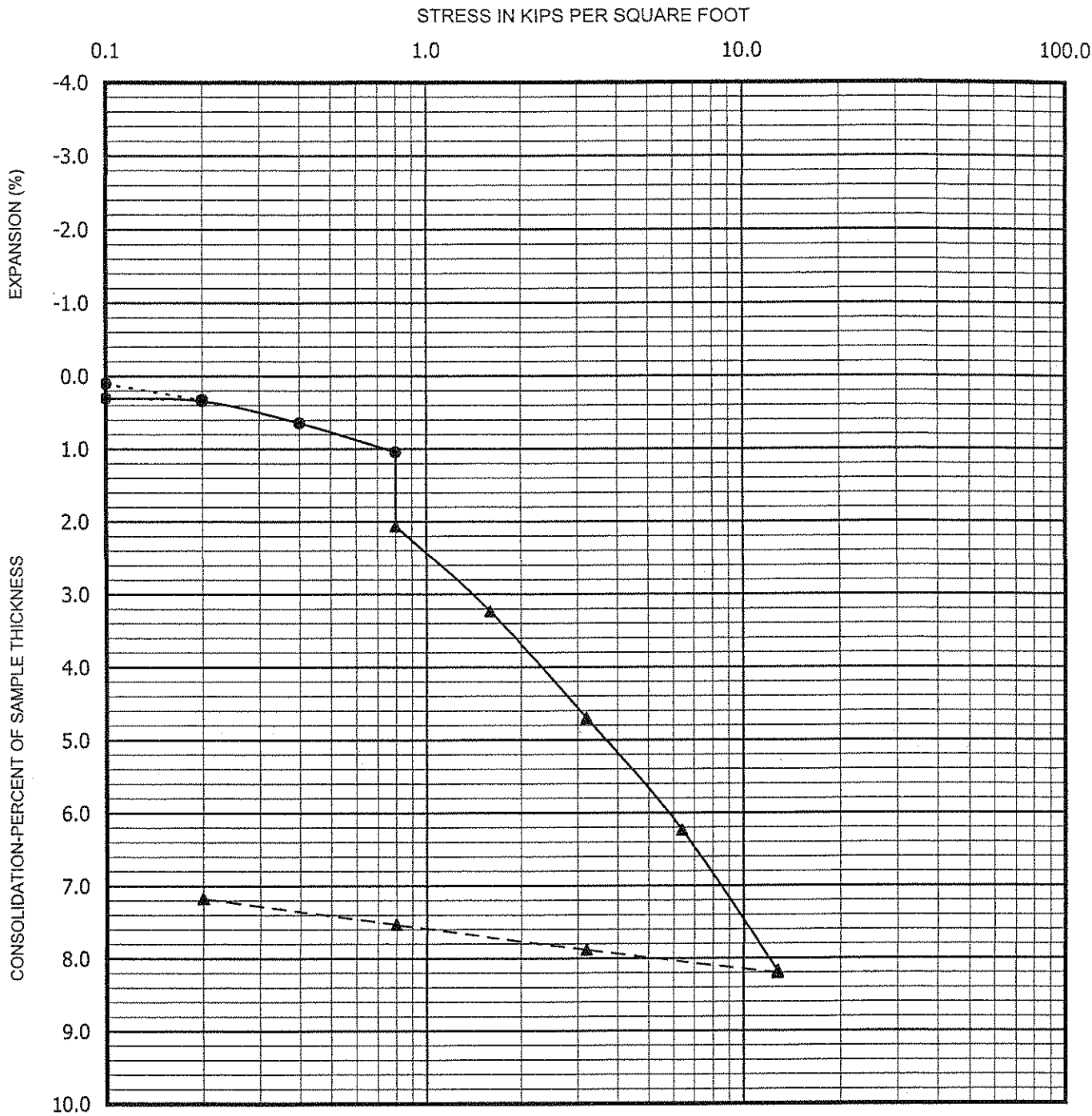
Ninyo & Moore

ATTERBERG LIMITS TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-37

RH ATTERBERG 4.xls



Seating Cycle	Boring No. RH-1
Loading Prior to Inundation	Depth (ft.) 10-11.5
Loading After Inundation	Soil Type SC
Rebound Cycle	PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96

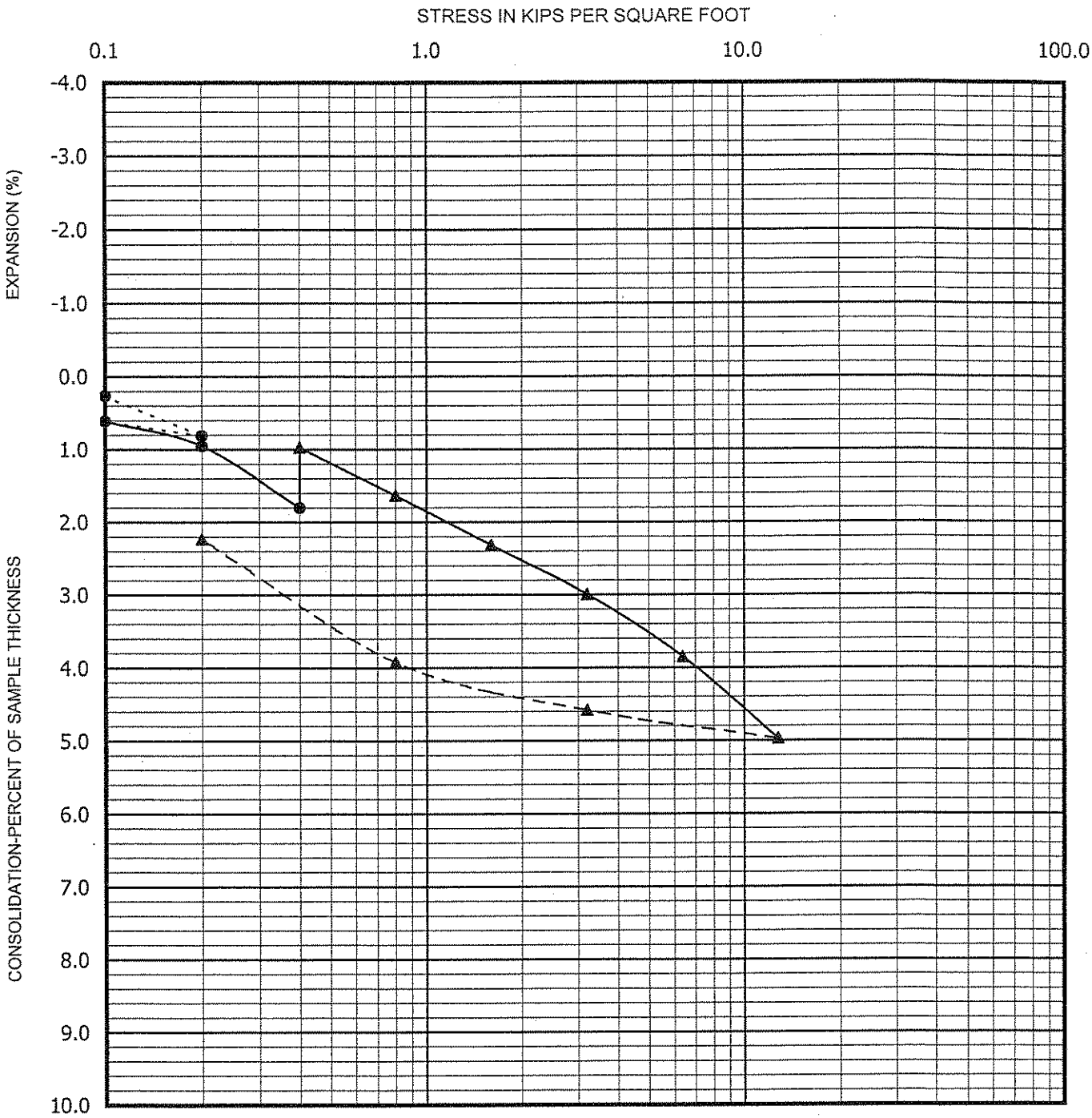
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-38

CONSOLIDATION RH-1 10-11.xls



Seating Cycle
Loading Prior to Inundation
Loading After Inundation
Rebound Cycle

Boring No. RH-3
Depth (ft.) 2.5-4
Soil Type SM

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96

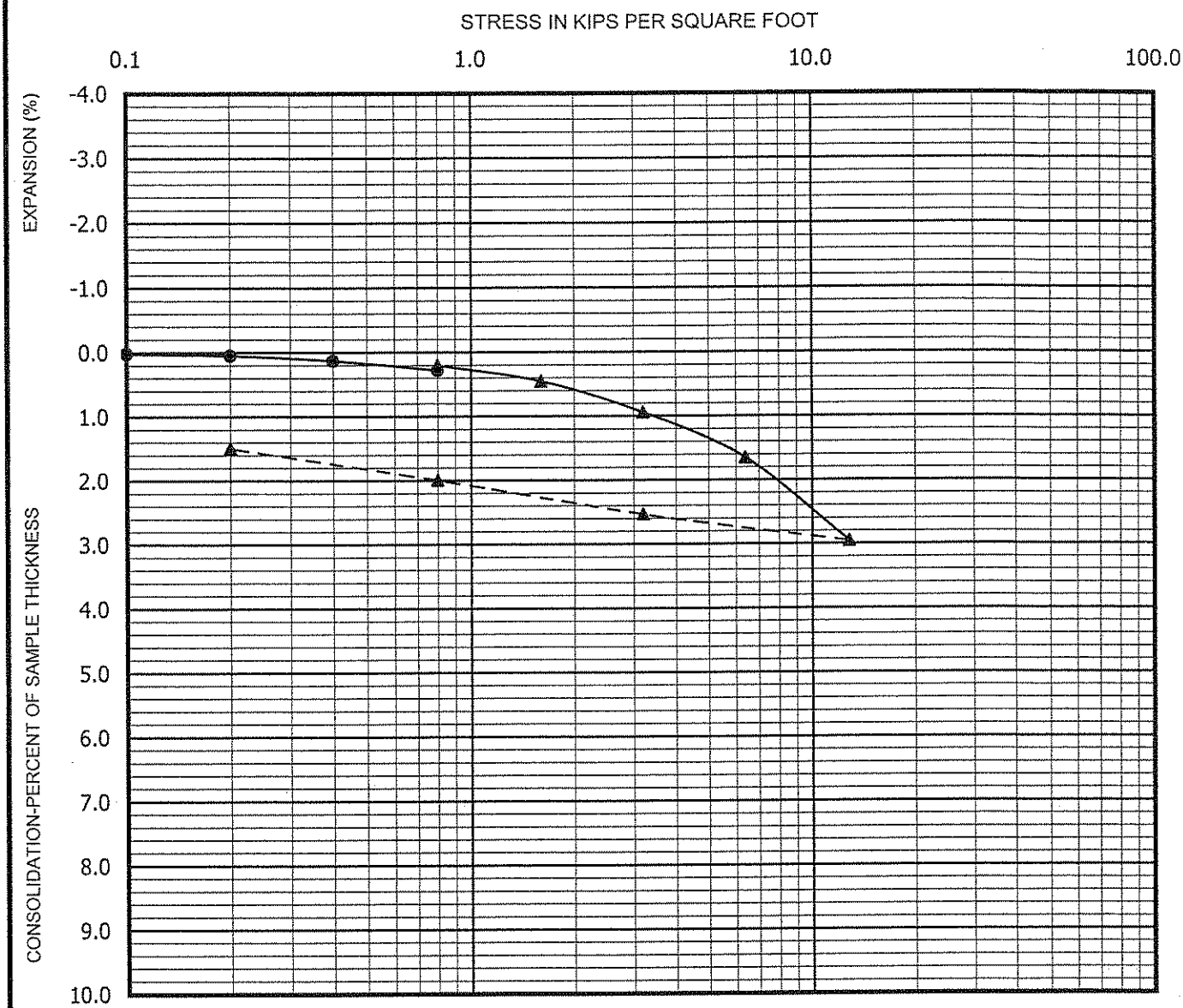
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-39

CONSOLIDATION RH-3 2.5-4.xls



Seating Cycle		Boring No.	RH-4
Loading Prior to Inundation		Depth (ft.)	5-6.5
Loading After Inundation		Soil Type	CL
Rebound Cycle		PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2435-96	

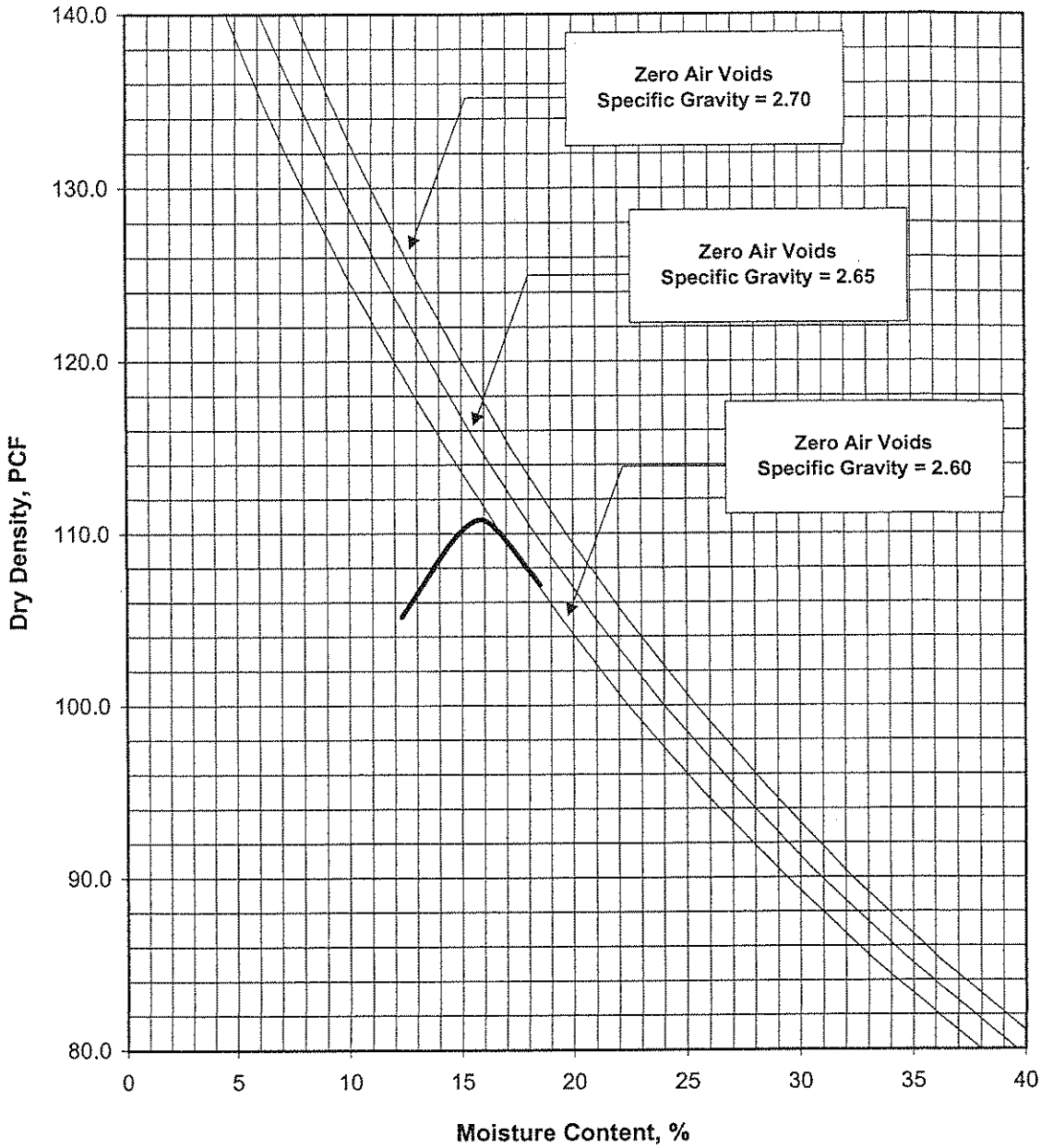
Ninyo & Moore

CONSOLIDATION TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE HEIGHTS DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-40

CONSOLIDATION RH-4 5-6.5.xls



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 1557-91

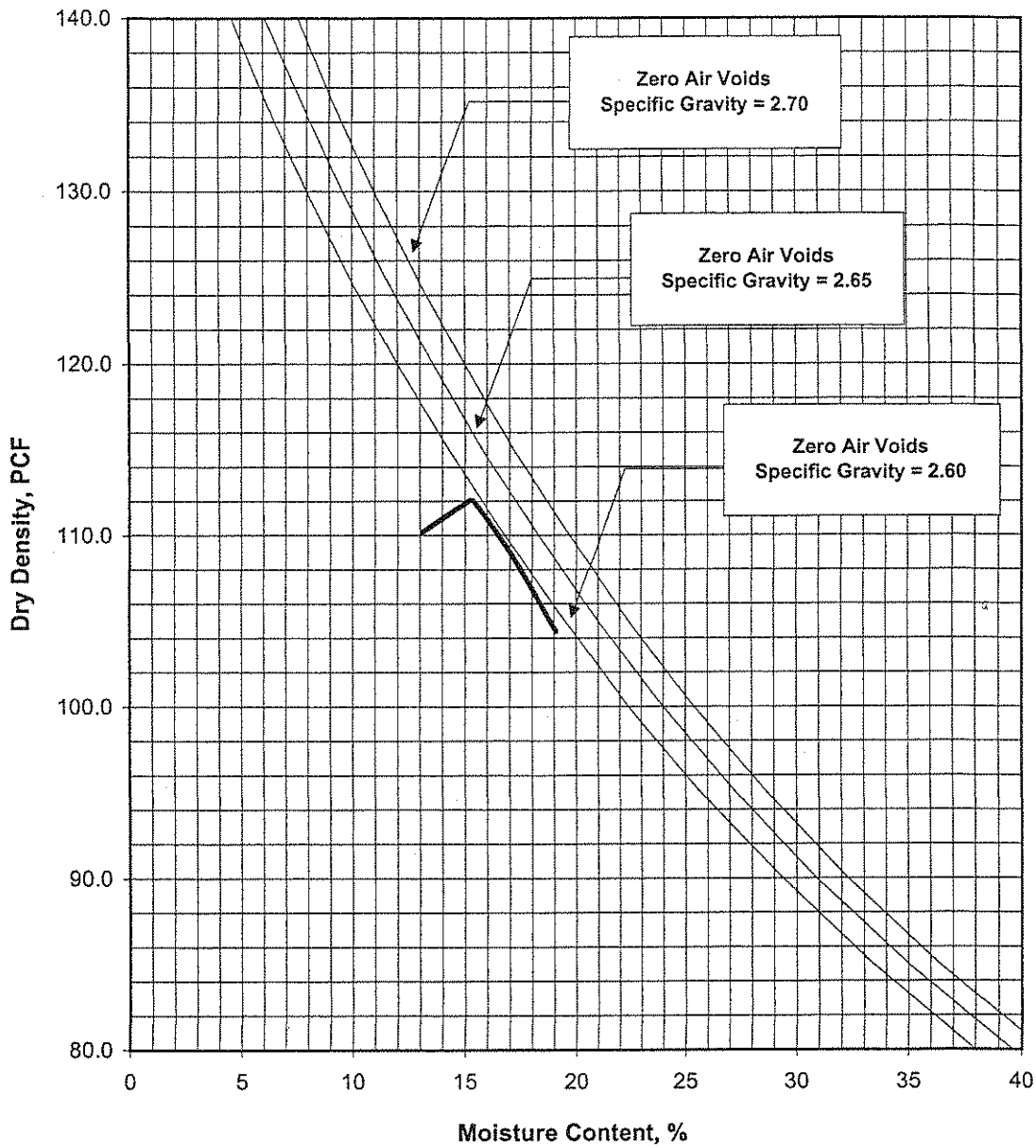
Ninyo & Moore

MAXDENSITY RH-6@0.xls

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-41



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 1557-91

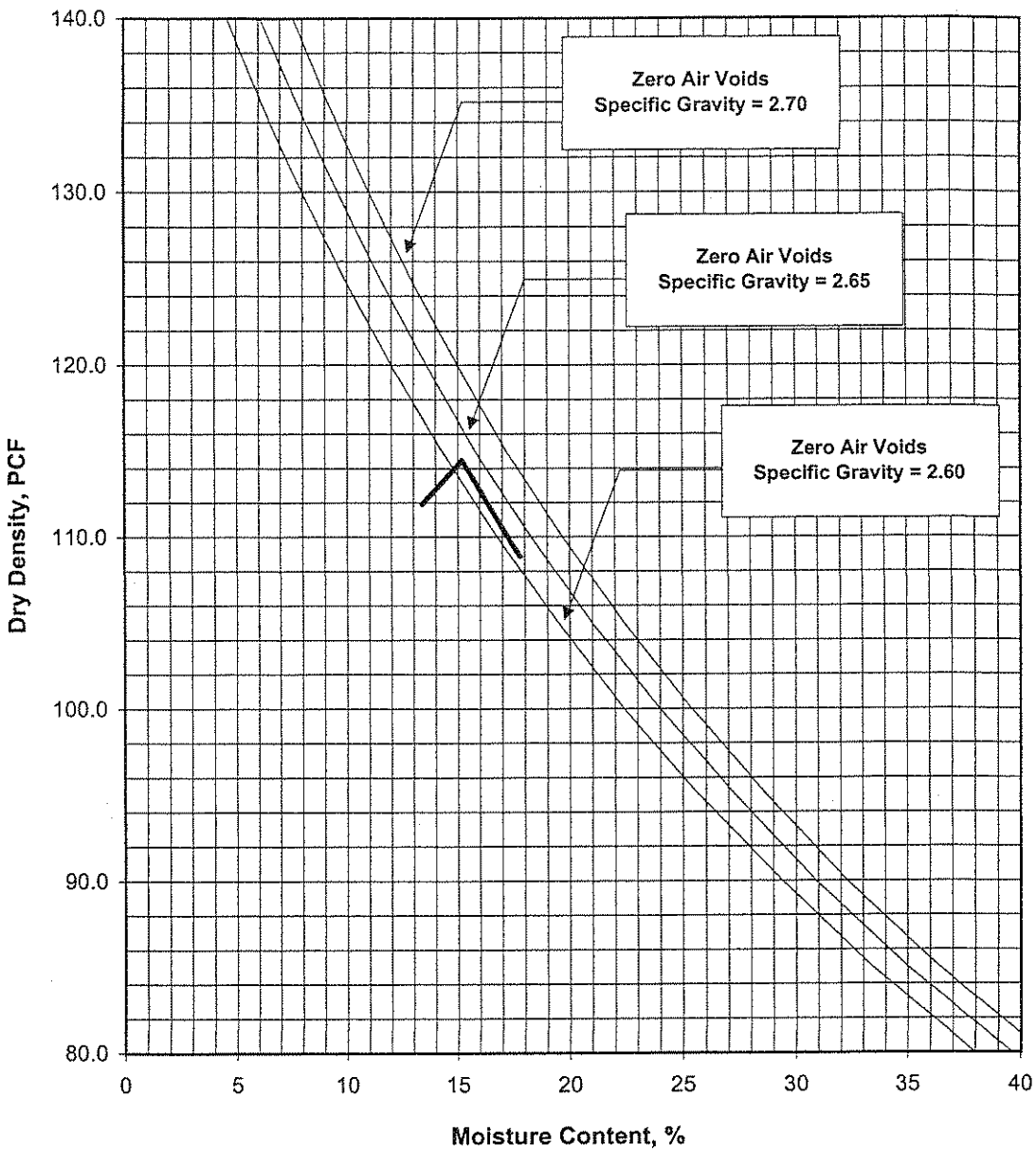
Ninyo & Moore

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-42

MAXDENSITY RH-12@12.xls



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 1557-91

Ninyo & Moore

MAXIMUM DENSITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-43

MAXDENSITY RH-14@0.xls

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
600198001	12/01	B-44

EXPANSION #240.xls

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 722

Ninyo & Moore

CORROSIVITY TEST RESULTS

EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-45

CORROSIVITY #240.xls

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

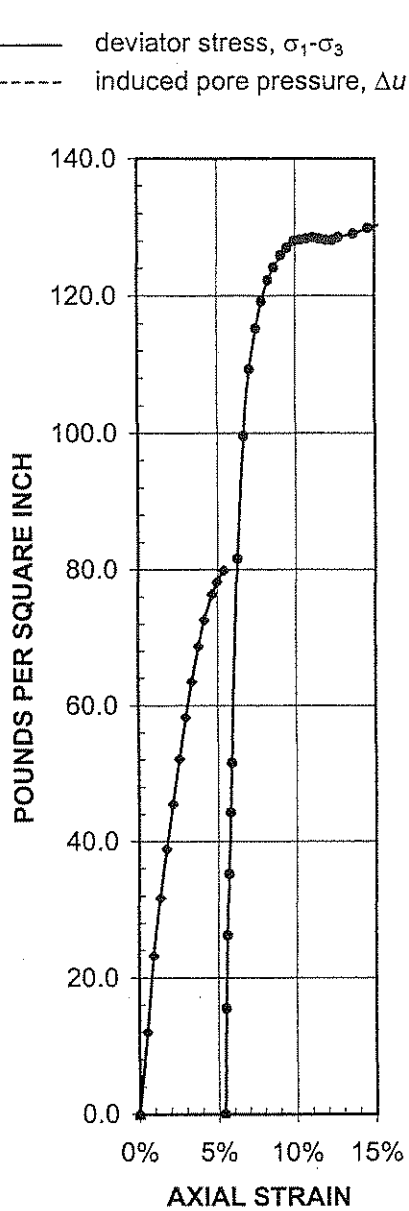
Ninyo & Moore

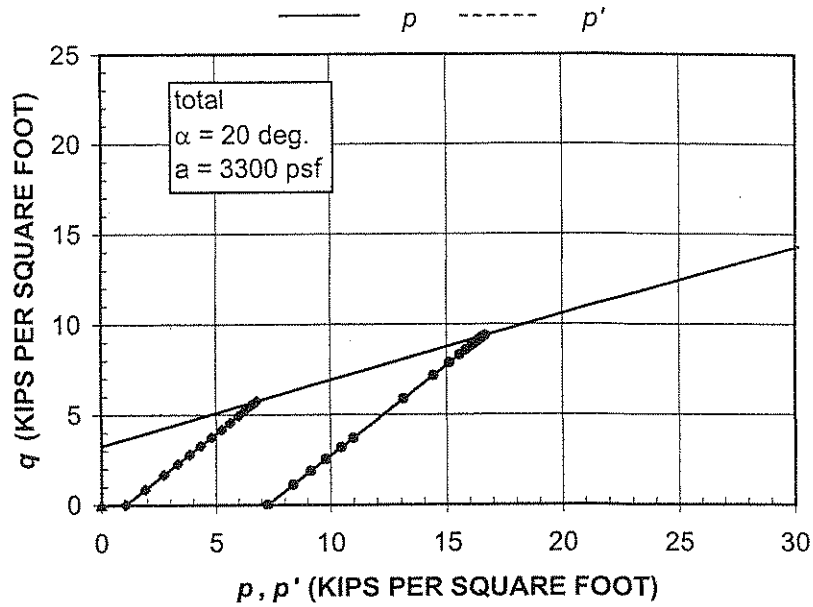
PERMEABILITY TEST RESULTS

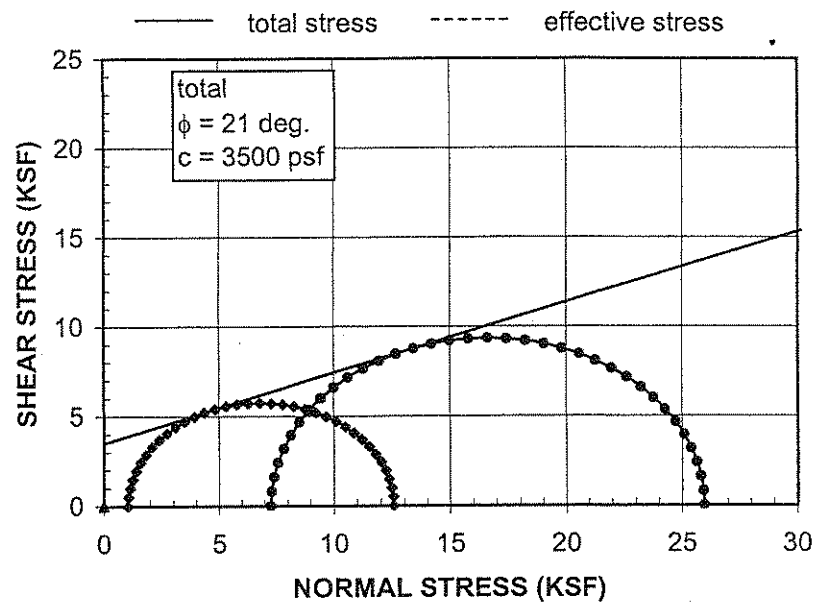
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-46

PERMEAB1.xls







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

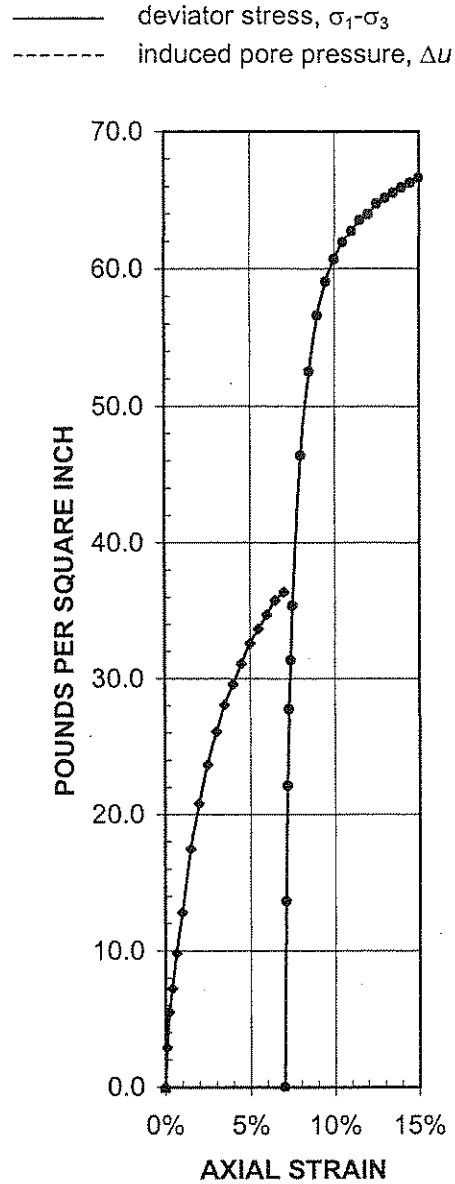
Ninyo & Moore

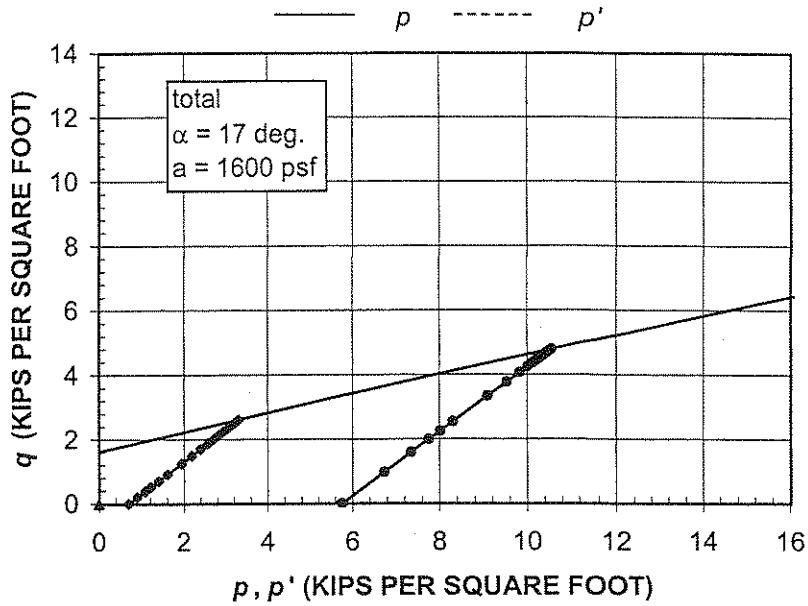
UU TRIAXIAL COMPRESSION RESULTS

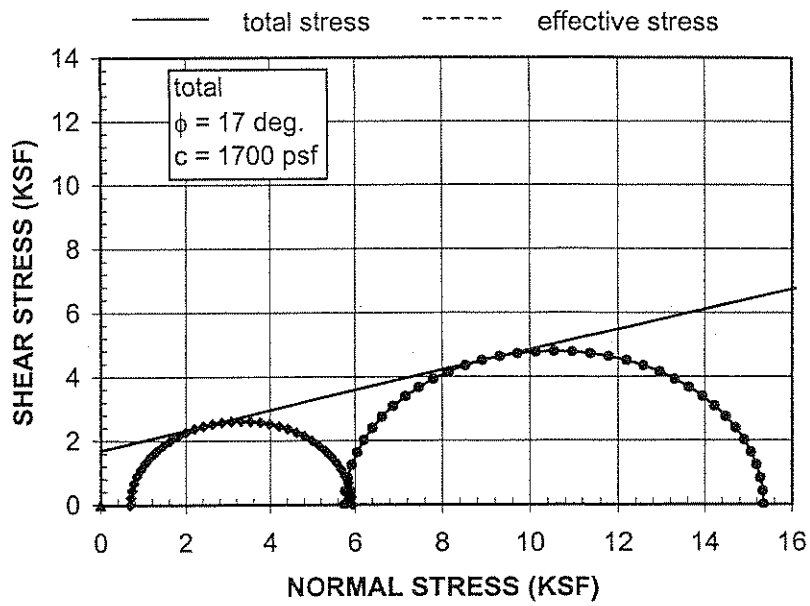
EAST MARICOPA FLOODWAY
RITTENHOUSE DETENTION BASIN
MARICOPA COUNTY, ARIZONA

PROJECT NO.	DATE	FIGURE
600198001	12/01	B-47

UUTRIAXITT1.xls







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
600198001	12/01	B-48

UUTRIAXRH12.xls

APPENDIX C

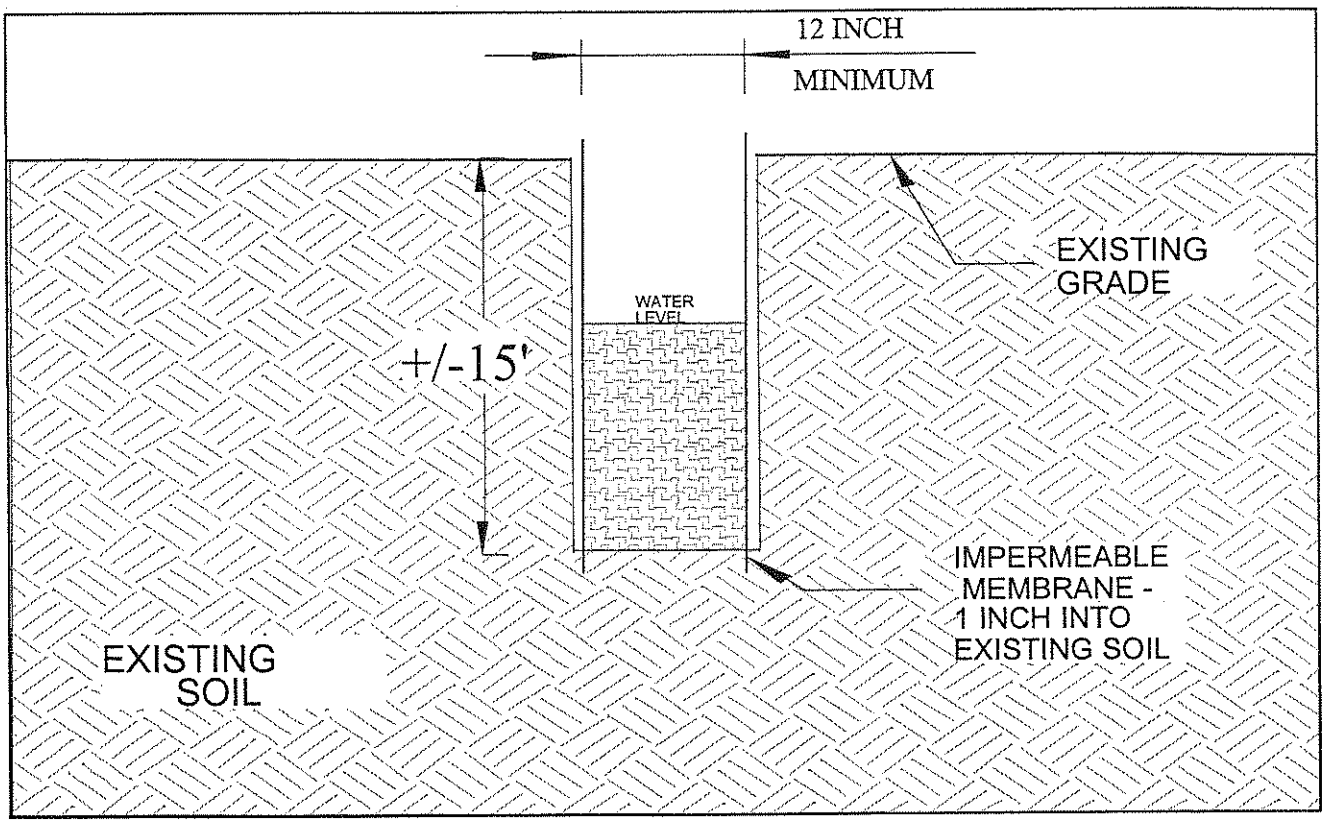
PERCOLATION TEST RESULTS

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198001

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.

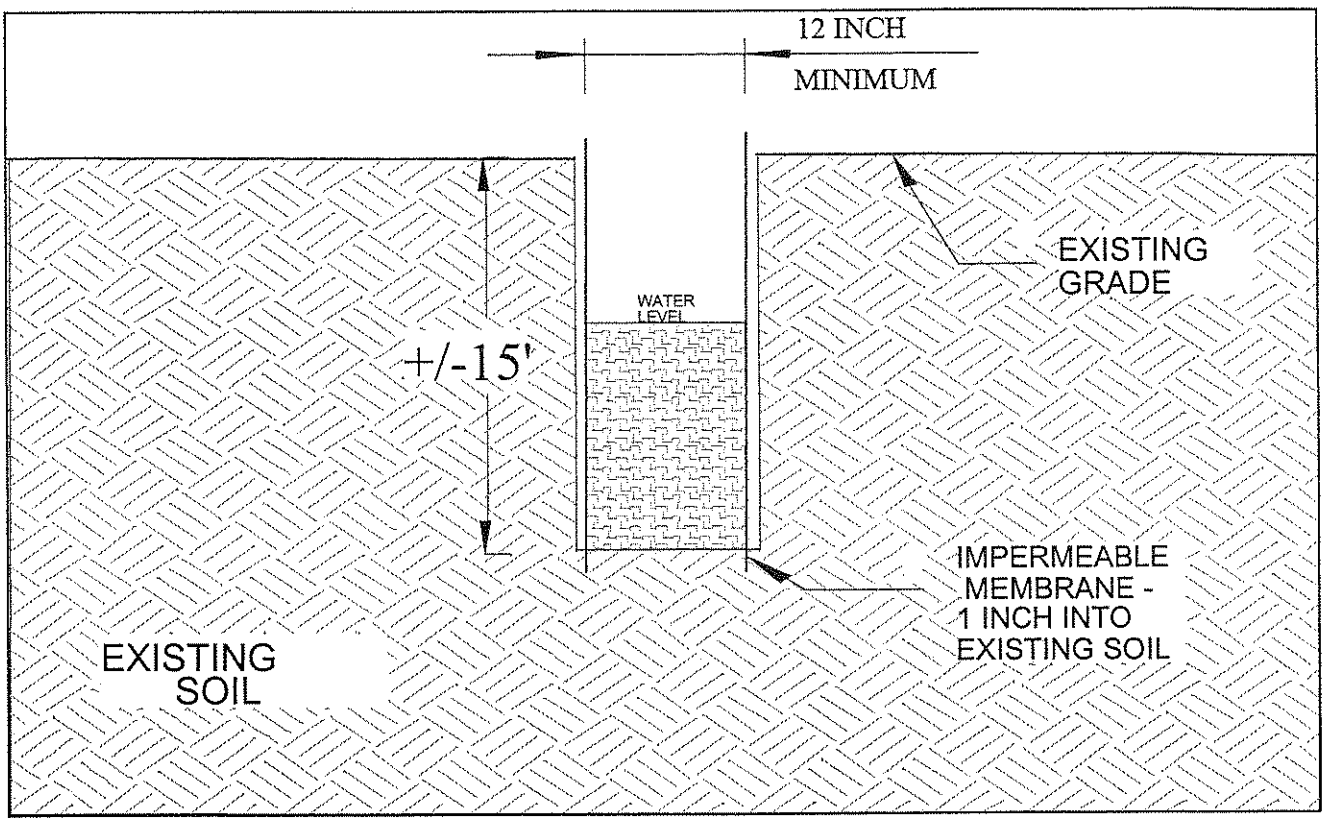
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS **0.08** $FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198001

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.

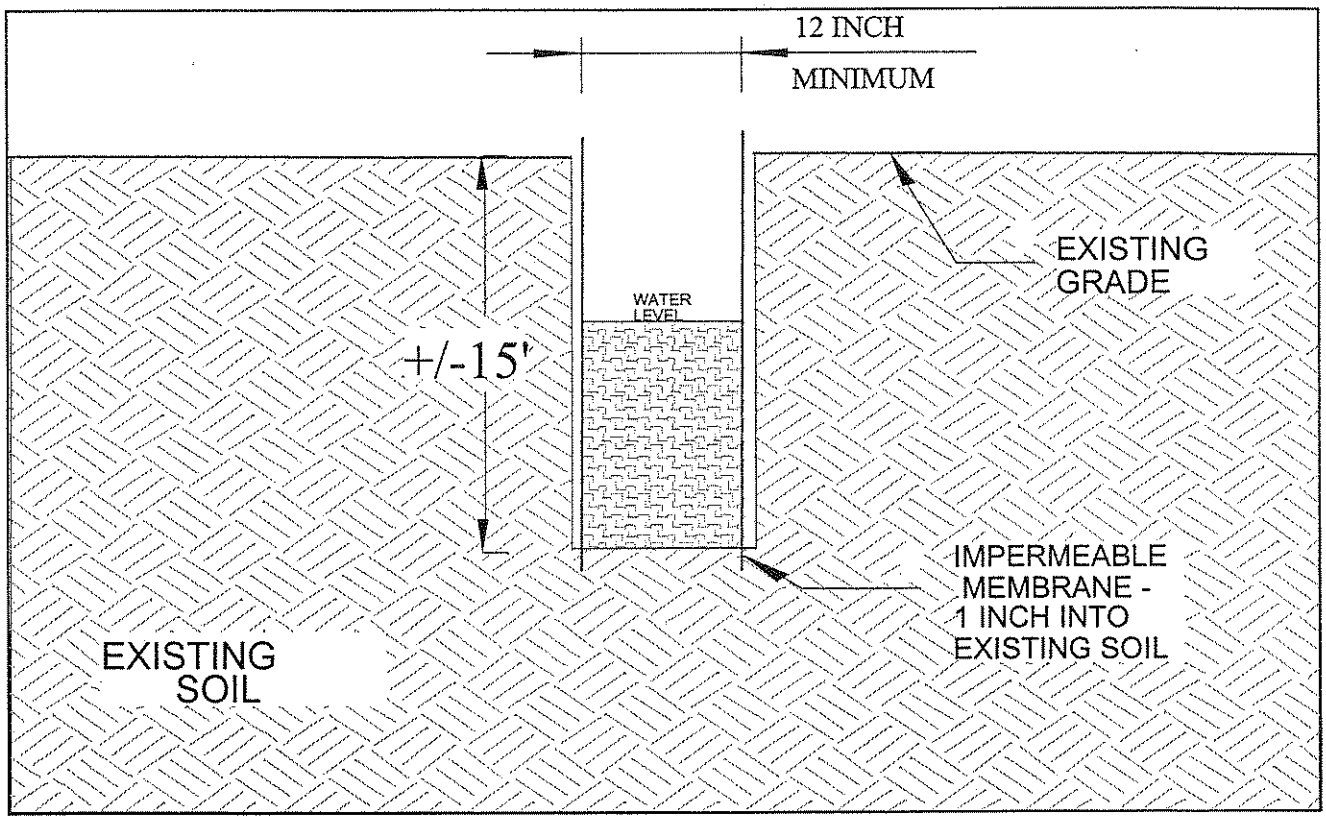
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS **2.09** $FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198001

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.

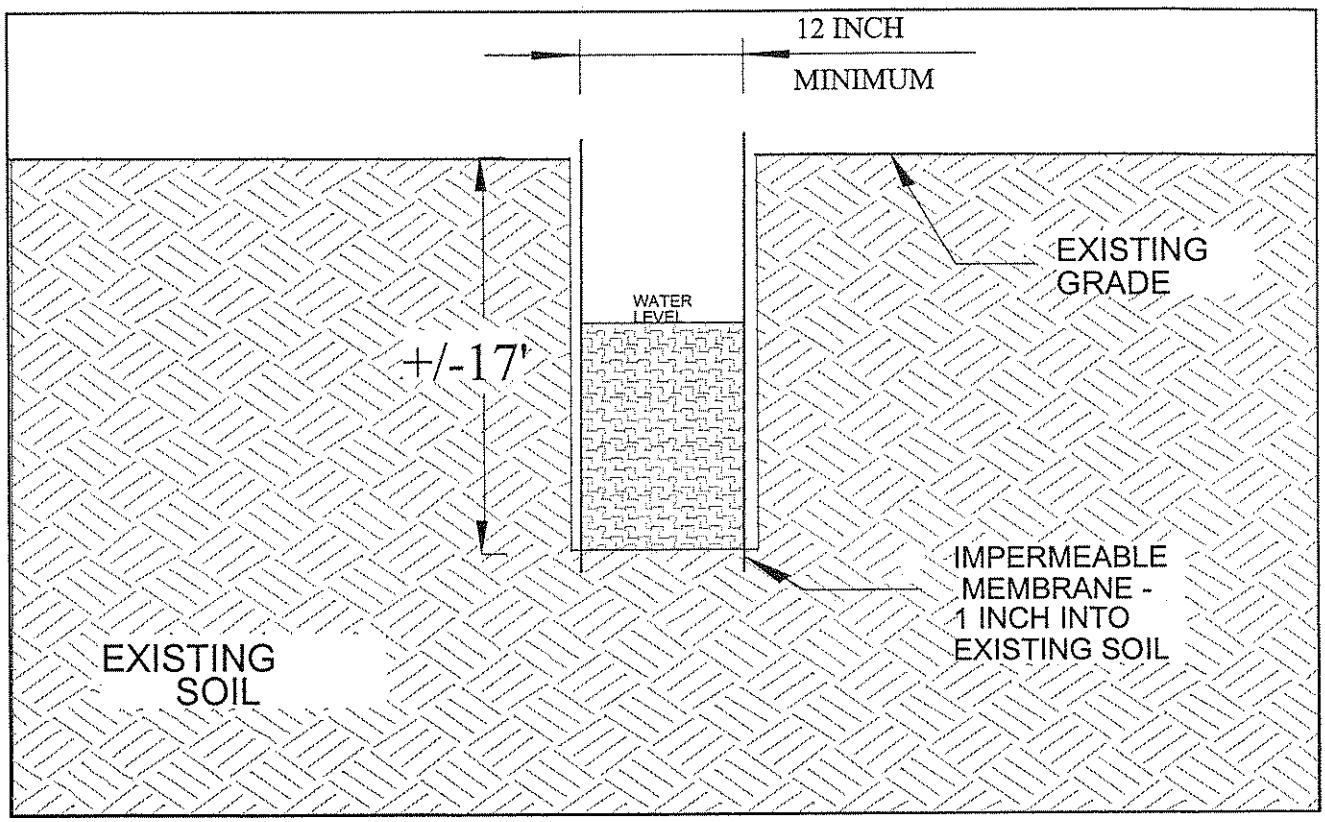
AVERAGE PERCOLATION RATE FOR LAST THREE READINGS **0.88** $FT^3/HOUR/FT^2$

Ninyo & Moore

SUMMARY OF PERCOLATION TEST RESULTS

PROJECT: Rittenhouse Detention Basin PROJECT NO.: 600198001

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
Santa Paula, CA 93061-0272
TEL: 805/659-0910
FAX: 805/525-4172

Office & Laboratory
2500 Stagecoach Road
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
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
pH	8.2	---	5.8 - 8.2

Graphical Results Presentation

Good Problem

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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