Geotechnical Investigation Report

February 2004

Bethany Home/Grand Canal Flood Control Project

Bethany Home Outfall Channel – 83rd Avenue to 67th Avenue

Contract No. FCD 2003C010, PCN No. 620 03 32

DMJM+HARRIS Project No. 6063

Prepared for:
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
Project No. 98-46

Prepared by:
DMJM+HARRIS
2777 East Camelback Road, Suite 200
Phoenix, Arizona 85016
Project No. 6888

Prepared in Cooperation with:
The City of Glendale
5850 West Glendale Avenue
Glendale, Arizona 85301

Prepared in Cooperation with:
The City of Phoenix
200 West Washington
Phoenix, Arizona 85003

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

This report is submitted subsequent to a geotechnical investigation performed by DMJM+HARRIS of the proposed 83rd Avenue to 67th Avenue segment (Reaches B and C) of the Bethany Home Outfall Channel (BHOC). The project is a partnership between the Flood Control District of Maricopa County (FCDMC) and the Cities of Glendale and Phoenix, and includes box culverts, open channels, a linear detention basin, trails, landscaping, and park amenities. The project will be designed to convey 100-year flood flows. The ultimate BHOC channel system is approximately 6 miles in length and parallels the Salt River Project (SRP) Grand Canal from the Sunset Detention Basin at 64th Avenue to the New River. A Project Site Vicinity Map is presented as Figure 1.

Within the 83rd Avenue to 67th Avenue segment; the channel system will consist of the following major construction elements:

- Vertical concrete channels varying in depth from 10 feet to 20 feet,
- 102-inch and 120-inch diameter storm drains,
- Multi-cell reinforced concrete box culverts,
- Grass lined channel/linear detention basin,
- Parking lot,
- Park plaza,
- Multi-use culvert crossings, and
- grading.

The project will also include landscaping and recreational facilities in combination with a 10-foot wide multi-use trail. The trail will meander both within and outside of the channel limits.

2.0 EXISTING DATA

A preliminary geotechnical investigation was prepared for this project during the pre-design stage by ATL, Inc. (1999). ATL advanced three test borings within the original Phase II limits. Test Boring No. 1 was drilled near the intersection of 83rd Avenue and Bethany Home Road. The other borings were advanced at 75th Avenue and Camelback Road and 67th Avenue and Indian School Road.

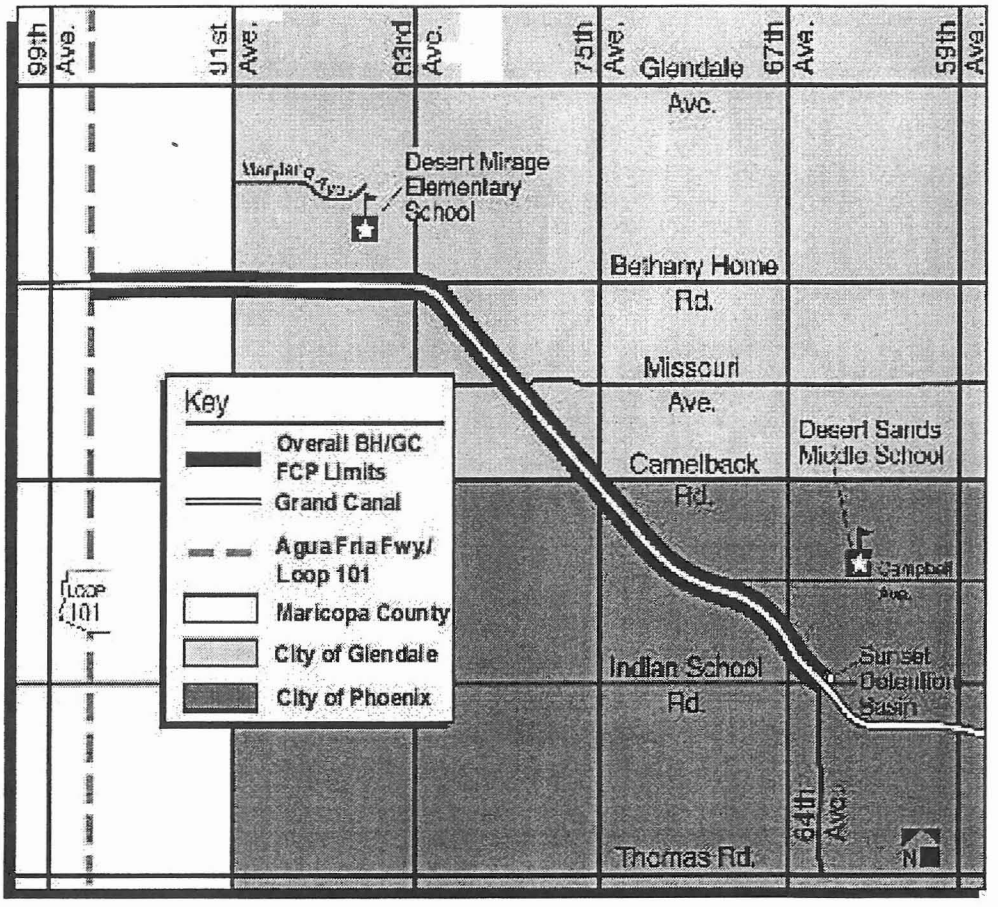


FIGURE 1

PROJECT SITE VICINITY MAP

The recommendations presented in this previous report were reviewed and incorporated within this report where deemed applicable to this design segment of the project and final design. The logs of Test Boring Nos. 1 through 3, and the laboratory test data provided in the ATL report, are included with this report in Appendices C and D, respectfully.

3.0 FIELD & LABORATORY INVESTIGATION

The field investigation for this design segment was directed by ATL, Inc. (ATL), based on locations and depths of test borings assigned by DMJM+HARRIS. Fifteen test borings were advanced for this investigation to depths of 16.5 to 21.5 feet using a truck-mounted Brainard Kilman 81HD drill and a track mounted LT-10 low overhead clearance drill, both using 8-inch O.D., hollow stem auger. The drill rigs are owned and operated by Yellow Jacket Drilling Company. Standard penetration tests and open-end drive (ring) samples were collected at intervals of 5 feet or less within the borings. Bulk samples of the auger cuttings were also collected at selected depths for laboratory testing. The soils encountered were visually classified by ATL's field engineer and logs of the borings were prepared. The locations of the test borings are shown on the site plans (Sheets 1 through 8) presented in Appendix A.

Laboratory testing, as assigned by DMJM+HARRIS, was performed by ATL on selected samples obtained from the test borings. The tests performed include moisture content, dry density, sieve analysis, Atterberg limits (plasticity index), direct shear, moisture-density (standard Proctor), pH, resistivity, sulfates and chloride. The moisture content and dry density results are presented on the boring logs. The other test results are presented in Appendix B.

4.0 SITE DESCRIPTION

The entire length of the 83rd Avenue to 67th Avenue reach of the BHOC Channel will parallel the immediate north/northeast side of the Grand Canal maintenance road and traverse thru residential areas. The Grand Canal, which typically flows full, is mostly lined with concrete and bordered on both sides by gravel-paved or compacted earth-surfaced access roads constructed at grade to partially raised embankments. The canal and access roads abut numerous back yards of residential properties, as well as several open park areas and the major cross-roads of 75th Avenue, Camelback Road, and 67th Avenue. High voltage overhead power lines are located along the north side of the canal west of 67th Avenue and east of 75th Avenue.

The proposed BHOC channel alignment is relatively flat, dropping about 12 feet in elevation (0.09 percent slope) from the southeast to northwest. Vegetation within the limits of the new channel include mainly residential, park and road landscaping related mature trees, grass and shrubs.

5.0 GEOLOGIC DESCRIPTION & GROUNDWATER CONDITIONS

5.1 SITE GEOLOGY

The project site is located on deep alluvial basin-fill deposits of the Agua Fria-Salt River valley area, within the Basin and Range Geologic Province of south-central Arizona. The Basin and Range Province is characterized by isolated fault-bounded mountain ranges separated by broad non-faulted alluvial valleys. Bedrock is not exposed in the near project vicinity and the alluvium in the general area is known to extend to depths of more than 1,000 feet.

5.2 GEOTECHNICAL PROFILE

Typically, the subsurface soils from existing grade to the depths investigated, consist of finer grained silty to sandy clays and clayey to silty sand, all of low to medium plasticity. Exceptions to this were encountered within Boring Nos. B-4, B-6, B-8 and B-11. In Boring B-4 cohesionless, non-plastic sand was encountered from the surface to a depth of four feet. This material is likely man-made fill, possibly associated with the Grand Canal. In Borings B-6 and B-8, similar cohesionless, medium dense sand was encountered within an approximate five foot thick layer at a depth of 10 feet. Based on the design plans, it appears that the channel inverts will bear within these sandy soils in the vicinity of 75th Avenue. Non plastic sand and sandy gravel was also encountered in Boring B-11 below a depth of 15 feet. At this location the channel invert is planned just above the granular soil contact.

The finer grained soils which predominate in the subsurface depths investigated along this alignment are generally uncemented to weakly cemented with calcium carbonate (lime) and are generally moderately firm to firm with isolated soft zones. East of 75th Avenue the soils remained relatively soft to the full depth of investigation. To the west of 75th Avenue, the soils tend to become firmer with depth. Very firm to hard soils were generally encountered below depths of 10 to 15 feet in Borings B-8 through B-15, with a trend in increasing hardness to the west/northwest of 75th Avenue.

5.3 SOIL MOISTURE & GROUNDWATER CONDITIONS

Groundwater was not encountered in any of the test borings. The depth to groundwater in the general site area, based on Hammet and Herther (1992), varies from about 120 to 180 feet. The moisture content of 33 samples tested in the laboratory varied from 3 to 42 percent. The moisture conditions described in the field typically varied from slightly moist to very moist, with isolated layers described as wet. It appeared in general that the soils east of 75th Avenue tend to have higher moisture contents than those sampled to the west. Given the similarity in soil types it appears likely that long-term seepage from the Grand Canal may be wetting and softening the soils east of 75th Avenue to a greater degree. However, the near-surface clayey, relatively low permeability soils present likely provide a natural barrier to significant amounts of subsurface seepage from the canal.

6.0 ANALYSIS & RECOMMENDATIONS

6.1 GENERAL

The 83rd Avenue to 67th Avenue design segment will be constructed with a combination of buried box culvert, open concrete channel with vertical side slopes, and grass-lined channel or detention basin, constructed with side slopes at or flatter than 4H:1V (horizontal to vertical). In general, the site soils would be considered suitable for the intended site improvements. Discussions regarding each of the separate channel and basin segments are presented below. The station limits are based on the DMJM+HARRIS Phase II Plans (2002). It is anticipated that some modification of the station limits and structure types as indicated below will occur during the design phase. The discussions below are intended to relate the existing soil conditions determined from the borings to the probable structures and earthen facilities to be utilized to some extent within a given area. Specific recommendations for site grading, allowable foundation bearing and lateral earth pressures for walls, excavations, recommended slopes and other miscellaneous elements are presented within the following subsections of this report.

Concrete Channel (Approximate Stations 120+00 to 123+00)

At the west end of the project, a concrete channel with a bottom width of 32 feet and vertical sides is planned. This section of channel will be constructed with an invert about 19 feet below existing site grade to match with the Phase II triple-barrel box culverts. Also within this section of channel will be a connection with the 102-inch diameter Bethany Home Road Storm Drain. At some point within this channel section, the channel bottom will rise about seven feet over a short distance (about 14 feet) to match grade with box culverts located at Station 122+98.

Based on test borings completed for the Phase II work, and for the Pedestrian Bridge located over the Grand Canal east of 83rd Avenue, it appears that the soils within this section of the channel should be sufficiently firm in their existing condition for support of the anticipated loads. Treatment of the exposed foundation materials other than scarification, moisture conditioning and recompaction of the exposed cut surface is not considered necessary. However, some variation in the condition of the soils which are adjacent to the Grand Canal from those encountered in the test borings is likely. Should soft, wet clay soils be encountered during construction, the soils should be overexcavated and replaced with higher quality materials, as recommended by the geotechnical engineer. Recommendations for site grading beneath concrete lined channels as well as for box culvert, transition, and pipe junction structures are presented in Section 6.5.

Excavations for installation of the walls should encounter generally medium plasticity, fine grained sandy clay to clayey sand soils, which may have elevated moisture contents at various depths. The bottom portion of the excavation may encounter cohesionless sands. The majority of materials can likely be cut to economical slopes; however, it may be preferable to shore these wall excavations depending on the proximity of existing structures. Recommendations for temporary slopes are presented in Section 6.6.

Buried Twin-Barrel Box Culverts (Approximate Stations 123+00 to 182+50)

This buried box culvert section will be founded at depths of about 10 to 16 feet below existing site grade. A double barrel 12-foot by 8-foot box is planned for this segment of the channel.

Based on the soils sampled at depths from 10 to 20 feet in Test Borings B-9 through B-15, it appears that the majority of soils should be sufficiently firm (with normal scarification, moisture conditioning, and compaction) for support of the relatively lightly loaded box culvert sections. The soils encountered at and below the planned bottom of box elevations consist mainly of firm to hard clayey sand and sandy clay with lesser layers of dense sand. Should soft, wet clay soils be encountered at the base of box excavations during construction, the soils should be overexcavated and replaced with higher quality soils.

Relative to excavations for installations of the boxes, it does not appear (based on the limited number of widely spaced borings) that seepage from the canal will significantly impact construction. However, soft, wet zones may be encountered and will need to be addressed on a localized basis during construction. The majority of soils encountered from the surface to the planned bottom of box elevation are moderately firm to firm clayey soils with minor silty sand and sand layers. Temporary construction slopes may need to be varied within this area to account for non-cohesive or excessively wet soils. Design recommendations for box culverts are presented in Section 6.3.

Concrete Channel and Buried Twin-Barrel Box Culverts (Approximate Stations 182+50 to 190+75)

An approximate 100-foot long variable-width rectangular cross-section transition will allow for interception of stormwater runoff and will provide the needed transition from the 12-foot by 8-foot boxes to twin 8-foot by 7-foot box sections just west of 75th Avenue. The twin barrel box will extend on a diagonal from the west side of 75th Avenue to just south of Camelback Road. An approximate 30-foot long junction structure for connection with a 102-inch diameter storm drain pipe will abut with the end of the box rectangular transition. From the junction structure, twin barrel 8-foot by 7-foot

box culverts will extend to about Station 190+75. The boxes, transitions and junction structure will be founded at depths of about 12 to 18 feet below existing grade.

The soils encountered in Test Borings B-8 and B-9 are considered to be adequate (with normal scarification, moisture conditioning and compaction) for support of the anticipated relatively light loadings imposed by the proposed culvert and channel elements within the above discussed design station limits. The soils encountered at depths of 15 to 20 feet consist of firm to hard clayey sand and dense sand. Should soft, wet clay soils be encountered at the base of box excavations during construction, the soils should be overexcavated and replaced with higher quality soils, as recommended by the geotechnical engineer.

Based on the widely spaced borings, it does not appear that excavations for installations of the boxes, transitions and junction structure should be impacted by excessive seepage from the canal. However, soft, wet zones may be encountered and will need to be addressed on a localized basis during construction. The soils encountered from the surface to the planned bottom of the box culverts, transitions and pipe junction structure consist of moderately firm to very firm clayey sand to sandy clay. An approximate five-foot thick layer of poorly graded sand was encountered in Boring B-8 from 10 to 15 feet. This non-cohesive layer of material will likely impact the stability of temporary excavations and require that slopes either be laid back in this area, or that the soils be shored.

Concrete Channel (Approximate Stations 190+75 to 200+00)

Rectangular concrete-lined open channel will be constructed within the referenced approximate station limits. The channel bottom will be constructed with invert depths which range from about 13 to 15 feet below existing grade. A 20-foot long section of box culvert is currently planned at the east end of the open lined channel (just west of 73rd Avenue) to provide a transition to the adjacent upstream, unlined channel.

Based on Test Borings B-6 and B-7 it appears that the soils encountered at and below the intended bottoms depths of channel are adequate (with normal scarification, moisture conditioning and compaction) for support of the anticipated relatively light loadings imposed by the proposed open channel and culvert elements within this area. The soils encountered at depths of 15 to 20 feet consist of firm to hard clayey sand. Should soft, wet clay soils be encountered at the required excavations during construction, the soils should be overexcavated and replaced with higher quality soils, as recommended by the geotechnical engineer.

It does appear that seepage from the canal has likely affected the firmness and moisture content of soils which may be encountered during channel excavations within this area. Elevated moisture contents and correspondingly low SPT N-value blow

counts were recorded within Boring B-7 at a depth of 10 feet, with some relatively soft soils being encountered at various other depths (above 15 feet) within both borings. The overall stability of excavations performed in this area should be considered with the possible need for shoring given the proximity of the channel to the Grand Canal.

There does appear to be some trend towards increasing moisture content and softer soils in the southeasterly direction beginning with Boring B-7. Within this area it still does not appear that seepage will significantly impact construction in terms of excavations. However, soft, wet zones are likely, and will need to be addressed on a localized basis during construction. The resident engineer assigned to the project should coordinate closely with a representative of the geotechnical engineer to deal with such issues.

Unlined Channel and Detention Basin (Approximate Station 200+00 to End of Project)

The remainder (upstream end) of the project will mainly consist of grass-lined, open channel and detention planned from about Station 214+00 to 232+00. Given the trend in increasing moisture and lower strength soils observed in Borings B-1 through B-5, this appears to be the area best suited for natural slopes and limited use of structures. Even with elevated moisture levels the soils can likely be cut at relatively flat (4H:1V or flatter) slopes provided that seepage is not excessive. Further recommendations concerning excavations and permanent slopes are presented in Section 6.7.

6.2 OPEN CHANNEL WALLS AND SHALLOW FOUNDATIONS

6.2.1 Vertical Capacity

The following provides recommended allowable uniform design bearing pressures for wall footings based on location, provided that site grading is performed in accordance with Section 6.5 of this report.

Design Station Limits (Approximate)	Recommended Maximum Allowable Uniform Design Bearing Pressure (ksf)
120+00 to 123+00	3.5
182+50 to 190+75	2.5
190+75 to 200+00	2.0

Should higher allowable pressures be desired in specific areas of the project, the areas affected should be looked at on an individual basis. The allowable uniform bearing pressure is based on Section 4.4.7 of AASHTO (2002), and the lower bound averages of SPT values obtained within the test borings.

6.2.2 Lateral Earth Pressures Acting on Walls

The earth pressures against vertical channel walls will depend upon the degree of restraint. Rigid, absolutely restrained walls will be subjected to earth pressures represented by a hydrostatic load diagram of about 55 psf per foot of depth. Rotation or lateral translation of the walls equal to about 0.001 times the height will reduce earth pressures to the active state represented by a hydrostatic load diagram of about 35 psf per foot of depth. It is anticipated that all open channel walls on this project will likely experience sufficient movement to be designed based on active pressures. The recommended equivalent fluid pressures are based on the walls having horizontal backfill. If sloping backfills are used, modified pressures can be provided upon request. These recommended values should be modified to account for anticipated live-load or construction surcharges.

Free-draining granular backfill should be utilized behind concrete-lined channel walls. This material should meet the requirements for granular base, presented in Section 6.5.6. This material should be compacted to at least 95 percent of maximum dry density in accordance with ASTM D698. As an alternate, wall backfill may consist of soils which meet the requirements for general fill (Section 6.5.4), if utilized in combination with geocomposite wall drains, such as TI Mirafi G100N, or an approved equal. Both granular backfill and geocomposite drains should be used in combination with adequate weep holes.

6.2.3 Passive Lateral Soil Resistance

The use of passive lateral soil resistance in design should be in conjunction with the specific structure foundation. It is recommended that at an absolute minimum, the passive lateral resistance be neglected for soils within 2.0 feet of finished channel invert. Below a depth of 2.0 feet, the passive lateral soil resistance against the edges of mat-type footings, wall stems and other vertical foundation elements, in contact with properly compacted backfill or native soil, may be considered as being equal to the force exerted by a fluid pressure of 300 pounds per square foot (psf) per foot of depth. A coefficient of friction of 0.40 is recommended for computing the lateral resistance between the base of the structure element and the underlying soils when analyzing lateral loads.

6.2.4 Concrete Slabs, Cast-on-Grade

A coefficient of subgrade reaction of 150 pounds per cubic inch (pci) should be utilized for the design of concrete slabs supported on compacted native subgrade soils, as discussed in Section 6.5. This value may be increased to 250 pci for slabs cast on a minimum of 6 inches of granular base backfill.

6.3 DESIGN OF BOX CULVERTS

The earth pressures imposed on buried, rigid, reinforced concrete box culverts are dependent upon support conditions, the placement and density of backfill, and the surcharge due to roadways or embankments above the box culverts. For the design of box culverts, earth pressures may be developed for an embankment condition provided the following criteria are adhered to:

- The backfill material surrounding the structure is as dense as the in-place natural soils at the site.
- The depth to an incompressible stratum is at least twice the width of the culvert.

The total vertical and lateral earth loads imposed on individual barrels within the box structure (based on Section 6.2 of AASHTO, 2002) should be calculated based on the following:

Vertical Earth Pressure = 120 lb/ft^3

Lateral Earth Pressure =

Case 1 – 30 lb/ft^3

Case 2 – 60 lb/ft^3

It is not anticipated that groundwater should impact the design of the box culverts. Consideration for hydrostatic uplift should, however, be given to box structures located immediately adjacent to the Grand Canal. The use of weepholes in combination with the granular wall backfill may lessen the potential for uplift of the structure.

6.4 SEISMIC CONSIDERATIONS

The project site is located within the Sonoran Zone described in the Arizona Department of Transportation (ADOT) report AZ92-344 (Euge, et al, 1992). The Sonoran Zone is not considered to be seismically active and is not located in the vicinity of a seismically active area. The maximum credible earthquake for the project area is conservatively estimated at a magnitude of 5.5. The ADOT report indicates a peak ground acceleration of about 0.026g with a 90 percent probability of non-exceedance in 50 years.

With respect to seismic design, the above range of acceleration coefficients would equate to a Seismic Performance Category (SPC) A, based on Table 3.4, Division 1A of AASHTO (2002). In accordance with Table 3.5.1, Division 1A of AASHTO (2002), the site soils should be considered as Type II.

6.5 SITE GRADING

In general, site grading for the project should be performed in accordance with the current Uniform Standard Specifications for Public Works by the Maricopa Association of Governments, incorporating the following:

6.5.1 General Channel and Site Grading

The entire project limits should be cleared of all existing vegetation, debris, rubble and other deleterious materials. Compaction of the exposed surfaces of all unlined channels is not considered to be necessary. Areas which are subjected to heavy compaction during earth moving operations should be scarified to a depth of 12 inches and recompacted at a lower density (90 percent of standard Proctor density) after operations are completed in order to accommodate future plant growth. Any embankment fills required, which will not support structures, should be compacted to 90 percent of standard (ASTM D698) density, within two percent of the optimum moisture content. Embankment fills which will support structures or pavement should be compacted to a minimum of 95 percent of standard (ASTM D698) density, within the range of minus 1 to plus 3 percent of the optimum moisture content. Compaction to this higher degree should extend a minimum of 5 feet beyond the perimeter of the structure or pavement section.

6.5.2 Near Surface Grading For Embankments

For support of new embankments of more than 4 feet in height, it is recommended that that the upper 12 inches of existing soils be overexcavated. The exposed surface should be scarified to a depth of 8 inches and be compacted to a minimum of 95 percent of standard (ASTM D698) density, with the range of minus 1 to plus 3 percent of the optimum moisture content. Embankment soils placed above the compacted surface should be placed in accordance with the recommendations presented in Section 6.5.1.

6.5.3 Grading Beneath Structures

For support of box and transition structures, or concrete-lined channel sections, embedded at least 5 feet below existing site grades, and to the minimum depths indicated in the previous sections, the exposed surface should be scarified. The scarification should extend to a depth of 8 inches and the soils should be recompacted to a minimum of 95 percent of standard Proctor density, within the range of minus 1 to plus 3 percent of the optimum moisture content. Prior to scarification, the exposed footprint should be observed by a representative of the geotechnical engineer for the presence of man-made fill or additional loose or soft zones. Should unsuitable materials be encountered, the materials should be overexcavated and replaced with either structural fill or low strength (one sack) sand-cement slurry.

If concrete lined channels which extend to the existing ground surface are to be constructed, it is recommended that the upper 0.5 feet of existing soils present within 8

feet (horizontally) of the lining be overexcavated and that the exposed surface be scarified to a depth of 8 inches. This material and all backfill required to achieve final site grade should be compacted to a minimum of 95 percent of standard Proctor density, and to within minus 1 to plus 3 percent of the optimum moisture content. This recommendation is based on the presence of potentially soft or loose near surface soils.

6.5.4 Grading Beneath Pedestrian Trail/ Maintenance Road Pavements

Soils beneath new pavement sections should be overexcavated, scarified and recompacted as necessary to provide a minimum of 12 inches of compacted subgrade. The soils should be compacted to a minimum of 95 percent of maximum standard Proctor Density determined in accordance with ASTM D968. The moisture content of the soils during compaction should be maintained within 2 percent of the optimum moisture content. Soils which meet the requirements for general fill in Section 6.5.4 will be acceptable as compacted fill beneath the pavement section.

6.5.5 General Fill and Topsoil

General fill which may be utilized to achieve final grades within unlined portions of the channel and to construct embankments in non-structural areas (if necessary) should consist of materials with no particles larger than 3 inches. Organic materials, if present, may be reused only in areas designated for unlined channel sections and may not be used beneath structures, lined channels, or pavements. The plasticity index of channel fill soils should not exceed 30. In general, the majority of the materials excavated from within the project limits should be suited for use as general fill. Some sorting or blending may be required to limit the plasticity of a small percentage of the soils.

Agronometric testing for potential topsoil was performed as part of this project. The results of that testing are presented in Appendix B. Soils considered for use as topsoil should be tested for conformance and modification requirements. It appears that the majority of near-surface clayey soils would be suitable for use as top soil without significant amendments.

6.5.6 Structural Backfill

Structural backfill placed beneath structures in areas requiring overexcavation (due to soft subgrade conditions) should meet the following requirements:

Item	Requirement
Percent Finer than 6-inch	100
Percent Finer than No. 200	45 (Maximum)
Plasticity Index	15 (Maximum)

Significant quantities of materials which meet the requirements for structural fill do not appear to be present within 20 feet of existing site grades, and importing of such materials will likely be necessary.

6.5.7 Granular Wall Backfill

Fill placed within 2 feet (measured horizontally) of all shotcrete or concrete lined channel sections (either sloped or vertical) should consist of free-draining granular base backfill meeting the following requirements:

Item	Requirement
Percent Finer than 3-inch	100
Percent Passing No. 4 Sieve	30 – 75
Percent Finer than No. 200	12 (Maximum)
Plasticity Index	5 (Maximum)

Granular wall backfill materials should be compacted to a minimum of 95 percent of the maximum standard Proctor density and to within two percent of the optimum moisture content.

Materials placed behind walls within 3.0 feet of finished ground, should consist of finer grained, low permeability soils that will tend to reduce surficial seepage into the granular backfill placed behind the walls. These materials should not be used, however, in any areas which will be overlain by pavements or other structures. The fine-grained soils should meet the following requirements:

Item	Requirement
Percent Finer than No. 4	100
Percent Finer than No. 200	50 (Minimum)
Plasticity Index	10 –25

The fine grained capping soils should be compacted to a minimum of 95 percent of the maximum standard Proctor density and within the range of minus 1 to plus 2 percent of the optimum moisture content.

Sloped and vertical channel walls should be constructed with adequate weep holes to evacuate excess water from behind the walls. Materials which meet the requirements for common fill may be utilized directly behind the walls provided that geocomposite wall drains, such as TC Mirafi G100N, or an approved equal, are used against the wall in combination with adequate weep holes.

It appears that only limited quantities of materials excavated from within the project limits would meet the requirements for granular wall backfill. Considerable material will, however, be available for the finer grained surface capping layer.

6.6 EXCAVATIONS AND SLOPE DESIGN

6.6.1 Excavation Conditions

Based on the test borings, conventional earthmoving equipment likely can be utilized to perform all required excavations on this project. It does not appear that significant hard or strongly cemented layers, which would necessitate ripping are present within the upper 20 to 25 feet of existing site grades.

6.6.2 Temporary and Permanent Excavation Slopes

In general, temporary excavation slopes should be performed in accordance with OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P. In accordance with Subpart P, Appendix A, the near surface clayey soils would be considered to be Type "B" soils. For excavations of less than 20 feet in depth, Subpart P, Appendix B indicates a maximum allowable unshored slope of 1H:1V.

Flatter excavation slopes may be required in some areas if loose man-made fills or uncemented, relatively clean, sandy to gravelly soils are encountered. Caving sandy soils are anticipated at, or near, the base of excavations for rectangular concrete-lined open channel in the vicinity of Test Borings B-8 and B-6 (approximate Stations 187+00 to 205+00). Temporary excavations, if performed in this area, may need to be laid back with slopes no steeper than 1.25H:1V. Steeper slopes likely will require the use of trench shields or shoring. Although groundwater was not encountered within the test borings, moist to wet conditions were observed from samples collected at various depths within the borings. Should seepage from the adjacent Grand Canal be encountered during construction, the slopes within those areas may need to be flattened, and/or temporary shoring may need to be utilized. The resident engineer assigned to the project should coordinate closely with a geotechnical engineer to deal with such issues.

Should steeper slopes be required due to proximity to existing structures or for purposes of economy, stability analyses should be performed by a registered geotechnical engineer. Steeper slopes will be likely be feasible at most locations, if confirmed through stability analysis by a geotechnical engineer.

The perimeter of all temporary excavations should be protected against surface water runoff with berms or other measures at the top of the slope. Moderate to severe raveling and erosion of the slopes could occur if impacted by runoff.

Permanent cut slopes should be constructed no steeper than 1.5H:1.0V provided that the slope is covered with a concrete or shotcrete lining. Unprotected slopes should be laid back to at least 4H:1V to minimize surface erosion. Vegetating the slopes with grass will inhibit erosion at low velocities. Likely, clayey soil vegetated slopes will be

stable provided flow velocities do not exceed about 5.5 to 6 feet per second (Flood Control District of Maricopa County, 1996).

6.7 EARTHWORK FACTORS

The average in-place dry unit weight of nine undisturbed ring samples of soils obtained within 15 feet of existing ground was 96.9 pcf. The average 95 percent standard proctor density value, determined from four moisture-density relationship tests was 110 pcf. The average earthwork factor based on the above results is 20 percent shrink when comparing the in-place densities to the 95 percent values. However, based on testing of generally similar soils within the Phase II project which indicated less shrink, and our experience from other projects, it is recommended that an earthwork factor of 12 percent shrink be used for cost estimating. This factor is based on the assumption that the excavated materials will be recompacted at 95% of standard Proctor density within the project limits, where handling and wind losses will be of limited extent. It is anticipated that lower shrink (10 percent or less) will occur for materials excavated at depths below 10 to 15 feet of existing ground, resulting in the overall estimate. An overall ground compaction factor of 0.05 feet is recommended for all areas of cut which require scarification and recompaction.

6.8 PIPE BEDDING AND BACKFILL

Pipe bedding and backfill should be done in conformance with Section 601 of the MAG Uniform Standard Specifications (1998). Jetting, as a method of compaction, is not recommended given the high percentage of clay soils. If performed, the contractor should be experienced with jetting and be prepared to drain the trench of all accumulated water.

6.9 CORROSIVITY OF SITE SOILS

Preliminary laboratory testing for pH, sulfates and chlorides was performed for this project, and the results are presented in Appendix B. The tests were performed to determine the potential for soil induced corrosion on concrete and concrete pipes. The pH of the 12 samples tested vary from 7.6 to 8.2. The results indicate favorable conditions relative to the use of Type II cement for pipes and structures. The sulfate and chlorides of four samples tested vary from 120 to 650 parts per million (ppm) and 92 to 750 ppm, respectively.

6.10 PEDESTRIAN TRAIL/ MAINTENANCE ROAD PAVEMENTS

It is understood that pedestrian/maintenance trail pavements will generally match those currently being constructed within Phase II. Un-reinforced Portland cement concrete pavement (PCCP) over aggregate base (AB), alternative full depth un-reinforced PCCP, and reinforced PCCP for underwater conditions for the trail/maintenance road, presented below, are based on the subgrade materials encountered within the test

borings and anticipated light traffic loading conditions. All pavement sections should be underlain by a minimum of 12 inches of compacted subgrade, as discussed in Section 6.5.3.

Item	Thickness of Aggregate Base (Inches)[1]	Thickness of PCCP or AC (Inches)
Un-reinforced PCCP Over AB Section	4.0	6.0
Un-reinforced PCCP	-	7.0
Reinforced PCCP	-	6.0

[1]Aggregate base course should conform to Section 702 of MAG.

7.0 ADDITIONAL SERVICES

The geotechnical investigation for this project was performed based upon the negotiated scope of work for the project. The number of test borings and general locations of the borings were as directed by the Flood Control District of Maricopa County. In general, the borings completed to date appear to provide sufficient information for final design.

Other project elements which may require additional services could include stability analysis of excavations, shoring for excavations, or handling seepage issues on an as-needed basis. DMJM+HARRIS would be pleased to provide these additional services at the request of the FCDMC.

8.0 CLOSURE

The recommendations presented in this report are based on a limited number of small diameter test borings, laboratory test data, our understanding of this project and our general experience in the project area. The subsurface conditions identified are based on the conditions encountered only at the specific test locations at the time of exploration, and it is anticipated that the subsurface conditions will vary somewhat between test locations.

This report was prepared for the exclusive use of the Flood Control District of Maricopa County, in accordance with the generally accepted standard of practice in Arizona and no warranty, expressed or implied is made. This report will become part of the contract documents. We should be notified of any contractor proposed changes to the Project Design Plans (which might have a geotechnical related impact) for review and possible revision to the recommendations.

The scope of this project did not include an investigation for contaminated or hazardous materials. If the owner is concerned about the potential for such conditions, additional studies should be performed.

REFERENCES

American Association of State Highway and Transportation Officials (AASHTO), 2002, *Standard Specifications for Highway Bridges, Sixteenth Edition*, Washington, D.C. and recent interims.

ATL, Inc., 2000, *Revised Geotechnical Investigation Letter Report, Bethany Home Road Outfall Channel – Phase II*, FCD 98-46, Pre-Design Stage, ATL Job No. 199027, January 21, 2000.

Euge, K.M., and Others, 1992, *Development of Seismic Acceleration Contour Maps for Arizona*, Arizona Department of Transportation.

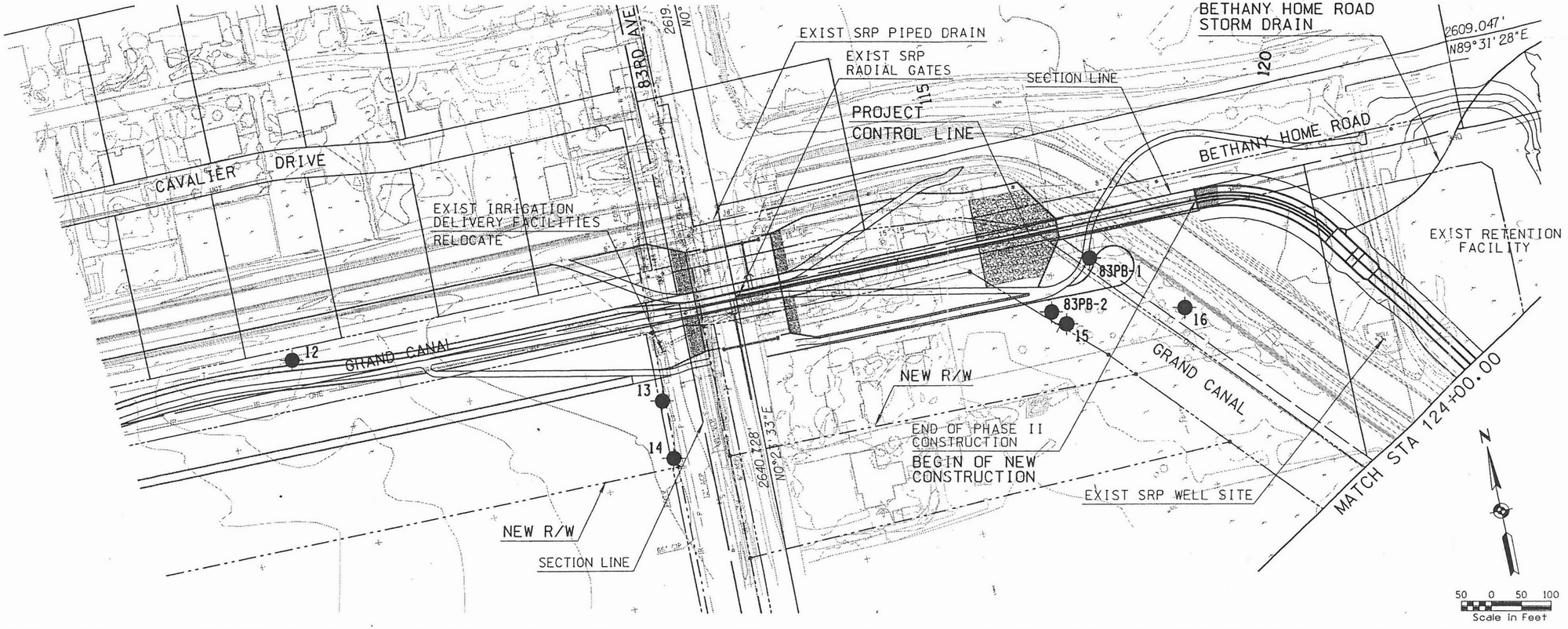
Flood Control District of Maricopa County, 1996, *Drainage Design Manual for Maricopa County, Volume II, Hydraulics, January.*

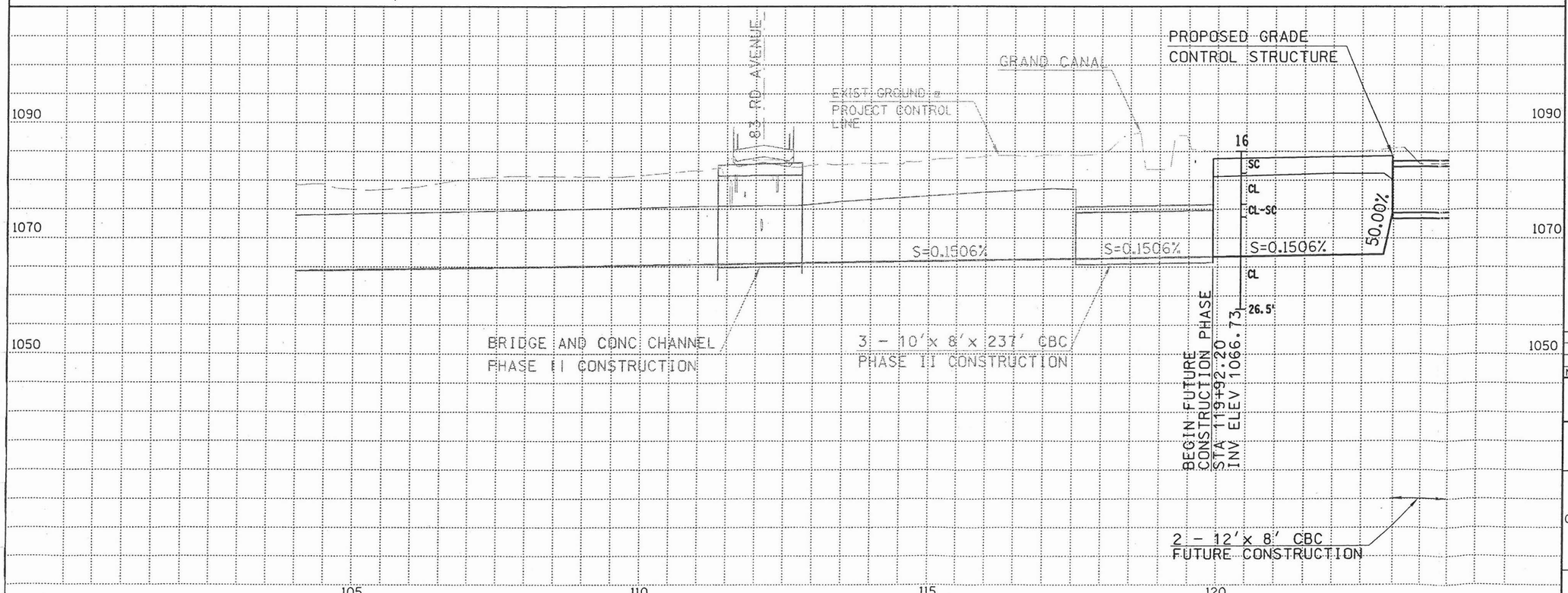
Hammet, B.A, and Herther, R.L., 1992, *Maps Showing Groundwater Conditions for the Phoenix Active Management Area, Maricopa, Pinal, and Yavapai Counties, Arizona*, Arizona Department of Water Resources, Hydrologic Map Series Report Number 27, July, Sheet 1 of 3.

Maricopa Association of Governments, 2002*, Uniform Standard Specifications for Public Works Construction,* Including Revisions through 1999, Arizona.

Occupational Safety and Health Administration, 1999, OSHA Regulations (Standards – 29 CFR) Sloping and Benching – 1926 Sulopart P, September.

APPENDIX A – SITE PLANS & ATL TEST BORING LOGS





☐ REMOVE ☐

○ CONSTRUCT ○

LEGEND

16 ● EXISTING DMJM+HARRIS TEST BORING LOCATION

16 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

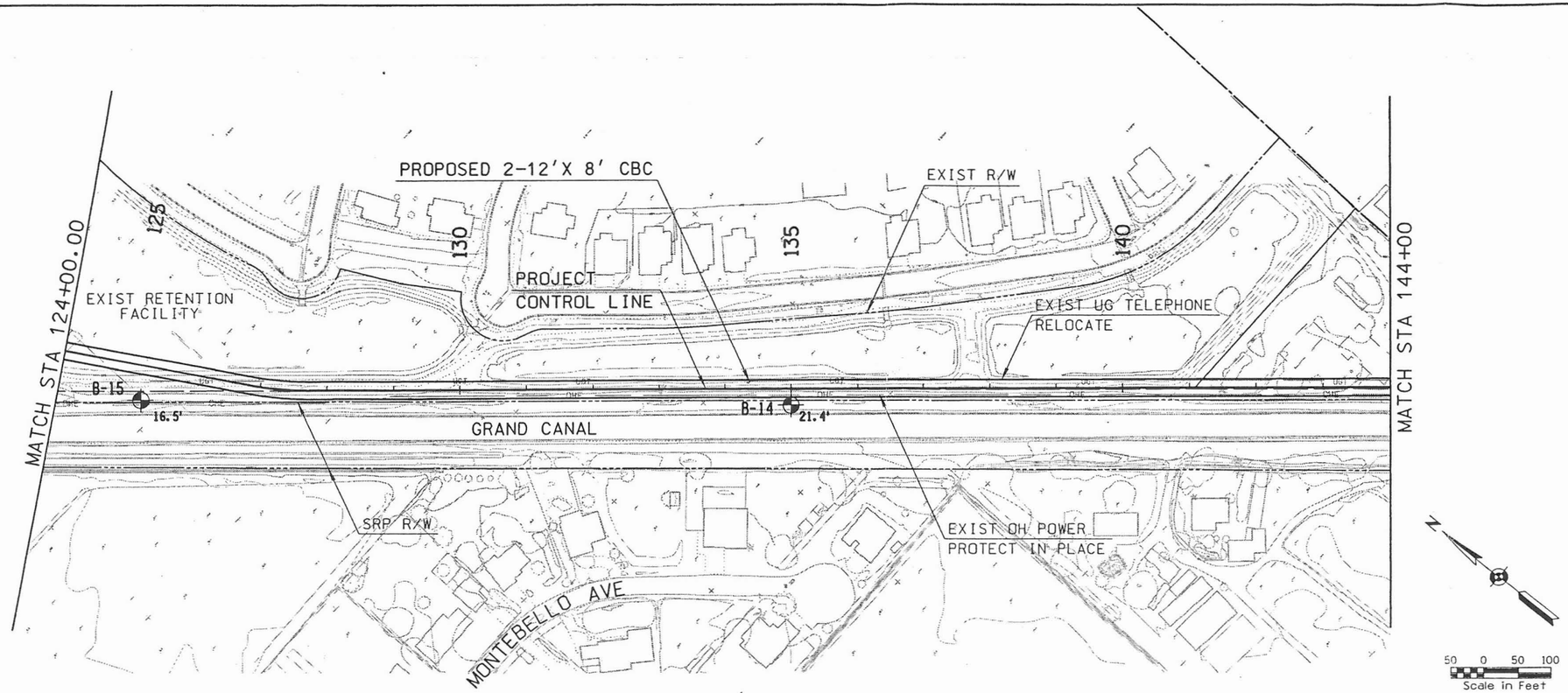
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

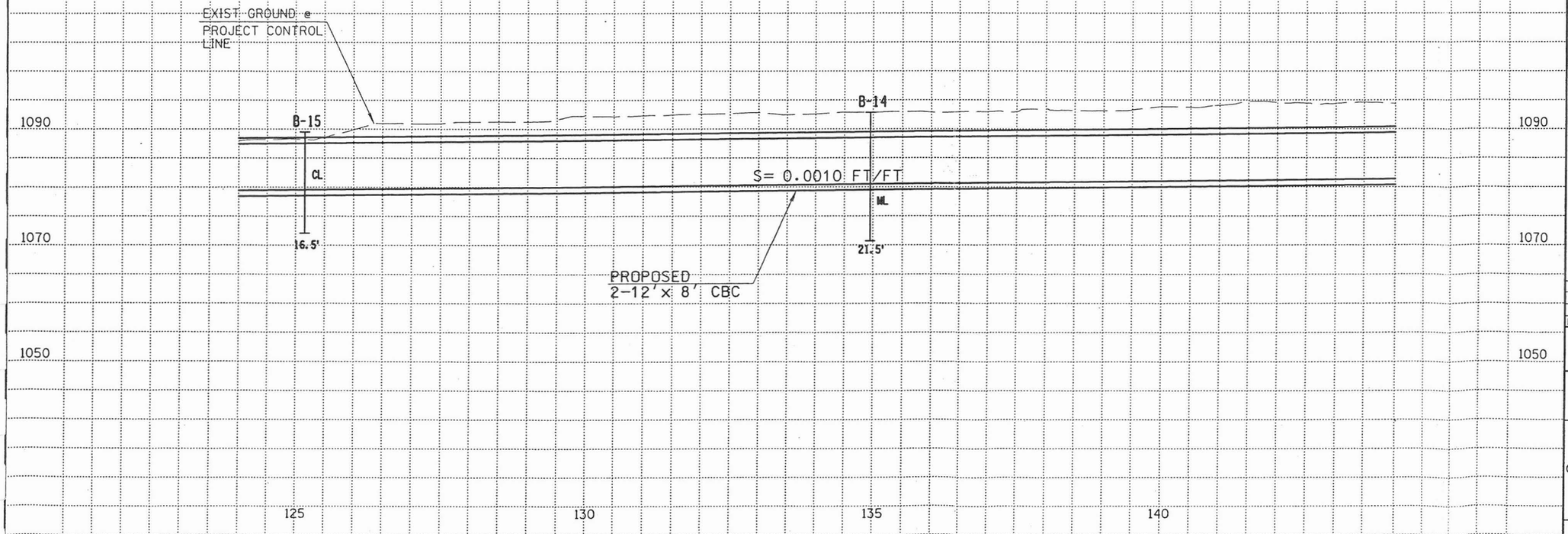
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 119+92.20 124+00.00 SHEET OF 1 8

n:\6888\Prod\geotek\6063\63bhocsp01.dgn 2/20/2004 4:16:54 PM





REMOVE

CONSTRUCT

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

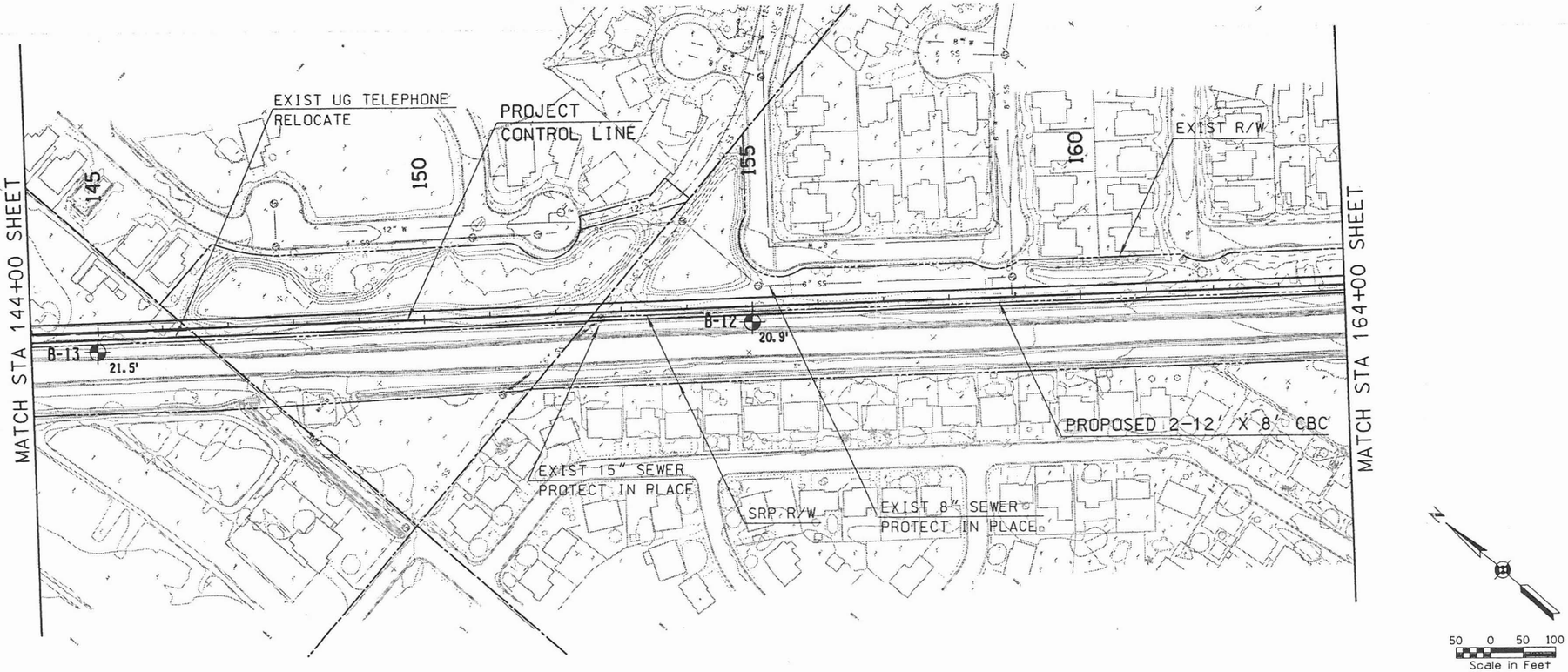
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

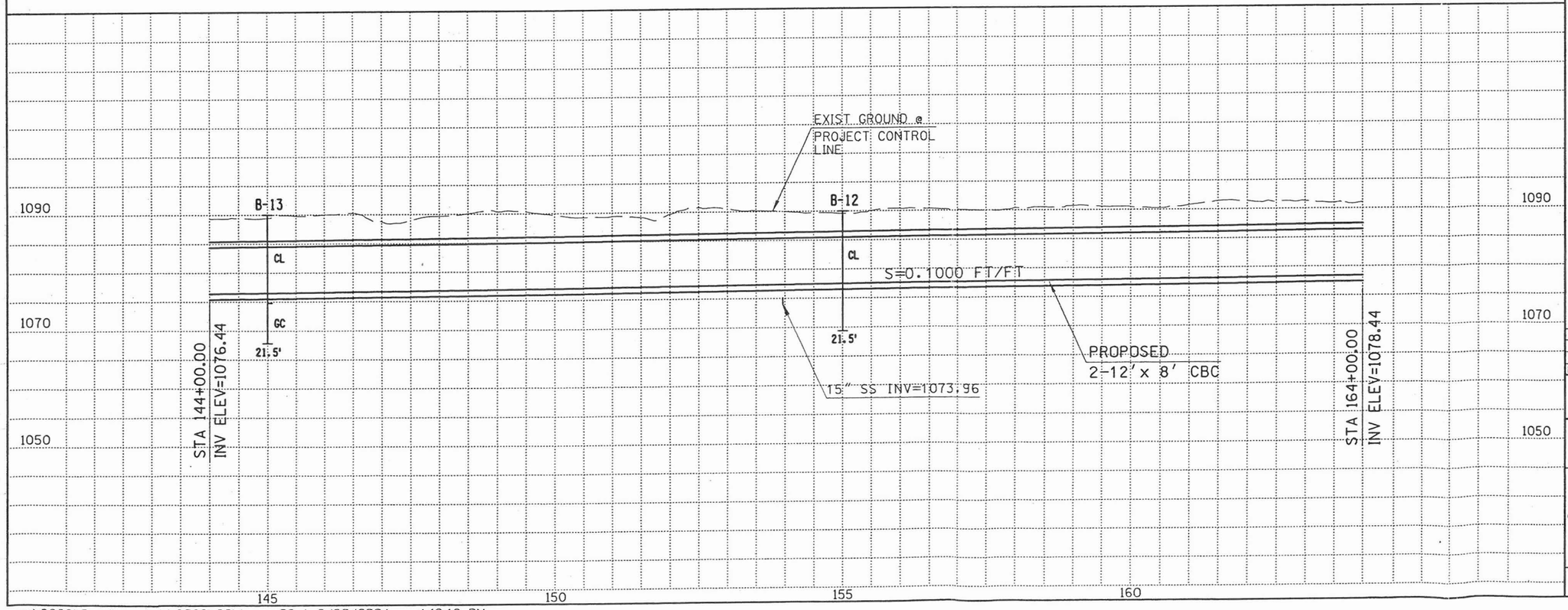
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 124+00 to 144+00 SHEET 2 OF 8

n:\6888\Prod\geotek\6063\63bhocsp02.dgn 2/20/2004 4:17:47 PM





n:\6888\Prod\geotek\6063\63bhocsp03.dgn 2/20/2004 4:18:18 PM

☐ REMOVE ☐

○ CONSTRUCT ○

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

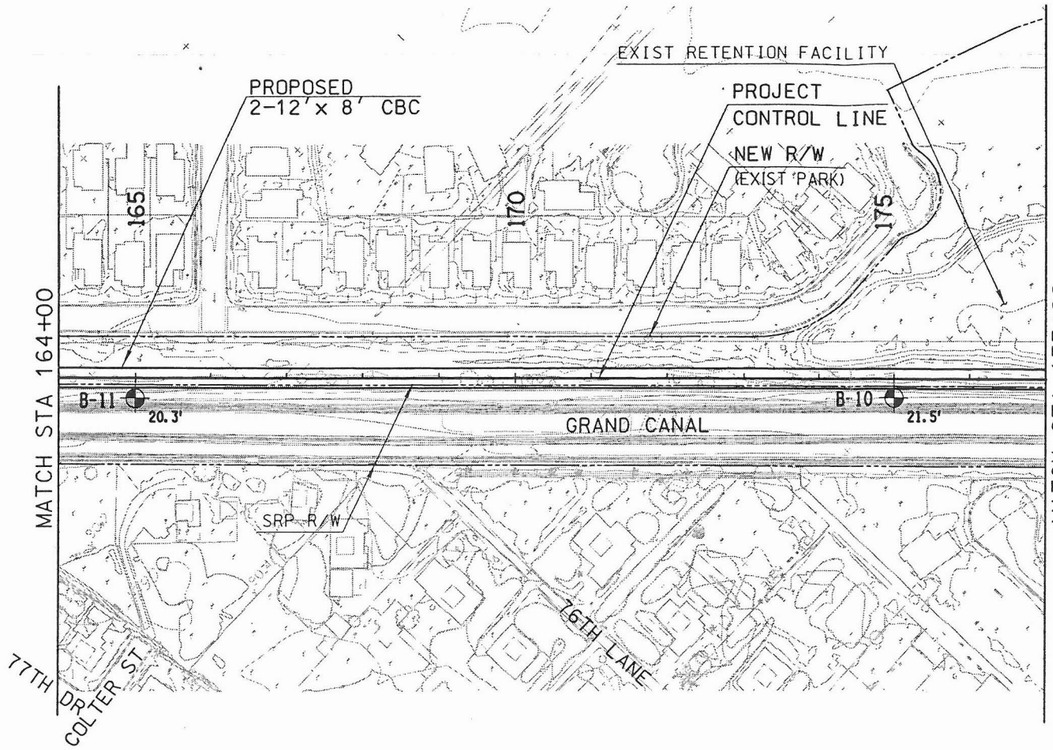
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

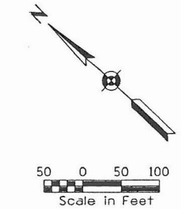
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

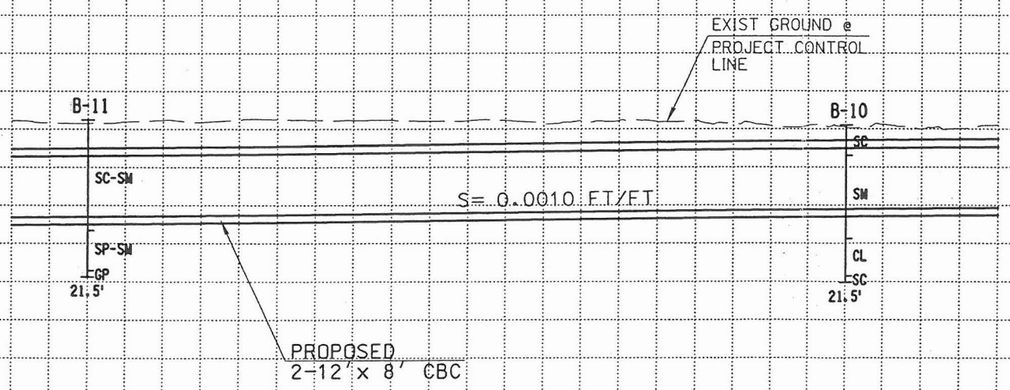
DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 144+00.00 to 164+00.00

SHEET OF 3 8







☐ REMOVE ☐

○ CONSTRUCT ○

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

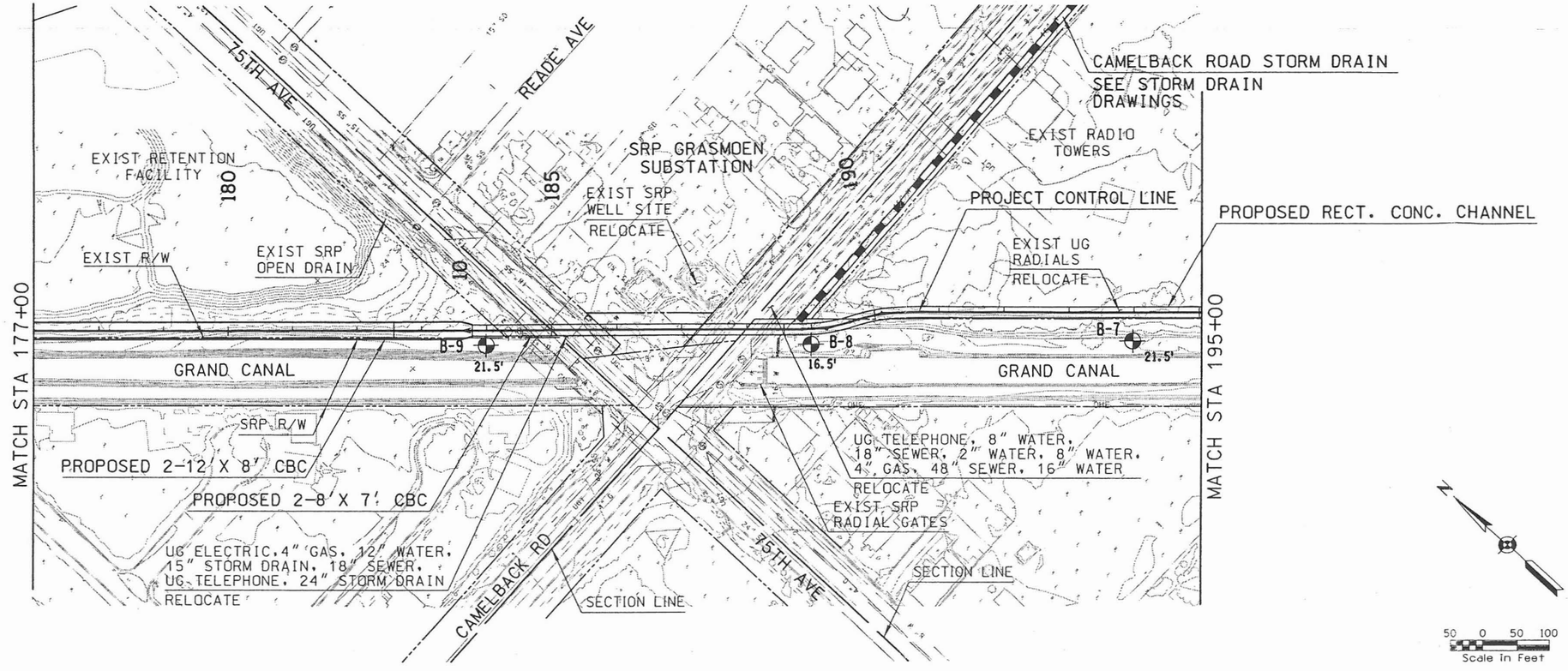
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

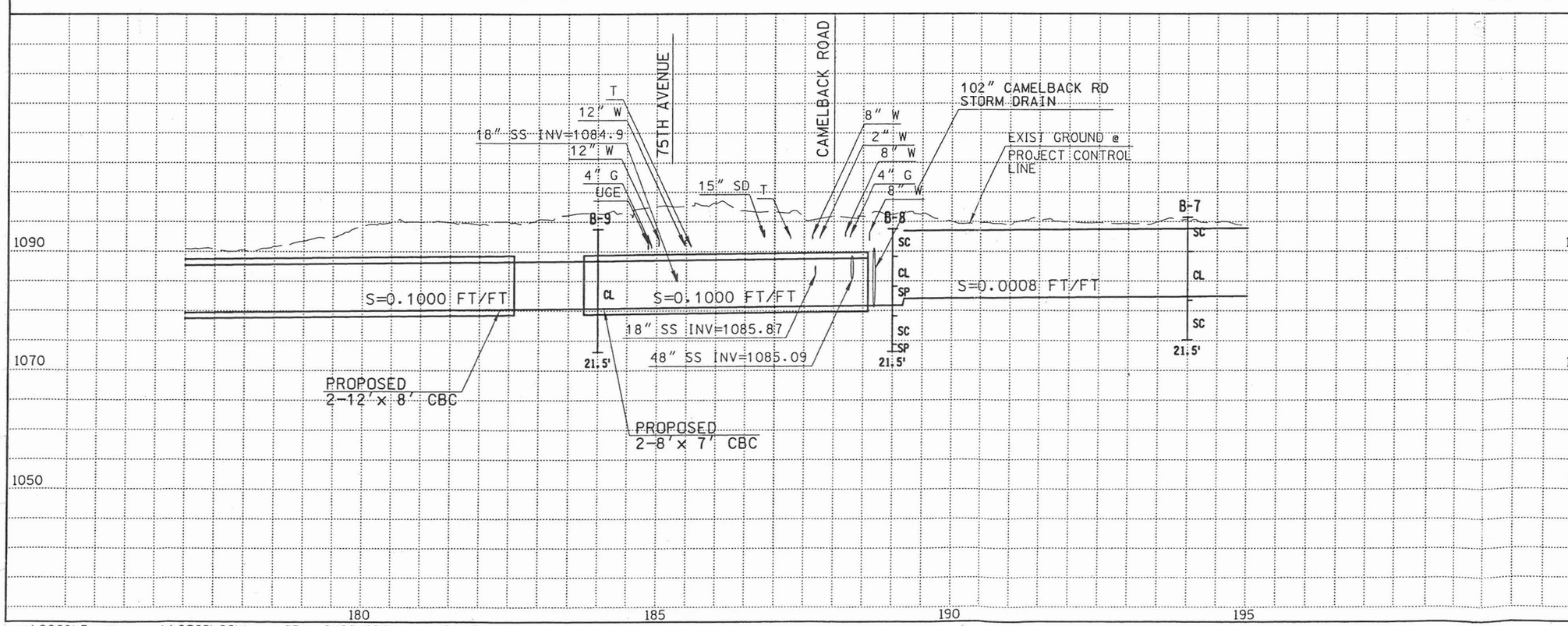
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJMHARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 164+00.00 to 177+00.00

SHEET OF 4 8





REMOVE

CONSTRUCT

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

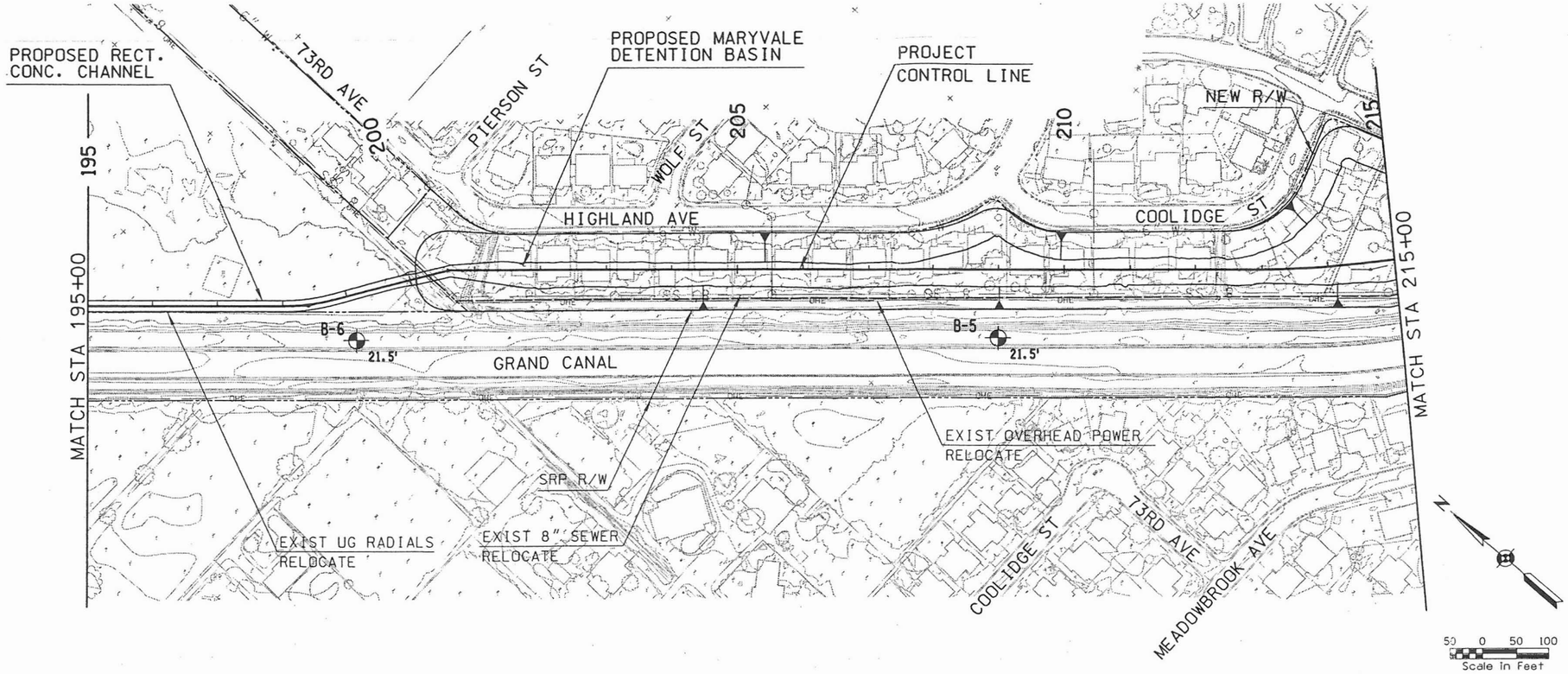
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

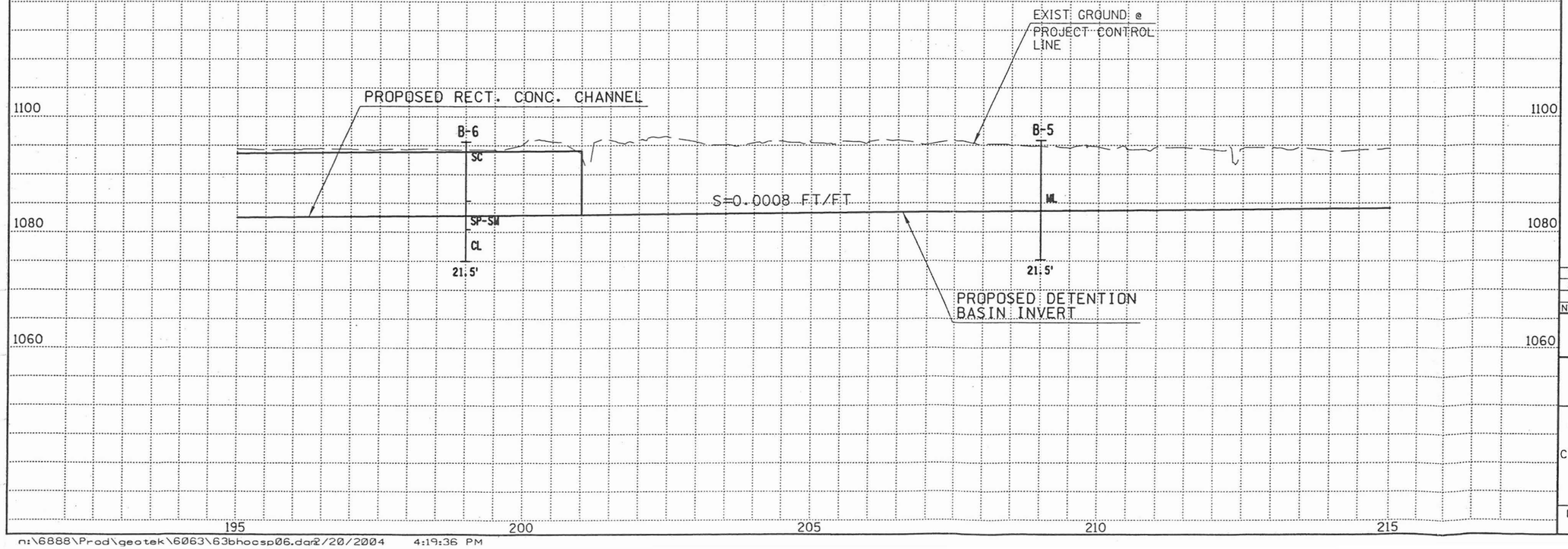
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 177+00.00 to 195+00.00 SHEET OF 5 8

n:\6888\Prod\geotek\6063\63bhocsp05.dgn 2/20/2004 4:19:11 PM





REMOVE

CONSTRUCT

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)

CL (USCS)

SC

21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

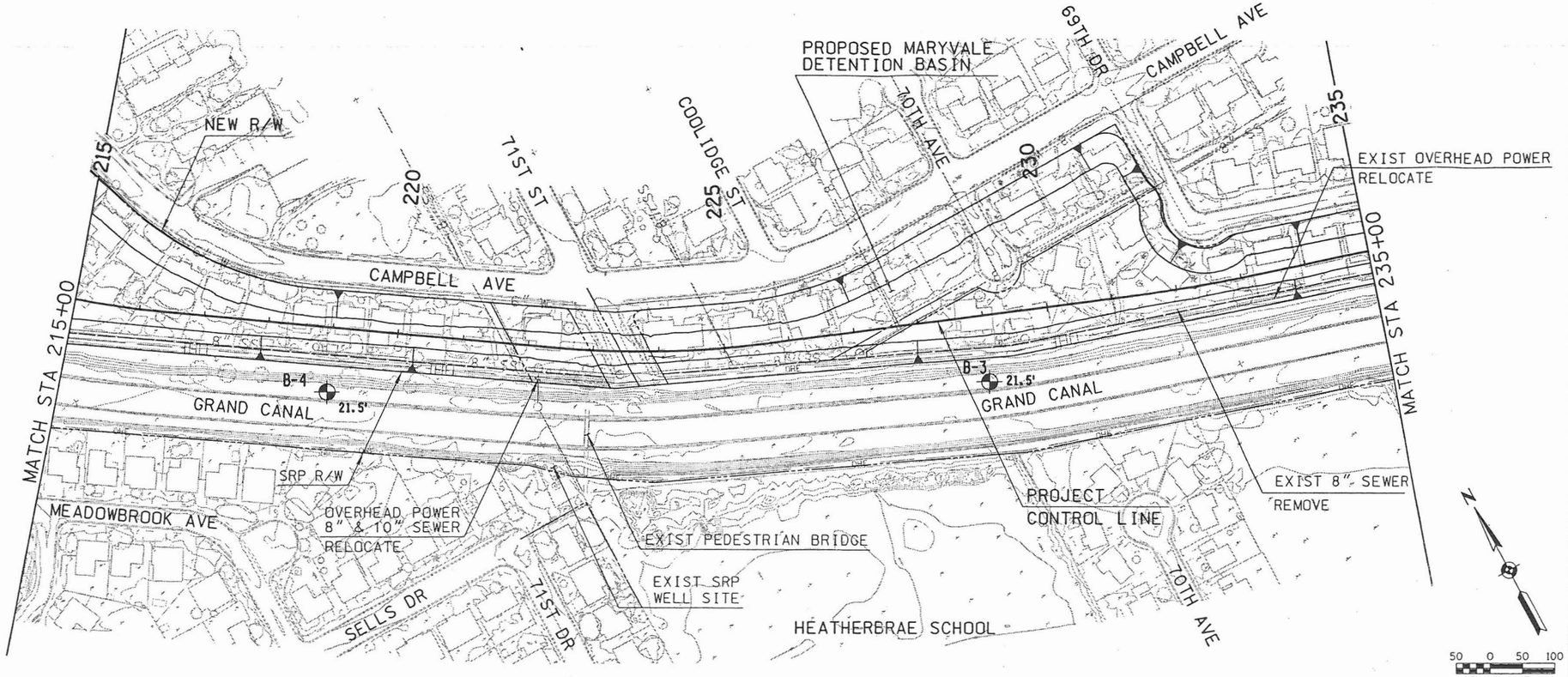
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

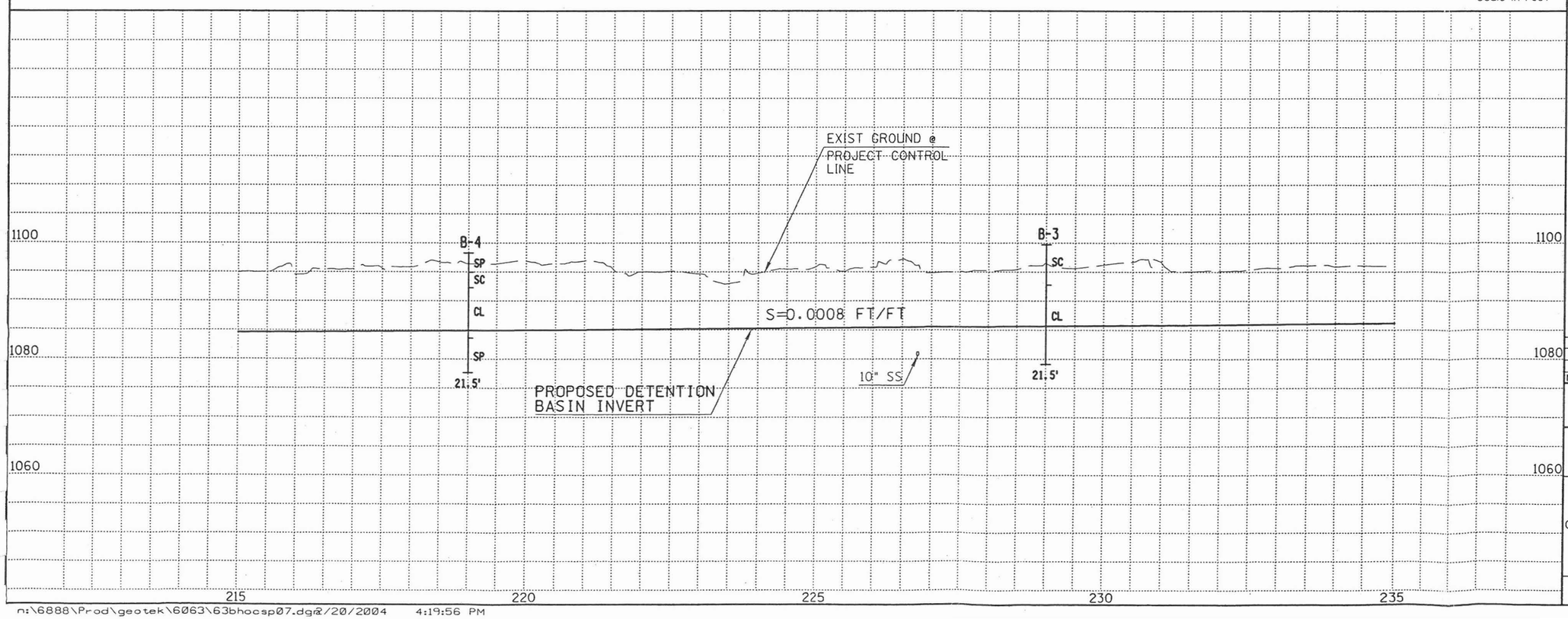
	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 195+00.00 to 215+00.00 SHEET OF 6 8

n:\6888\Prod\geotek\6063\63bhocsp06.dgn 2/20/2004 4:19:36 PM





n:\6888\Prod\geotek\6063\63bhocsp07.dgn 2/20/2004 4:19:56 PM

☐ REMOVE ☐

○ CONSTRUCT ○

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

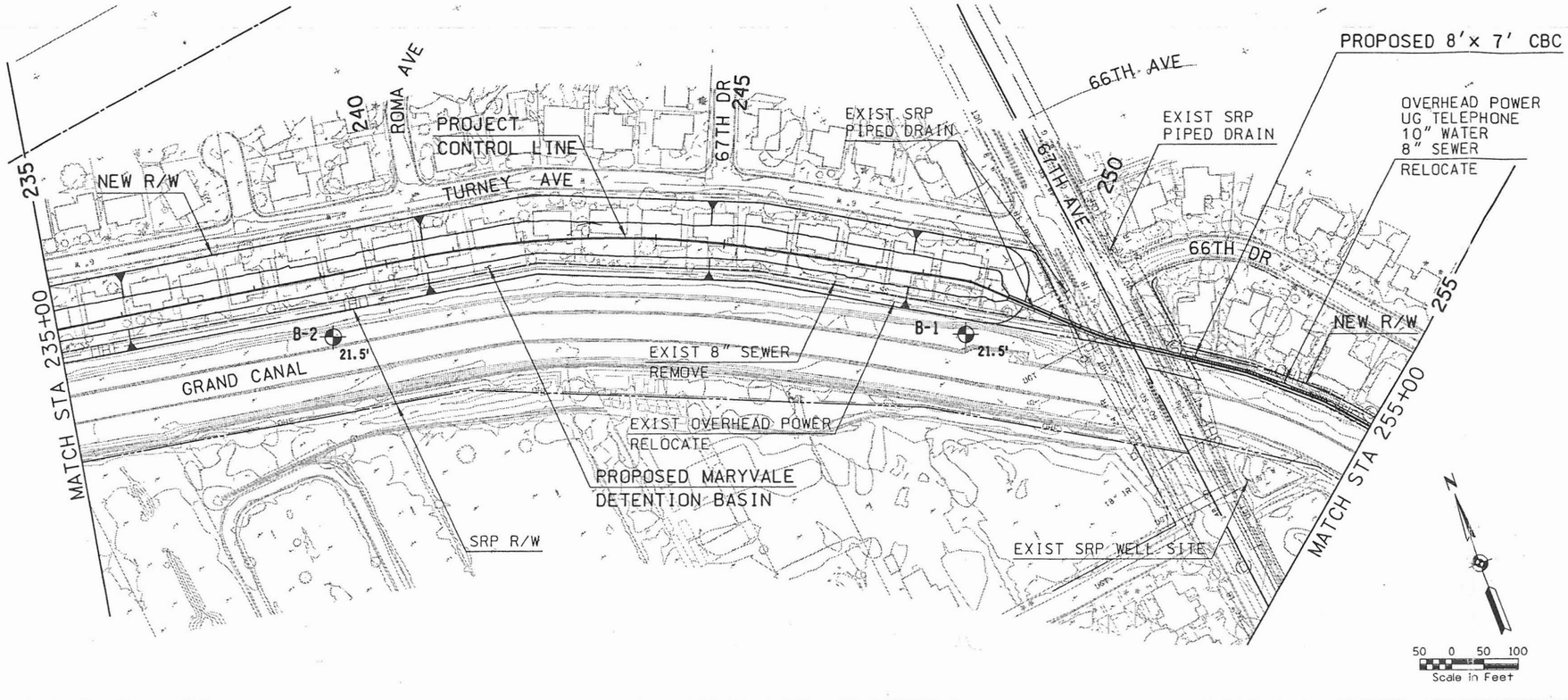
BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

	BY	DATE
DESIGNED	KHD	02/04
DRAWN	KMD	02/04
CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO. 215+00.00 235+00.00 SHEET 7 OF 8



REMOVE

CONSTRUCT

LEGEND

B-15 ⊕ 16.5' ATL TEST BORING LOCATION & DEPTH

B-15 (BORING I.D.)
CL
(USCS)
SC
21.5' (TOTAL BORING DEPTH) (FEET))

FUTURE CONSTRUCTION

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

BETHANY HOME OUTFALL CHANNEL
83RD AVE TO 67TH AVE
SITE PLAN SHOWING BORING LOCATIONS

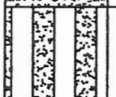
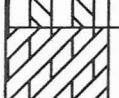
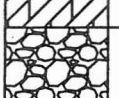
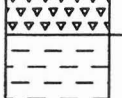
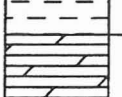
PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING		BY	DATE
	DESIGNED	KHD	02/04
	DRAWN	KMD	02/04
	CHECKED	JRM	02/04

DMJM HARRIS
2777 E. CAMELBACK ROAD SUITE 200
PHOENIX, AZ. 85016-4302 (602) 337-2777

DRAWING NO.		SHEET OF
	235+00.00 255+00.00	8 8

n:\6888\Prod\geotek\6063\63bhocsp08.dgn 2/20/2004 4:20:16 PM

SOIL CLASSIFICATION & TERMINOLOGY

GRAPHIC SYMBOL	GROUP SYMBOL	TYPICAL NAMES
	GW	Well-graded gravels, gravel-sand mixtures, little to no fines, cobbles and boulders possible
	GP	Poorly-graded gravels, gravel-sand mixtures, little to no fines, cobbles and boulders possible
	GM	Silty gravels, gravel - sand - silt mixtures, cobbles and boulders possible
	GC	Clayey gravels, gravel-sand-clay mixtures, cobbles and boulders possible
	SW	Well-graded sands, gravelly sands, little to no fines
	SP	Poorly graded sands, gravelly sands, little to no fines
	SM	Silty sands, sand and silt mixtures
	SC	Clayey sands, sand-clay mixtures
	ML	Inorganic silts, clayey silts with slight plasticity silty or clayey fine sands, rock flour
	CL	Inorganic clays of low to medium plasticity gravely clays, sandy clays, silty clays, lean clays
	MH	Inorganic silts, miscaceous or diatomaceous fine sandy or silty soils, elastic silts
	CH	Inorganic clays of medium to high plasticity gravely clays, sandy clays, silty clays, fat clays
	-	Aggregrate Base Course
	-	Asphaltic Concrete
	-	Portland Cement Concrete Pavement
	-	Cinders - Commonly with Silty or Clayey Sands
	-	Weathered Bedrock - Commonly with Clays, Silts, Sands and Gravels
	-	Bedrock

1. RELATIVE DENSITY - TERMS FOR DESCRIPTION OF RELATIVE DENSITY OF COHESIONLESS, UNCEMENTED SANDS AND SAND-GRAVEL MIXTURES

N	RELATIVE DENSITY
0-4	VERY LOOSE
5-10	LOOSE
11-30	MEDIUM DENSE
31-50	DENSE
>50	VERY DENSE

2. RELATIVE CONSISTENCY - TERMS FOR DESCRIPTION OF CLAYS WHICH ARE SATURATED OR NEAR SATURATION

N	RELATIVE CONSISTENCY	REMARKS
0-2	VERY SOFT	EASILY PENETRATED SEVERAL INCHES WITH FIST
3-4	SOFT	EASILY PENETRATED SEVERAL INCHES WITH THUMB
5-8	MEDIUM STIFF	CAN BE PENETRATED SEVERAL INCHES WITH THUMB WITH MODERATE EFFORT
9-15	STIFF	READILY INDENTED WITH THUMB BUT PENETRATED ONLY WITH GREAT EFFORT
16-30	VERY STIFF	READILY INDENTED WITH THUMB NAIL
>30	HARD	INDENTED ONLY WITH DIFFICULTY BY THUMB NAIL

3. RELATIVE FIRMNESS - TERMS FOR DESCRIPTION OF PARTIALLY SATURATED AND/OR CEMENTED SOILS WHICH COMMONLY OCCUR IN THE SOUTHWEST INCLUDING CLAYS, CEMENTED GRANULAR MATERIALS, SILTS AND SILTY AND CLAYEY GRANULAR SOILS

N	RELATIVE FIRMNESS
0-4	VERY SOFT
5-8	SOFT
9-15	MODERATELY FIRM
16-30	FIRM
31-50	VERY FIRM
>50	HARD

4. STANDARD PENETRATION TESTS (SPT)

 - Blows/ft

DEFINITIONS OF SOIL FRACTIONS

SOIL COMPONENT	PARTICLE SIZE RANGE
COBBLES	Above 3 inches
GRAVEL	3 inches to No.4 sieve
Coarse gravel	3 inches to 3/4 inch
Fine gravel	3/4 inch to No. 4 sieve
SAND	No. 4 sieve to No. 200
Coarse	No. 4 sieve to No. 10
Medium	No. 10 sieve to No. 40
Fine	No. 40 sieve to No. 200
FINES (silt or clay)	Below No. 200 sieve

ATL JOB NO. 103048

PLATE NO. 2

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 1

Boring Location: *Structural Investigation Borehole, STA 249 + 00, 75' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/29/04*

Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.*

Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	0.0	*Clayey SAND* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	32			
	5.0			45	28.1	92.1
		SILT (ML) *No Gravel, About 10% Sand, About 90% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	10			
	10.0		12		29.1	
	15.0		18			
	20.0	*Poorly Graded SAND* *Brown, Moist, Strong Reaction with HCL, No Plasticity with No Cementation*	23			
		(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A1

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 2*

Boring Location: *Structural Investigation Borehole, STA 239 + 00, 90' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/29/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Clayey SAND *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	12			
	5.0		14			
		Lean CLAY with Sand and trace Gravel *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*				
	10.0	*10-15 ft, Increase in moisture (wet)*	7	13	11.5	
	15.0	*Poorly Graded SAND* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Weak Cementation*	8			
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	19			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 3*

Boring Location: *Structural Investigation Borehole, STA 231 + 00, 100' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/29/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Lean CLAY with Sand (CL) *No Gravel, About 25% Sand, About 75% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Low Toughness*				
		0-5 ft, Increase in sand noted	16			
	5.0		16		19	
	10.0		17			
	15.0	*Silt (ML)* *No Gravel, About 5% Sand, About 95% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	11	17	29.3 37.3	88.5
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	16			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A3

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 4*

Boring Location: *Structural Investigation Borehole, STA 219 + 00, 100' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/29/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Silty SAND (SM) *No Gravel, About 60% Sand, About 40% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with No Cementation*	10		10.1	
	5.0	*Clayey SAND* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	16	36	27.2	92.6
		Lean CLAY with some Sand and trace Gravel *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Weak Cementation*				
	10.0	*10-15 ft, Increase in moisture (wet)*	8		33.9	
	15.0	*Poorly Graded SAND* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Weak Cementation*	11		33.7	
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	23			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A2

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 5

Boring Location: *Structural Investigation Borehole, STA 209 + 00, 100' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04*

Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.*

Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	0.0	*Sandy SILT (ML)* *No Gravel, About 40% Sand, About 60% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	24		11.6	
	5.0		30			
	10.0	*SILT (ML)* *No Gravel, About 5% Sand, About 95% Fines* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Weak Cementation*	18	22		
	15.0		11		39.9	
		18-20 feet, Increase in sand noted				
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	20			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 6*

Boring Location: *Structural Investigation Borehole, STA 199 + 00, 70' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04*

Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.*

Reviewed By: *D. Smith*

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	Clayey SAND with trace Gravel *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	14			
5.0		11			
10.0	*Poorly Graded SAND with Silt (SP-SM)* *No Gravel, About 90% Sand, About 10% Fines* *Brown, Moist, No Reaction with HCL, No Plasticity with No Cementation*	26		3.1	
15.0	*Lean CLAY with Sand (CL)* *No Gravel, About 30% Sand, About 70% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	22	29	34.4 17.8	84.6
20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	39			
25.0					
30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 7

Boring Location: *Structural Investigation Borehole STA 194 + 00, 40' Rt.*
Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*
Driller: *Yellow Jacket Drilling Services*
Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*
Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Clayey SAND with trace Gravel *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	10			
	5.0	*Minimal Recovery*		17	13.6	91.7
		Sandy Silty CLAY (CL-ML) *No Gravel, About 35% Sand, About 65% Fines* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Low Toughness*	12		23.9	
	10.0		4		38.8	
	15.0	*Lean CLAY with Sand* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	51			
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	20			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 8

Boring Location: *Structural Investigation Borehole, STA 189 + 00, 22' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Clayey SAND *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	24			
	5.0	*Sandy SILT (ML)* *No Gravel, About 50% Sand, About 50% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Low Toughness*	19		12	
	10.0	*Silty SAND (SM)* *Minimal Recovery* *No Gravel, About 60% Sand, About 40% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	15	19	13	
	15.0	*Clayey SAND* *Brown, Moist, Weak Reaction with HCL, No Plasticity with Weak Cementation*	18			
	20.0	*Silty SAND* *Brown, Moist, Weak Reaction with HCL, Low Plasticity with Weak Cementation*	40			
		(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 9*

Boring Location: *Structural Investigation Borehole, STA 184 + 00, 22' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Sandy Lean CLAY (CL) *No gravel, About 40% Sand, About 60% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	37			
	5.0		40		12.6	
	10.0		12			
	15.0		57	50/5"	18.1	99.9
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	28			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 10

Boring Location: *Structural Investigation Borehole, STA 175 + 00, 25' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	Clayey SAND with trace Gravel *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	30			
5.0	*Sandy Silty CLAY (CL)* *No Gravel, About 45% Sand, About 55% Fines* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Low Toughness*	17			
10.0		42	50/5"	6.7	
15.0	*Lean CLAY with Sand (CL)* *No Gravel, About 25% Sand, About 75% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	30		19.4	
20.0	*Clayey SAND with trace Gravel* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	42			
	(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
25.0					
30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 11

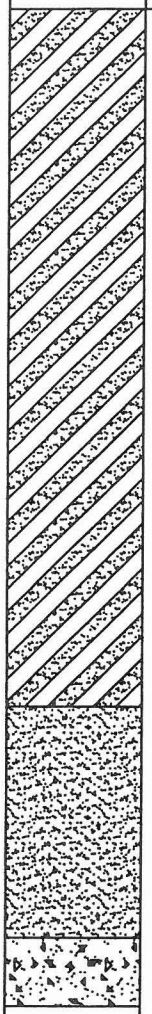
Boring Location: *Structural Investigation Borehole, STA 165 + 00, 25' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*



Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	Silty, Clayey SAND (SC-SM) *About 5% Gravel, About 55% Sand, About 40% Fines* *Brown, Moist, Strong Reaction with HCL, Low Plasticity with Weak Cementation*	18			
5.0		11			
	9-15 feet, Increase in gravel noted				
10.0		40		4.5	
15.0	*Poorly Graded SAND with Silt (SP-SM)* *Minimal Recovery* *About 5% Gravel, About 85% Sand, About 10% Fines* *Brown, Moist, Weak Reaction with HCL, No Plasticity with No Cementation*	32	49	3.1	
20.0	*Poorly Graded GRAVEL with Sand* *Brown, Moist, Weak Reaction with HCL, No Plasticity with Weak Cementation*	50/4"			
	(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
25.0					
30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 12

Boring Location: *Structural Investigation Borehole, STA 155 + 00, 25' Rt.*

Boring Equipment: *BK - 81 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
	0.0	*Lean CLAY with Sand (CL)* *No Gravel, About 20% Sand, About 80% Fines* *Brown, Moist, Strong Reaction with HCL, High Plasticity with Low Toughness*	14			
	5.0		11			
	10.0			50/5"	15.4	89.5
			25		14.4	
	15.0		39			
	20.0		50/5"		16.7	
		(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

A12

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 13*

Boring Location: *Structural Investigation Borehole, STA 145 + 00, 30' Rt.*

Boring Equipment: *Limited Access L-10 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Lean CLAY with Sand (CL) *About 5% Gravel, About 15% Sand, About 80% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	5		21.4	
	5.0		37			
	10.0		32			
	15.0	*Clayey SAND with Gravel* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*	50	57	7.5	124.1
	20.0	*(Bore Terminated At 20 Feet Below Existing Grade)* *(SPT Depth To 21.5 Feet Below Existing Grade)*	59			
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. 103048
Bore No. B - 14

Boring Location: *Structural Investigation Borehole, STA 135 + 00, 25' Rt.*

Boring Equipment: *Limited Access L-10 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Sandy SILT (ML) *About 5% Gravel, About 45% Sand, About 50% Fines* *Brown, Moist, Strong Reaction with HCL, No Plasticity with Weak Cementation*				
			8			
	5.0		8			
	10.0			89/11"		
			90/11"		12	
	15.0		70/11"			
	20.0		83/11"			
		(Bore Terminated At 20 Feet Below Existing Grade) *(SPT Depth To 21.5 Feet Below Existing Grade)*				
	25.0					
	30.0					

Bore Stopped at 20.0 Feet Below Existing Grade

Groundwater

Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL PHASE II
83RD AVENUE TO 67TH AVENUE

ATL Job No. *103048*
Bore No. *B - 15*

Boring Location: *Structural Investigation Borehole, STA 125 + 25, 52' Rt.*

Boring Equipment: *Limited Access L-10 With 8-Inch Hollow Stem Auger*

Driller: *Yellow Jacket Drilling Services*

Date of Boring: *1/30/04* Elevation of Boring: *Existing Grade*

Logger: *R. Christensen - ATL, Inc.* Reviewed By: *D. Smith*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Unit Wt. (pcf)
		Sandy Lean CLAY (CL) *No Gravel, About 30% Sand, About 70% Fines* *Brown, Moist, Strong Reaction with HCL, Medium Plasticity with Low Toughness*	16			
	5.0		15			
	10.0		53		17.4	
	15.0			24	13.6	109.4
		(Bore Terminated At 15 Feet Below Existing Grade) *(SPT Depth To 16.5 Feet Below Existing Grade)*	84			
	20.0					
	25.0					
	30.0					

Bore Stopped at 15.0 Feet Below Existing Grade

Groundwater

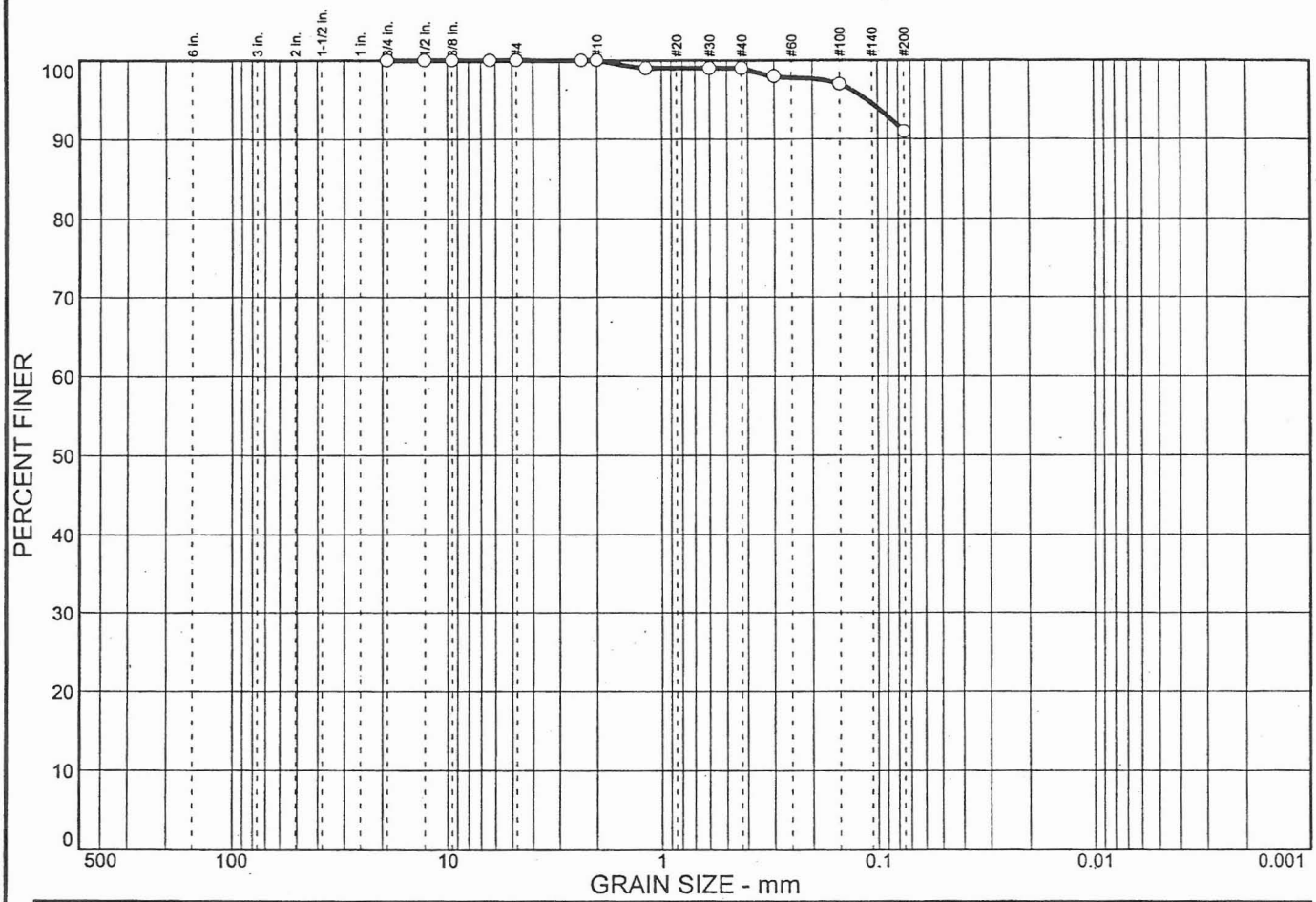
Groundwater Observed	Initial Depth	24 Hour Depth
NONE	—	—

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

The Stratification Lines Represent the Approximate Soil Boundaries And The In-Situ Transitions May Be Gradual

APPENDIX B – ATL LABORATORY TEST DATA

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	9	91	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100		
0.5 in.	100		
0.375 in.	100		
0.25 in.	100		
#4	100		
#8	100		
#10	100		
#16	99		
#30	99		
#40	99		
#50	98		
#100	97		
#200	91		

* (no specification provided)

Soil Description

Silt

Atterberg Limits

PL= 26 LL= 37 PI= 11

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

In-situ Moisture=29.1%

Sample No.: 4-2305 **Source of Sample:** B-1 **Date:** 2/03/04
Location: **Elev./Depth:** 10'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	23	77	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	99		
#16	99		
#30	98		
#40	97		
#50	96		
#100	88		
#200	77		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 20 LL= 29 PI= 9

Coefficients

D_{85}= 0.126 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

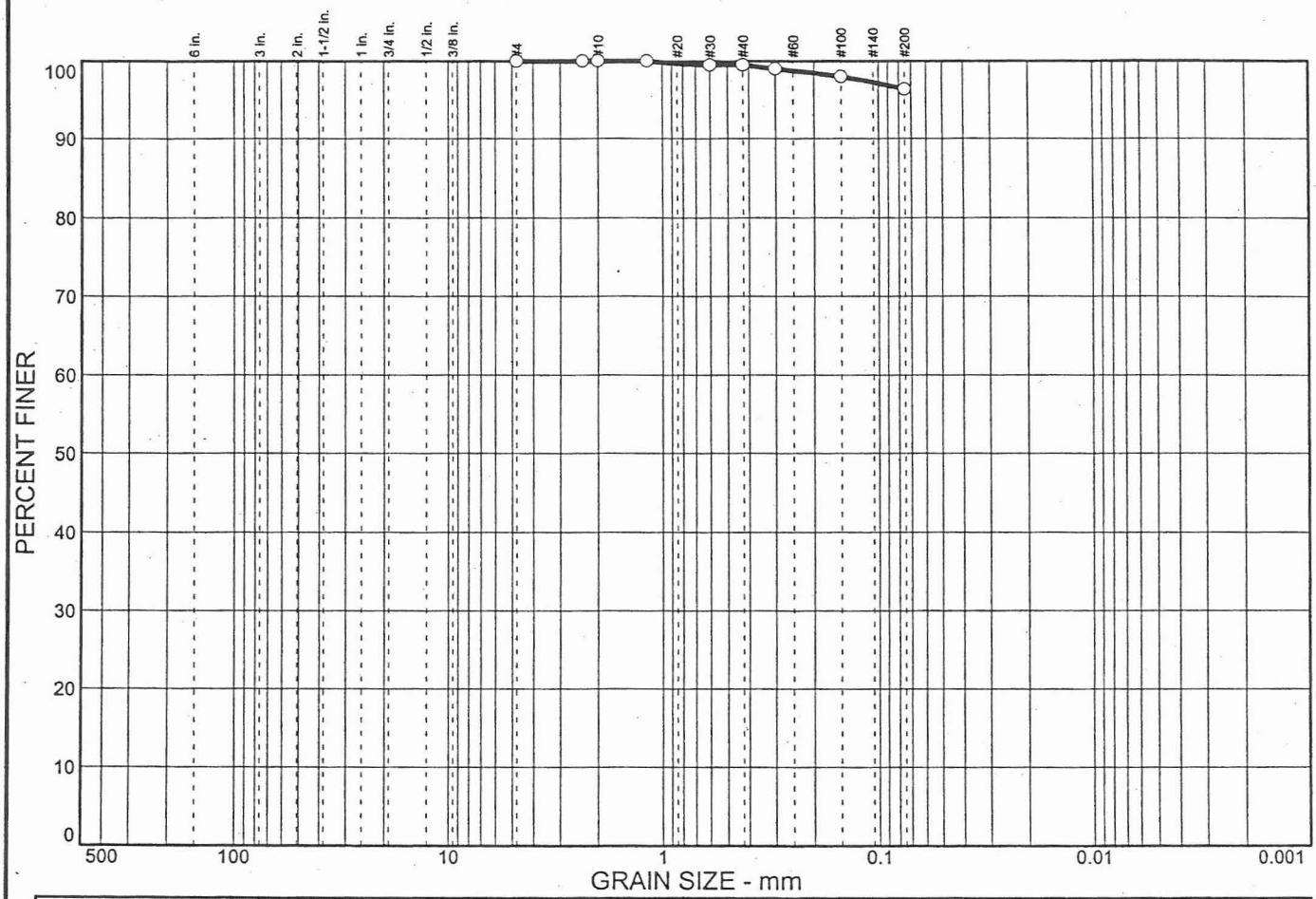
In-situ Moisture= 19.0%

Sample No.: 4-2309 **Source of Sample:** B-3 **Date:** 2/03/04
Location: **Elev./Depth:** 5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	4	96	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	100		
#16	100		
#30	100		
#40	100		
#50	99		
#100	98		
#200	96		

* (no specification provided)

Soil Description

Silt

Atterberg Limits

PL= 30 LL= 48 PI= 18

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

In-situ Moisture= 37.3%

Sample No.: 4-2310 **Source of Sample:** B-3 **Date:** 2/03/04
Location: **Elev./Depth:** 16.5'

ATL, INC.

Client: DMJM HARRIS
Project: Bethany Home Outfall Channel

Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	58	42	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	99		
#16	99		
#30	97		
#40	95		
#50	91		
#100	70		
#200	42		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= 20 LL= 22 PI= 2

Coefficients

D_{85}= 0.235 D_{60}= 0.116 D_{50}= 0.0906
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

In-situ moisture = 10.1%

Sample No.: 4-2312 **Source of Sample:** B-4 **Date:** 2/03/04
Location: **Elev./Depth:** 2.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	42	58	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	99		
#16	98		
#30	97		
#40	95		
#50	92		
#100	75		
#200	58		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= 19 LL= 22 PI= 3

Coefficients

D_{85}= 0.215 D_{60}= 0.0818 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

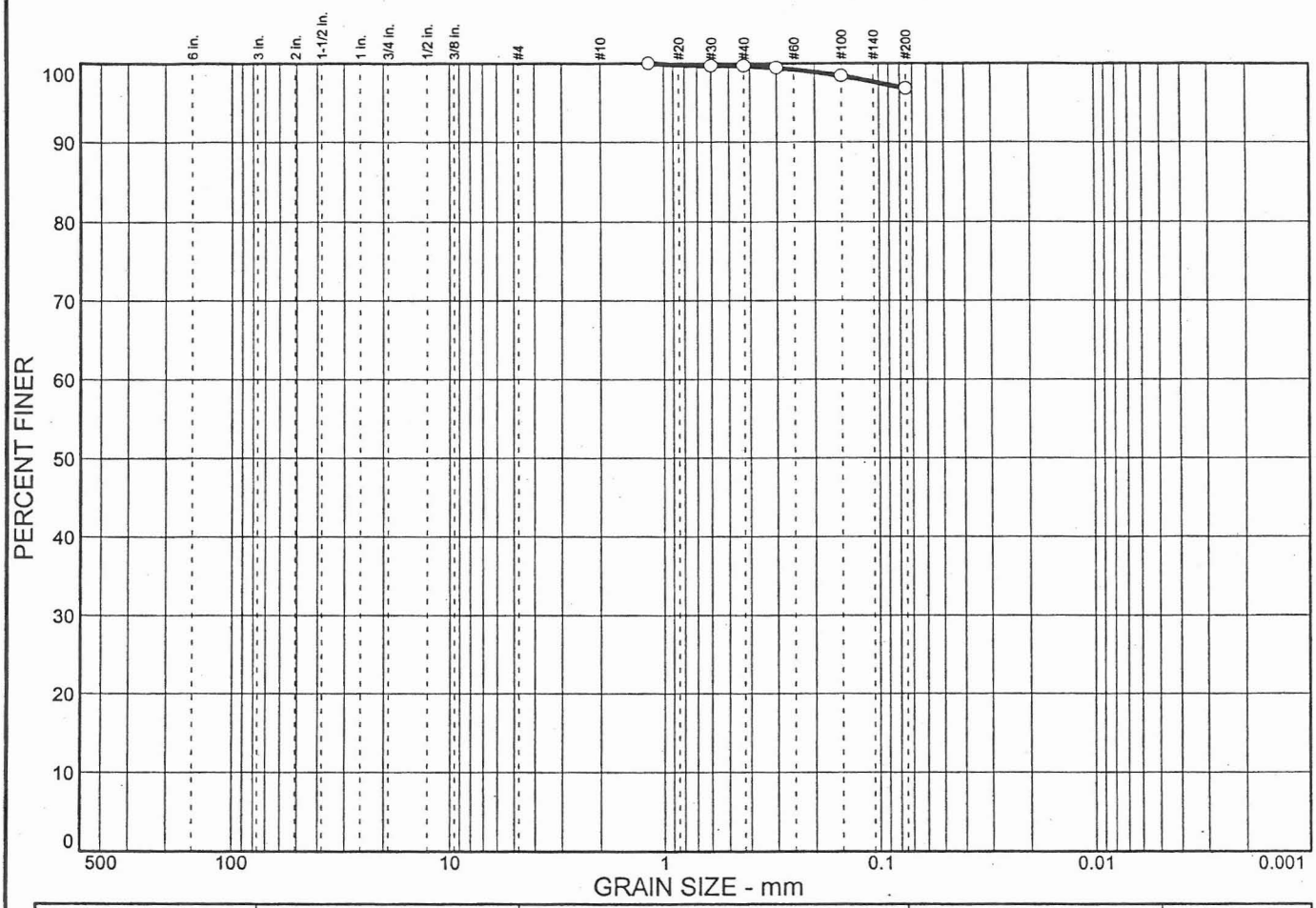
In-situ Moisture= 11.6%

Sample No.: 4-2316 **Source of Sample:** B-5 **Date:** 2/03/04
Location: **Elev./Depth:** 2.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	3	97	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100		
#30	100		
#40	100		
#50	99		
#100	98		
#200	97		

* (no specification provided)

Soil Description

Silt

Atterberg Limits

PL= 30 LL= 44 PI= 14

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

In-situ Moisture=39.9%

Sample No.: 4-2317 **Source of Sample:** B-5 **Date:** 2/03/04

Location: **Elev./Depth:** 15'

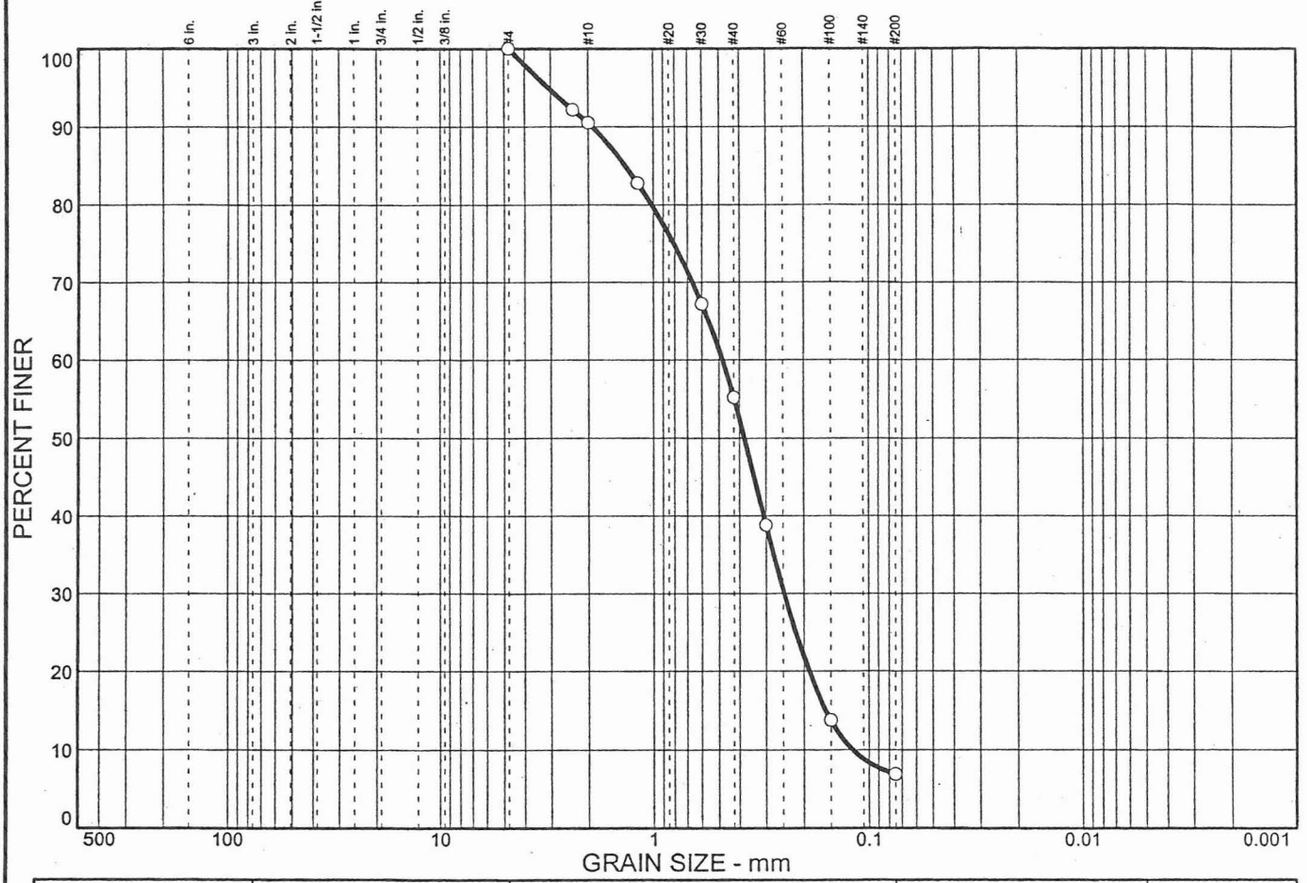
ATL, INC.

Client: DMJM+HARRIS

Project: Bethany Home Outfall Channel

Project No: 103048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	93	7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	92		
#10	91		
#16	83		
#30	67		
#40	55		
#50	39		
#100	14		
#200	6.9		

* (no specification provided)

Soil Description

Poorly graded sand with silt

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 1.34 D_{60}= 0.480 D_{50}= 0.378
D_{30}= 0.247 D_{15}= 0.158 D_{10}= 0.119
C_u= 4.04 C_c= 1.06

Classification

USCS= SP-SM AASHTO=

Remarks

In-situ Moisture=3.1%

Sample No.: 4-2345 **Source of Sample:** B-6 **Date:** 2/03/04
Location: **Elev./Depth:** 10'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	30	70	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	100		
#16	100		
#30	99		
#40	98		
#50	96		
#100	87		
#200	70		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 19 LL= 30 PI= 11

Coefficients

D_{85}= 0.137 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

In-situ Moisture= 17.8%

Sample No.: 4-2346 **Source of Sample:** B-6 **Date:** 2/03/04
Location: **Elev./Depth:** 16.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel

Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	37	63	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	99		
#16	96		
#30	92		
#40	88		
#50	84		
#100	74		
#200	63		

* (no specification provided)

Soil Description

Sandy silty clay

Atterberg Limits

PL= 21 LL= 25 PI= 4

Coefficients

D_{85}= 0.331 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO=

Remarks

In-situ Moisture=23.9%

Sample No.: 4-2348 **Source of Sample:** B-7 **Date:** 2/03/04
Location: **Elev./Depth:** 6.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	49	51	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	99		
#16	98		
#30	95		
#40	92		
#50	88		
#100	71		
#200	51		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= 19 LL= 21 PI= 2

Coefficients

D_{85}= 0.256 D_{60}= 0.101 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

In-situ Moisture=12.0%

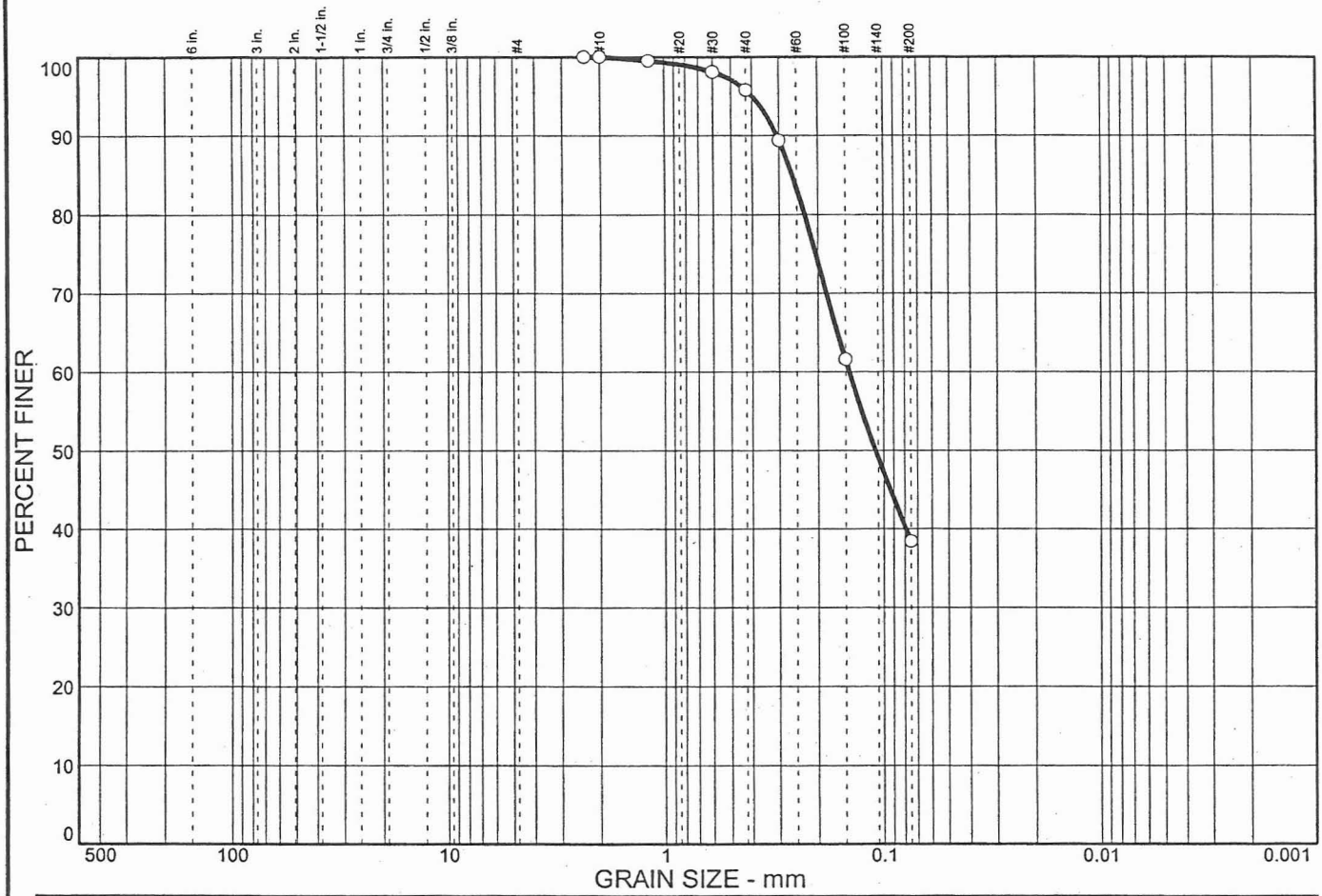
Sample No.: 4-2350 **Source of Sample:** B-8 **Date:** 2/03/04
Location: **Elev./Depth:** 5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel

Project No: 103048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	62	38	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100		
#10	100		
#16	100		
#30	98		
#40	96		
#50	89		
#100	62		
#200	38		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 0.262 D_{60}= 0.144 D_{50}= 0.109
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

In-situ Moisture=13.0%

Sample No.: 4-2350 **Source of Sample:** B-8 **Date:** 2/03/04
Location: **Elev./Depth:** 10'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	1	39	60	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5 in.	100		
0.375 in.	100		
0.25 in.	99		
#4	99		
#8	98		
#10	98		
#16	96		
#30	94		
#40	91		
#50	88		
#100	75		
#200	60		

* (no specification provided)

Soil Description

Sandy lean clay

Atterberg Limits

PL= 20 LL= 29 PI= 9

Coefficients

D_{85}= 0.244 D_{60}= 0.0750. D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

In-situ Moisture=12.6%

Sample No.: 4-2355 **Source of Sample:** B-9 **Date:** 2/03/04
Location: **Elev./Depth:** 5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	47	53	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	98		
#16	96		
#30	91		
#40	87		
#50	81		
#100	66		
#200	53		

* (no specification provided)

Soil Description

Sandy silty clay

Atterberg Limits

PL= 19 LL= 24 PI= 5

Coefficients

D_{85}= 0.377 D_{60}= 0.110 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO=

Remarks

In-situ Moisture=6.7%

Sample No.: 4-2331 **Source of Sample:** B-10 **Date:** 2/03/04
Location: **Elev./Depth:** 10.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	25	75	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	99		
#10	99		
#16	98		
#30	96		
#40	94		
#50	91		
#100	84		
#200	75		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 21 LL= 34 PI= 13

Coefficients

D_{85}= 0.162 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

In-situ Moisture=19.4%

Sample No.: 4-2330 **Source of Sample:** B-10 **Date:** 2/03/04
Location: **Elev./Depth:** 15'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel

Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	3	56	42	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5 in.	100		
0.375 in.	99		
0.25 in.	98		
#4	97		
#8	94		
#10	92		
#16	87		
#30	77		
#40	70		
#50	64		
#100	52		
#200	41		

* (no specification provided)

Soil Description

Silty, clayey sand

Atterberg Limits

PL= 18 LL= 22 PI= 4

Coefficients

D_{85}= 1.04 D_{60}= 0.241 D_{50}= 0.129
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC-SM AASHTO=

Remarks

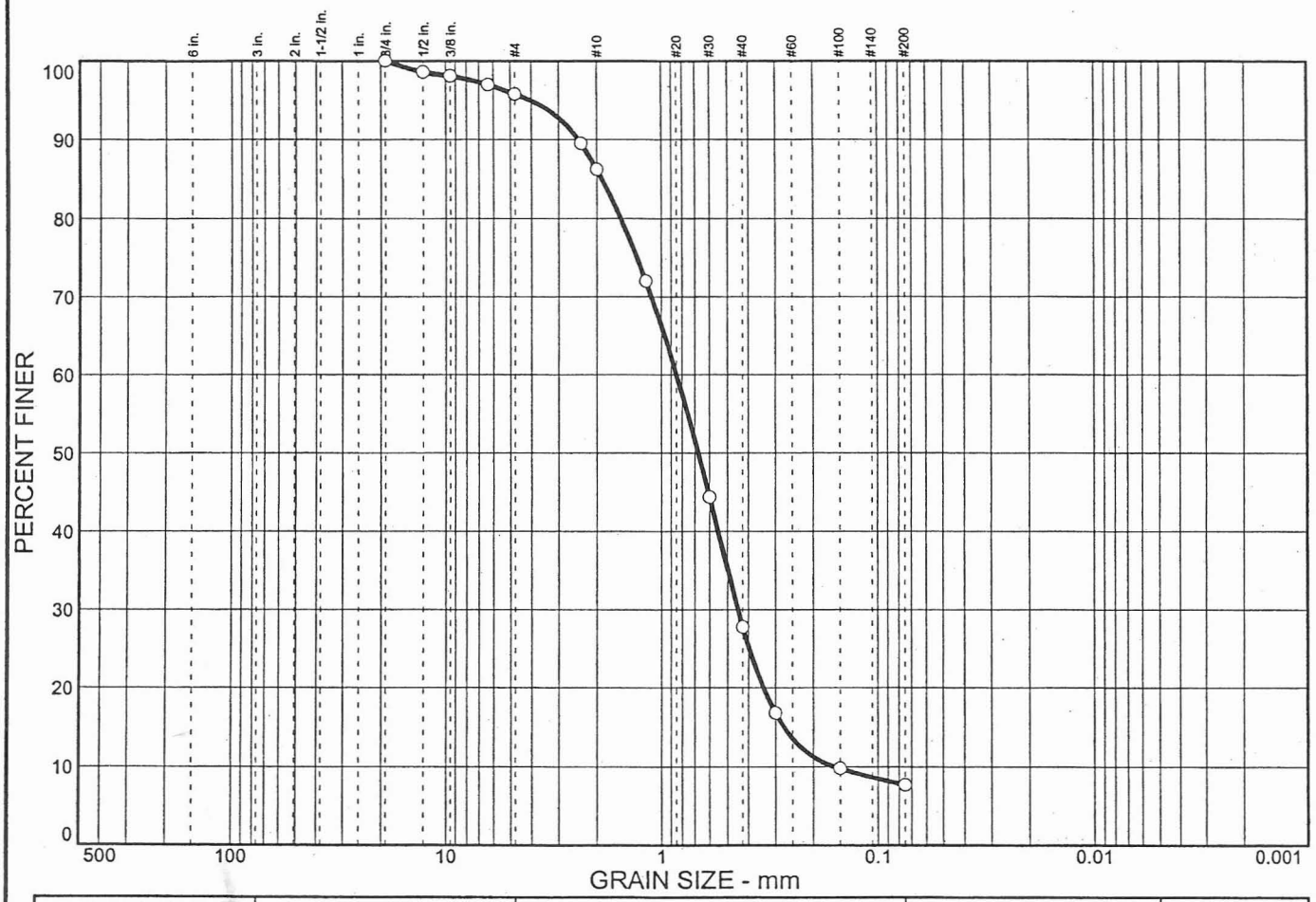
In-situ Moisture = 4.5%

Sample No.: 4-2332 **Source of Sample:** B-11 **Date:** 2/03/04
Location: **Elev./Depth:** 10'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	4	88	8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100		
0.5 in.	99		
0.375 in.	98		
0.25 in.	97		
#4	96		
#8	90		
#10	86		
#16	72		
#30	44		
#40	28		
#50	17		
#100	10		
#200	7.7		

* (no specification provided)

Soil Description

Poorly graded sand with silt

Atterberg Limits

PL= NP LL= PI= NP

Coefficients

D_{85}= 1.90 D_{60}= 0.850 D_{50}= 0.675
D_{30}= 0.447 D_{15}= 0.274 D_{10}= 0.158
C_u= 5.37 C_c= 1.49

Classification

USCS= SP-SM AASHTO=

Remarks

In-situ Moisture=3.1%

Sample No.: 4-2333 **Source of Sample:** B-11 **Date:** 2/03/04
Location: **Elev./Depth:** 15'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	0	19	81	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100		
#8	100		
#10	99		
#16	98		
#30	96		
#40	94		
#50	93		
#100	88		
#200	81		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 22 LL= 46 PI= 24

Coefficients

D_{85}= 0.108 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

In-situ Moisture=14.4%

Sample No.: 4-2335 **Source of Sample:** B-12 **Date:** 2/03/04
Location: **Elev./Depth:** 11'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	2	17	81	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100		
0.5 in.	99		
0.375 in.	99		
0.25 in.	99		
#4	98		
#8	98		
#10	97		
#16	96		
#30	94		
#40	93		
#50	91		
#100	87		
#200	81		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 25 LL= 40 PI= 15

Coefficients

D_{85}= 0.116 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

In-situ Moisture=21.4%

Sample No.: 4-2336 **Source of Sample:** B-13 **Date:** 2/03/04
Location: **Elev./Depth:** 5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	5	45	50	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100		
0.5 in.	99		
0.375 in.	99		
0.25 in.	97		
#4	95		
#8	92		
#10	90		
#16	86		
#30	79		
#40	75		
#50	70		
#100	59		
#200	50		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= 26 LL= 42 PI= 16

Coefficients

D_{85}= 1.05 D_{60}= 0.160 D_{50}= 0.0750
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

In-situ Moisture= 12.0%

Sample No.: 4-2340 **Source of Sample:** B-14 **Date:** 2/03/04
Location: **Elev./Depth:** 11.5'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

Particle Size Distribution Report

% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0	2	29	69	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.25 in.	100		
#4	98		
#8	96		
#10	94		
#16	91		
#30	89		
#40	86		
#50	83		
#100	78		
#200	69		

* (no specification provided)

Soil Description

Sandy lean clay

Atterberg Limits

PL= 25 LL= 42 PI= 17

Coefficients

D_{85}= 0.380 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

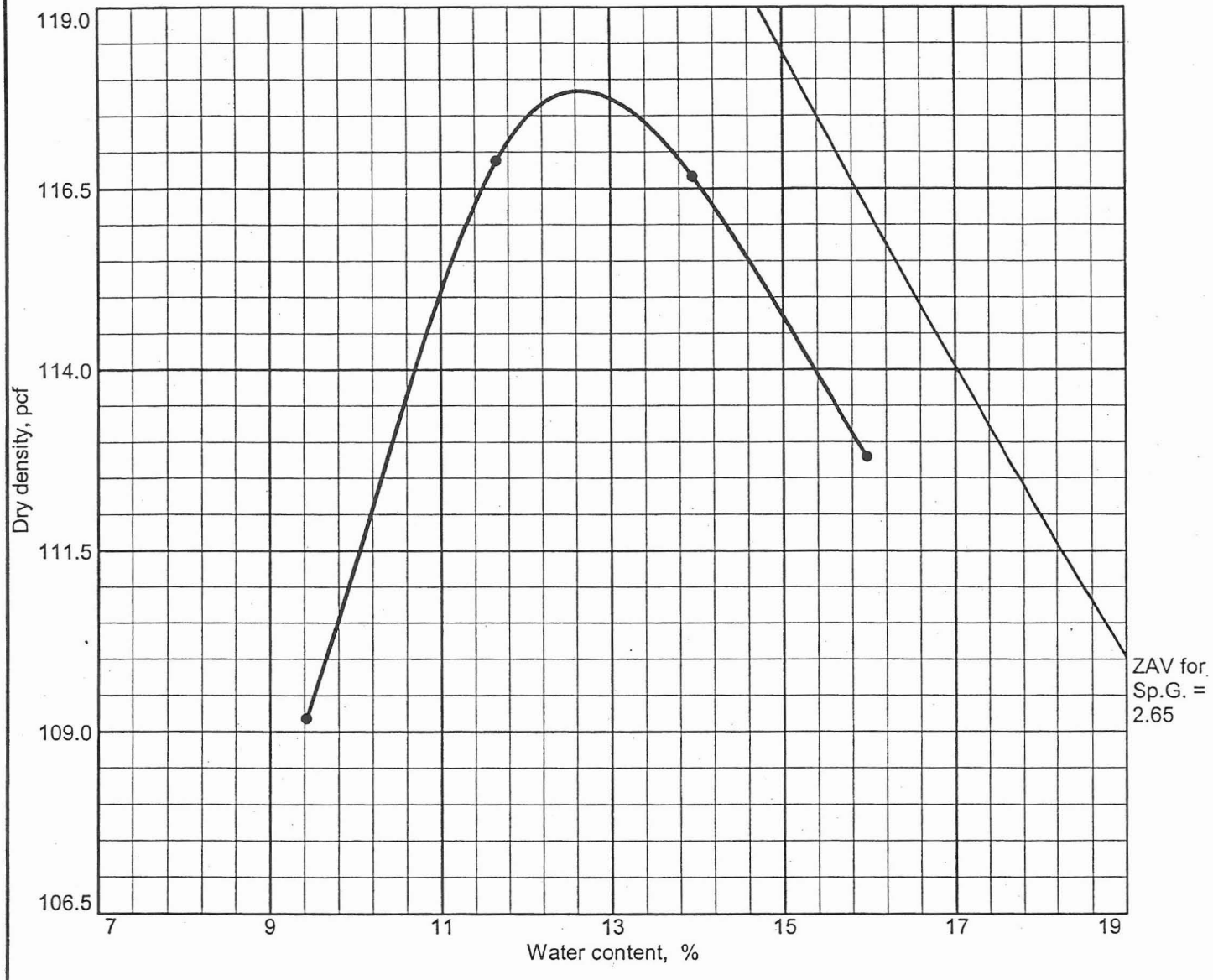
In-situ Moisture= 17.4%

Sample No.: 4-2341 **Source of Sample:** B-15 **Date:** 2/03/04
Location: **Elev./Depth:** 10'

ATL, INC.

Client: DMJM+HARRIS
Project: Bethany Home Outfall Channel
Project No: 103048 **Figure**

MOISTURE-DENSITY RELATIONSHIP TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1'-5'				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 117.8 pcf Optimum moisture = 12.6 %	

Project No. 103048 **Client:** DMJM+HARRIS

Project: Bethany Home Outfall Channel

● **Source:** B-1 **Sample No.:** 4-2319 **Elev./Depth:** 1'-5'

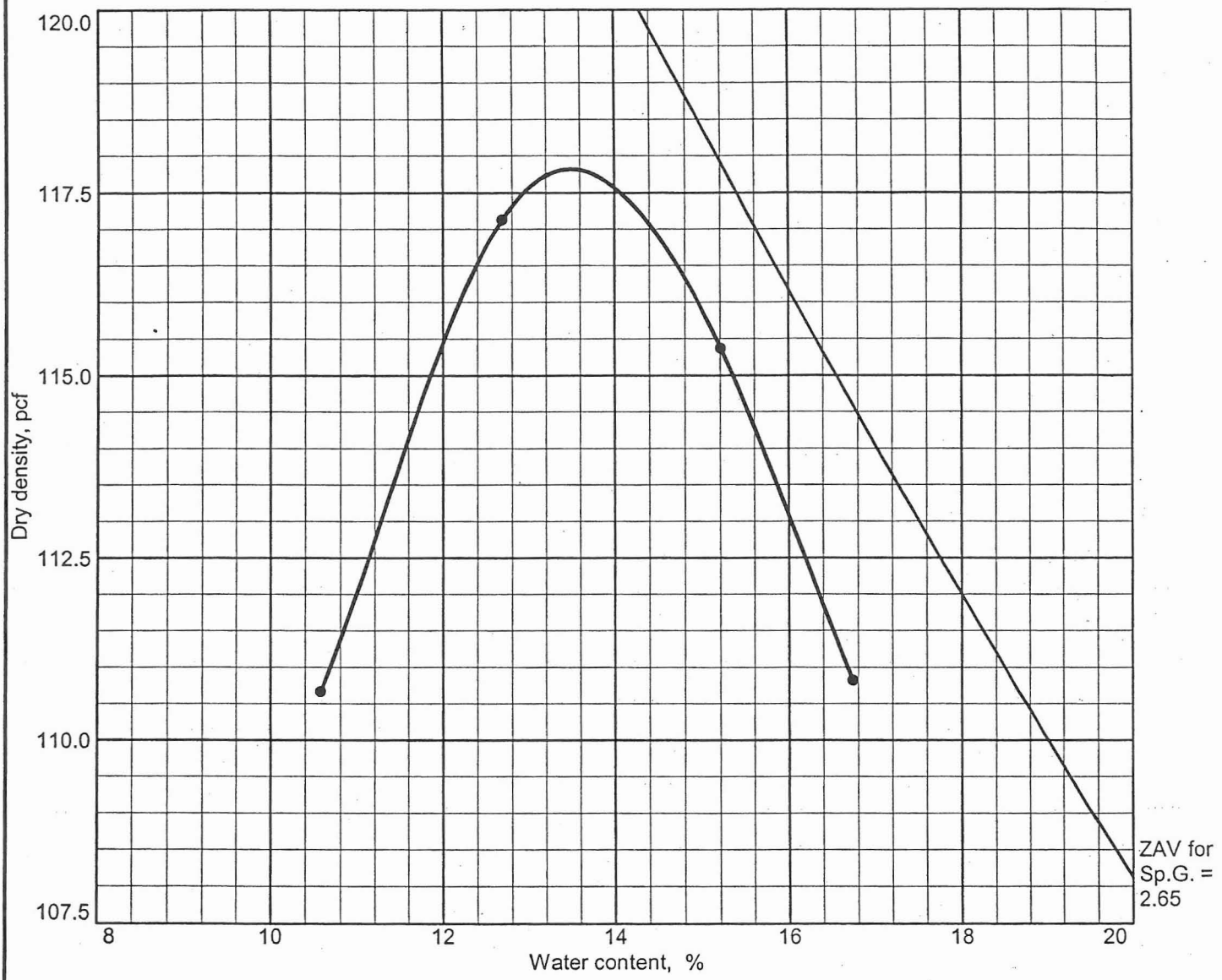
Remarks:

MOISTURE-DENSITY RELATIONSHIP TEST REPORT

ATL, INC.

Figure

MOISTURE-DENSITY RELATIONSHIP TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5'-10'				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 117.8 pcf Optimum moisture = 13.5 %	

Project No. 103048 **Client:** DMJM+HARRIS

Project: Bethany Home Outfall Channel

● **Source:** B-5 **Sample No.:** 4-2318 **Elev./Depth:** 5'-10'

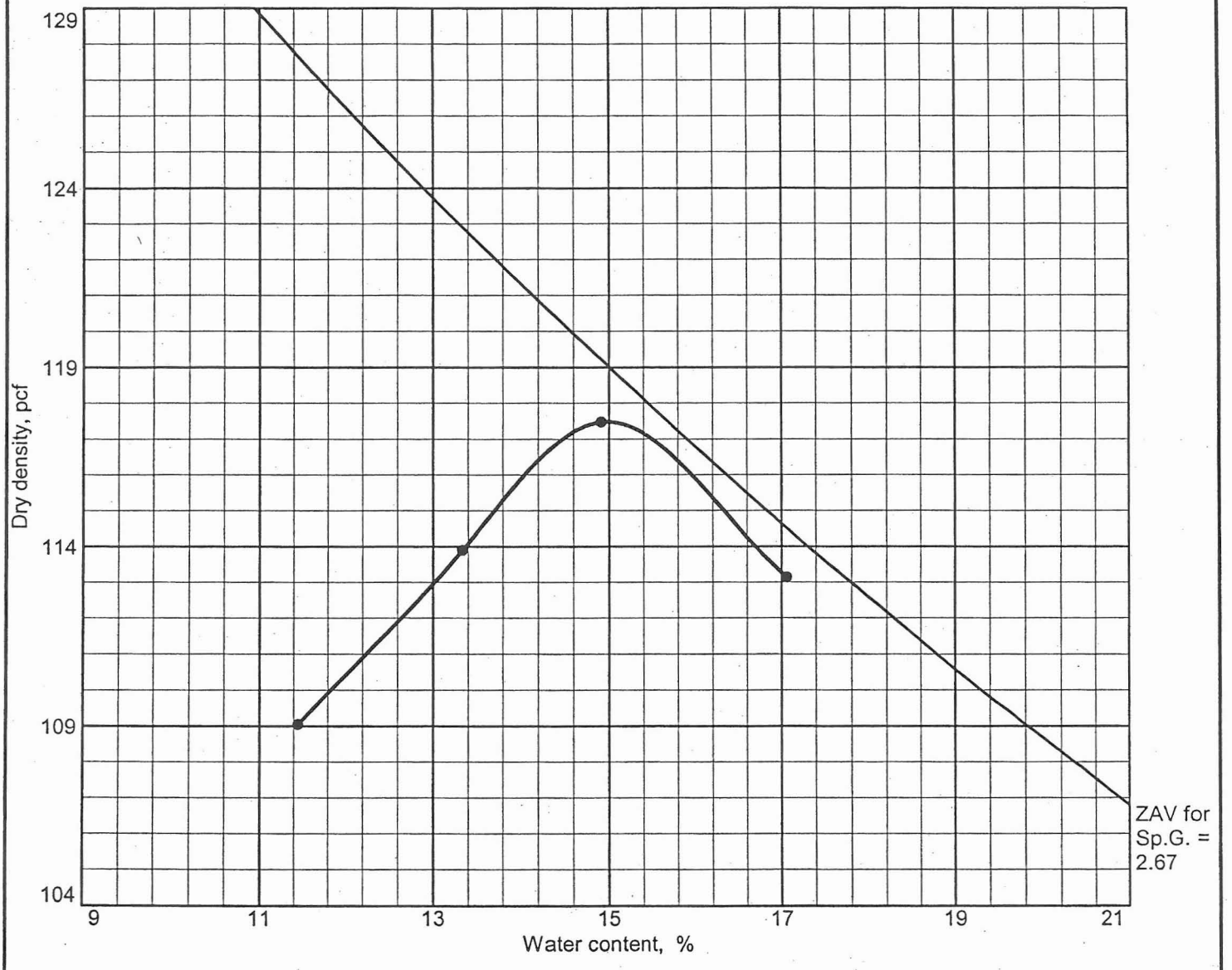
Remarks:

MOISTURE-DENSITY RELATIONSHIP TEST REPORT

ATL, INC.

Figure

MOISTURE-DENSITY RELATIONSHIP TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
1' - 5'				2.67				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 117.5 pcf Optimum moisture = 15.0 %	

Project No. 103048 **Client:** DMJM+HARRIS

Project: Bethany Home Outfall Channel

● **Source:** B-7 **Sample No.:** 4-2320 **Elev./Depth:** 1' - 5'

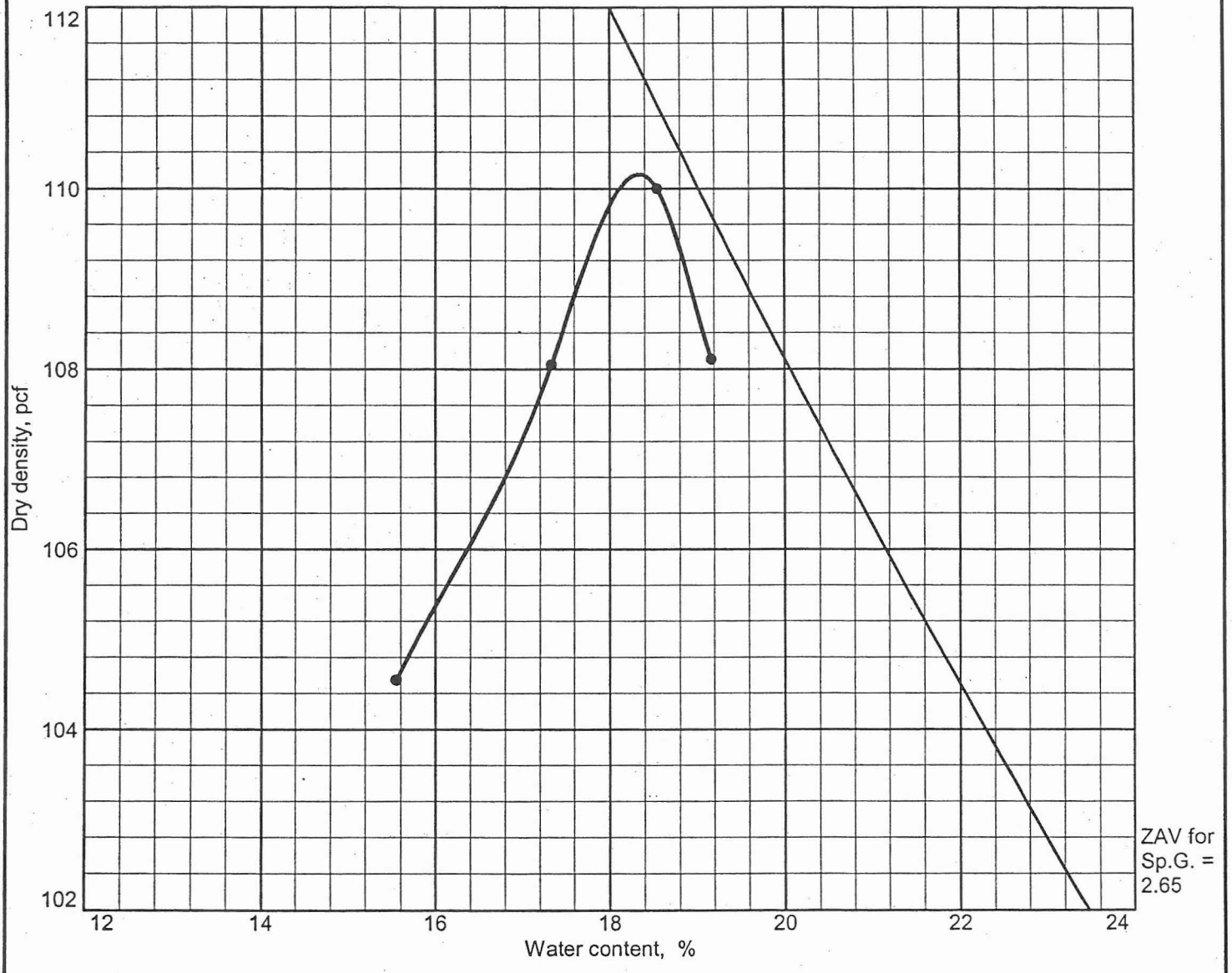
MOISTURE-DENSITY RELATIONSHIP TEST REPORT

ATL, INC.

Remarks:

Figure

MOISTURE-DENSITY RELATIONSHIP TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
5' - 10'				2.65				

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 110.2 pcf Optimum moisture = 18.3 %	

Project No. 103048 **Client:** DMJM+HARRIS

Project: Bethany Home Outfall Channel

● **Source:** B-15 **Sample No.:** 4-2321 **Elev./Depth:** 5' - 10'

Remarks:

MOISTURE-DENSITY RELATIONSHIP TEST REPORT

ATL, INC.

Figure

ATL, INC.
Excellence In Quality
Q.A./Q.C. ENGINEERING CONSULTANTS
GEOTECHNICAL • CIVIL • ENVIRONMENTAL

DMJM+HARRIS
BETHANY HOME OUTFALL CHANNEL
GLENDALE, ARIZONA
ATL JOB NO. 102048

MOISTURE CONTENT AND DRY UNIT WEIGHT

Bore Hole No.	Sample Depth (ft)	Moisture Content (%)	Unit Weight (pcf)
B-1	5.0	28.1	92.1
B-2	11.5	30.9	-
B-2	20.0	21.0	-
B-3	15.0	29.3	88.5
B-4	5.0	27.2	92.6
B-4	10.0	33.9	-
B-4	15.0	33.7	-
B-6	15.0	34.4	84.6
B-7	5.0	13.6	91.7
B-7	10.0	38.8	-
B-8	11.5	28.7	-
B-8	15.0	11.2	-
B-9	15.0	18.1	99.9
B-12	20.0	16.7	-
B-12	10.0	15.4	89.5
B-13	15.0	7.5	124.1
B-15	15.0	13.6	109.4

Submitted By:

Ammi Osorio, P.E.
Central Laboratory Engineer

2912 W. Clarendon Ave. ▪ Phoenix, AZ 85017-4609 ▪ 602.**241.1097** ▪ 602.277.1306 fax

ATL, INC.
Excellence In Quality
Q.A./Q.C. ENGINEERING CONSULTANTS
GEOTECHNICAL • CIVIL • ENVIRONMENTAL

DMJM + HARRIS
BETHANY HOME OUTFALL CHANNEL
GLENDALE, ARIZONA
ATL JOB NO. 103048

PH, SOIL RESISTIVITY, CHLORIDES AND SULFATES CONCENTRATION

Bore Hole No.	Depth (ft)	pH	Soil Resistivity (ohm-cm)	Chloride (ppm)	Sulphur (SO_4 - S) (ppm)
B-1	1 - 5	7.8	1141	630	310
B-1	5 - 10	8.0	2483	-	-
B-2	5 - 10	7.9	2617	-	-
B-3	1 - 5	7.6	738	-	-
B-3	5 - 10	7.9	550	-	-
B-4	10 - 15	7.8	3758	-	-
B-5	5 - 10	7.8	2080	120	92
B-6	5 - 10	8.0	2013	-	-
B-7	1 - 5	7.9	295	650	750
B-13	5 - 10	8.0	1543	-	-
B-14	1 - 5	8.2	3422	-	-
B-15	5 - 10	7.7	2483	120	110

Note: Sulfates and Chlorides tests were performed by IAS laboratories using ADOT Method ARIZ 733 and ADOT Method ARIZ 736.

Submitted by:

Ammi Osorio, P.E.
Laboratory Engineer

2912 W. Clarendon Ave. ▪ Phoenix, AZ 85017-4609 ▪ 602.**241.1097** ▪ 602.277.1306 fax

IAS Laboratories

2515 East University Drive
Phoenix, Arizona 85034
(602) 273-7248

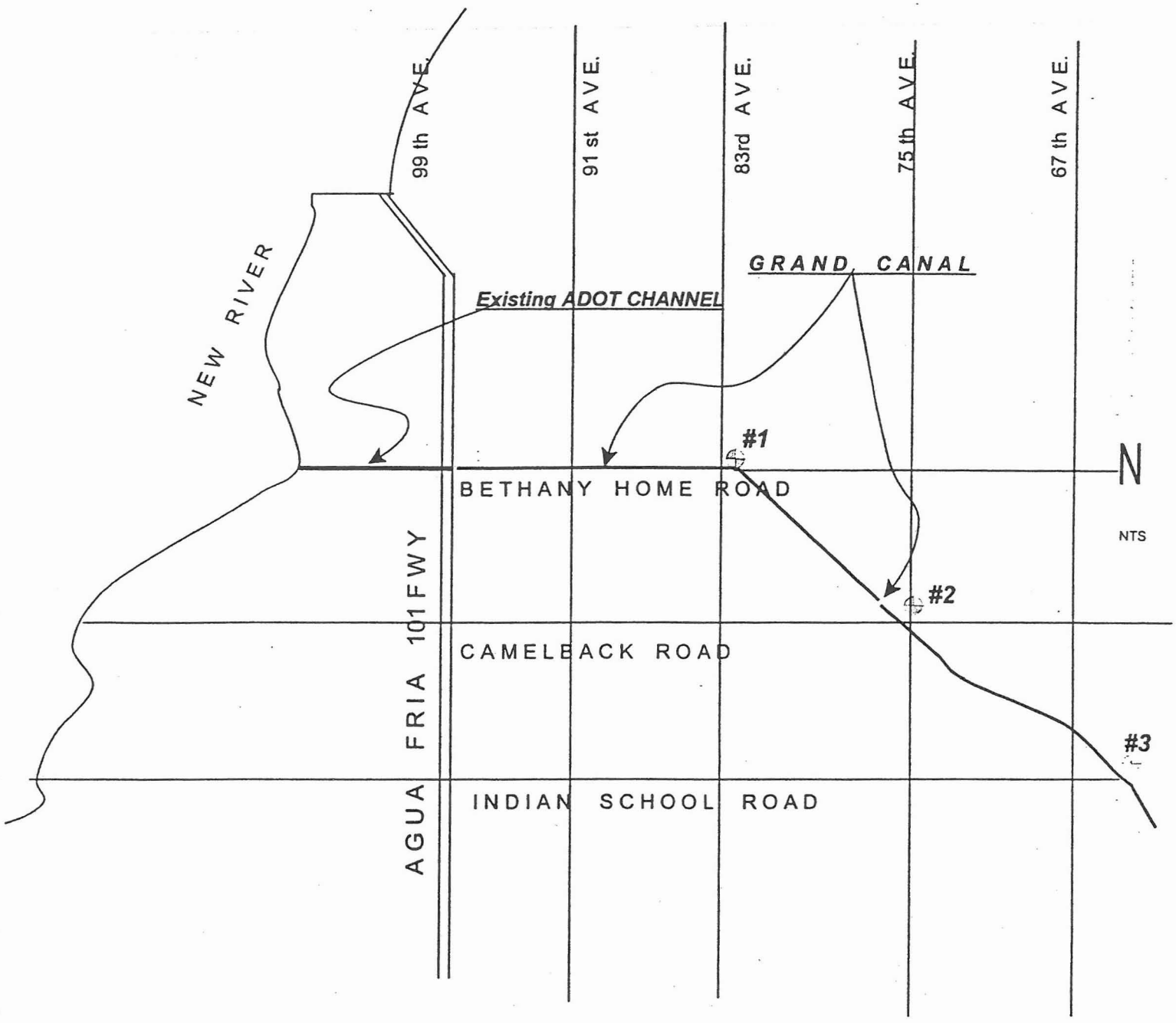
SOIL ANALYSIS REPORT

Today's Date: 2/13/2004
Grower: 103048
Submitted By: Ammi Osorio
Send Report To: ATL
Report Number: 6622689
Crop: No Interpretive Levels
Date Received: 2/10/2004

VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

	Sender Sample Id	Depth Ft.	Lab #	pH	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potash (K)	Iron (Fe)	Zinc (Zn)	Manganese (Mn)	Copper (Cu)	Salinity (EC x K) dS/m	Nitrate Nitrogen (NO3-N)	Phosphorus (Bicarb - Soluble P)	Computed % Sodium	Sulfur (SO4-S)	Boron (B)	Free Lime Level
	ATL LAB				PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM		PPM	PPM	(ESP)	PPM	PPM	
B1	04-2318	1-5	777	7.8	6700 VH	490 VH	190 M	230 H					2.8 M	100.0 VH	11.0 M	2.1	92 VH	.26 VL	High
B5	04-2319	5-10	778	7.6	7300 VH	610 VH	370 VH	280 VH					10.0 VH	540.0 VH	13.0 M	3.7	310 VH	.47 L	High
B7	04-2320	1-5	779	7.9	7600 VH	430 VH	850 VH	250 H					10.0 VH	340.0 VH	12.0 M	8.0	750 VH	1.1 M	High
B15	04-2321	5-10	780	7.7	8800 VH	560 VH	210 H	350 VH					3.0 M	98.0 VH	9.1 L	1.8	110 VH	.25 VL	High

APPENDIX C – ATL TEST BORING LOGS (Preliminary Investigation)



⊕ BORING LOCATIONS

BORING LOCATIONS

BETHANY HOME ROAD OUTFALL CHANNEL-PHASE II
FCD 98-46
Pre-Design Stage

ATL JOB NO. 199027

PLATE 4

APPENDIX A

BORING LOGS

BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II
FCD 98-46
Pre-Design Stage

ATL Job No. 199027

Boring No.: 1

Boring Location: 29 feet north of north edge Bethany Home
23 feet east of east edge 83rd Ave.

Boring Equipment: CME 55 6 5/8" auger

Date of Boring: 9/24/99 **Elevation of Boring:** Existing grade **Driller:** Manny with Enviro **Logger:** K. Phillips **Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Brown, clayey SAND(SC) with gravel, slightly moist		23		
	5		13			
	10		16			
	15	Dark brown, sandy lean CLAY(CL), moist	20			
	20	(Boring was Terminated at 20 feet below grade)				
	25					

Boring was Terminated at 20' below Existing Grade

Groundwater	Initial Depth	Hour	24 Hour Depth
	None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II
FCD 98-46
Pre-Design Stage

ATL Job No. 199027

Boring No.: 2

Boring Location: *102 feet north of north edge Camelback Road 32 feet east of east edge 75th Ave.*

Boring Equipment: *CME 55 6 5/8" auger*

Date of Boring: *9/24/99* **Elevation of Boring:** *Existing grade* **Driller:** *Manny with Enviro* **Logger:** *K. Phillips* **Reviewed By:** *A. Osorio*

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Brown, clayey SAND(SC) with gravel, sligthly moist		12		
	5		16			
	10	*Brown, sandy lean CLAY(CL), moist*	8			
	15	*Brown, clayey sand(SC), slightly moist*	32			
	20		11			
		(Boring was Terminated at 21 feet 6 inches below grade)				
	25					

Boring was Terminated at	21' 6"	below Existing Grade	Groundwater	Initial Depth	Hour	24 Hour Depth
				None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II
FCD 98-46
Pre-Design Stage

ATL Job No. 199027

Boring No.: 3

Boring Location: 40 feet north of north edge Indian School
9 feet east of east edge Grand Canal

Boring Equipment: CME 55 6 5/8" auger

Date of Boring: 9/24/99 **Elevation of Boring:** Existing grade **Driller:** Manny with Enviro **Logger:** K. Phillips **Reviewed By:** A. Osorio

Graphical Log	Depth (Feet)	SOIL DESCRIPTION	SPT Blows/ft	Ring Blows/ft	Water Content %	Dry Density (pcf)
		Brown, sandy lean CLAY(CL), moist		9		
	5	Brown, sandy, silty CLAY(CL-ML) , moist to saturated	5			
	10		3			
	15		11			
	20	(Boring was Terminated at 20 feet below grade)				
	25					

Boring was Terminated at 20' below Existing Grade	Groundwater	Initial Depth	Hour	24 Hour Depth
		None		

NOTE: THE ABOVE DATA FOR DESIGN PURPOSES ONLY.

APPENDIX D – ATL LABORATORY TEST DATA (Preliminary Investigation)

SUMMARY OF LABORATORY ANALYSIS

CLIENT: DMJM ARIZONA, INC. DATE: 11/15/99

PROJECT: BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II PRE-DESIGN STAGE

LOCATION: GLENDALE - PHOENIX, ARIZONA

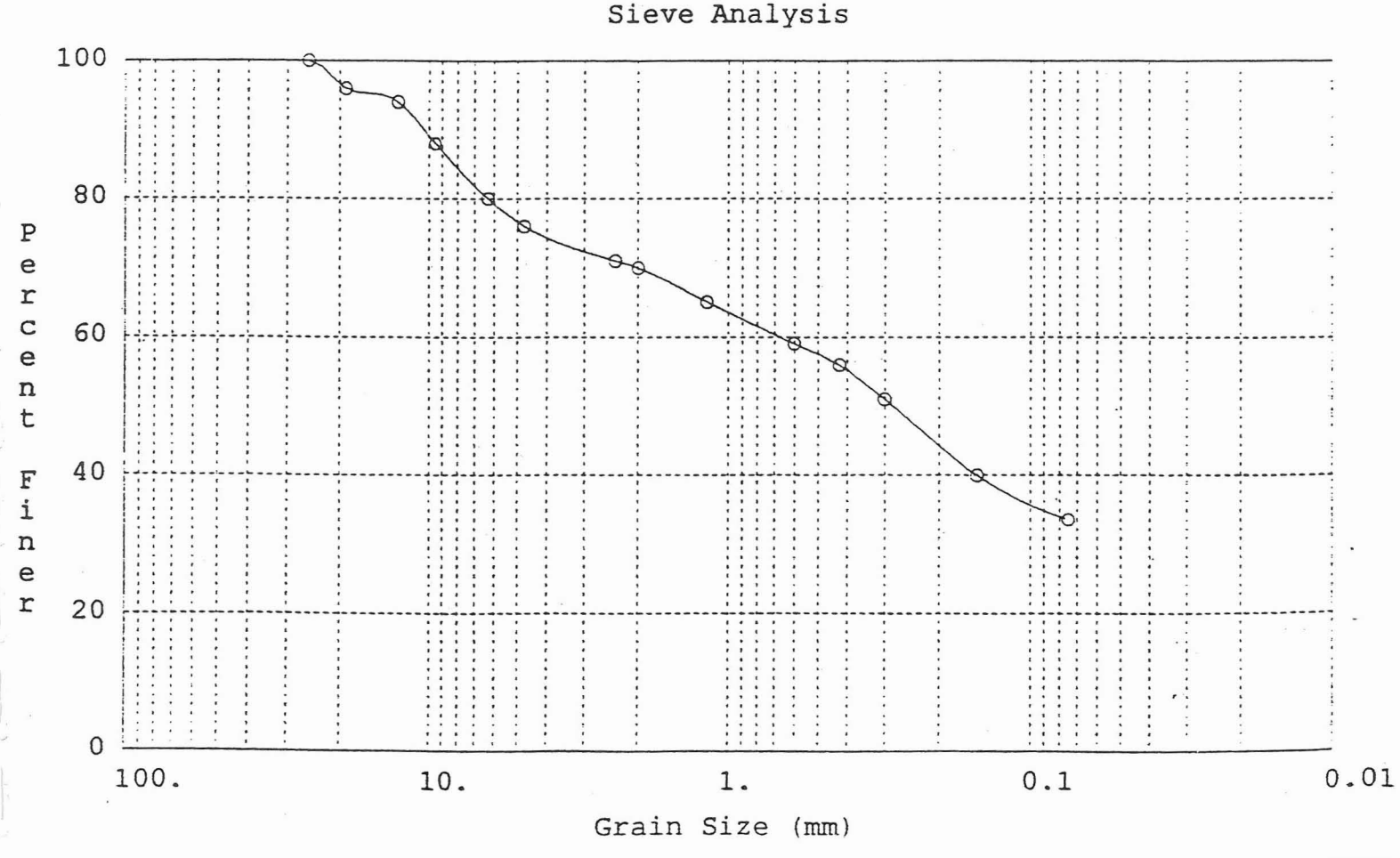
MATERIAL: See Below SAMPLING DATE: 09/24/99

REQUESTED BY: David Hayes ATL JOB NO: 199027

BORING No.	DEPTH (Feet)	IN-SITU Moist %	USCS	LL	PI	SIEVE ANALYSIS - PERCENT PASSING #200	#100	#50	#40	#30	#16	#10	#4	3/8"	3/4"	1.5"	3.0"
1	0 - 5	5.8	SC	27	10	33.6	40	51	56	59	65	70	76	88	96	100	-
1	10 - 15	9.2	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0 - 5	5.3	SC	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	10 - 15	13.2	CL	35	17	60.5	65	73	76	78	83	87	92	98	100	-	-
3	0 - 5	13.0	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	5 - 10	24.5	CL - ML	26	7	61.6	72	96	98	99	100	100	100	-	-	-	-

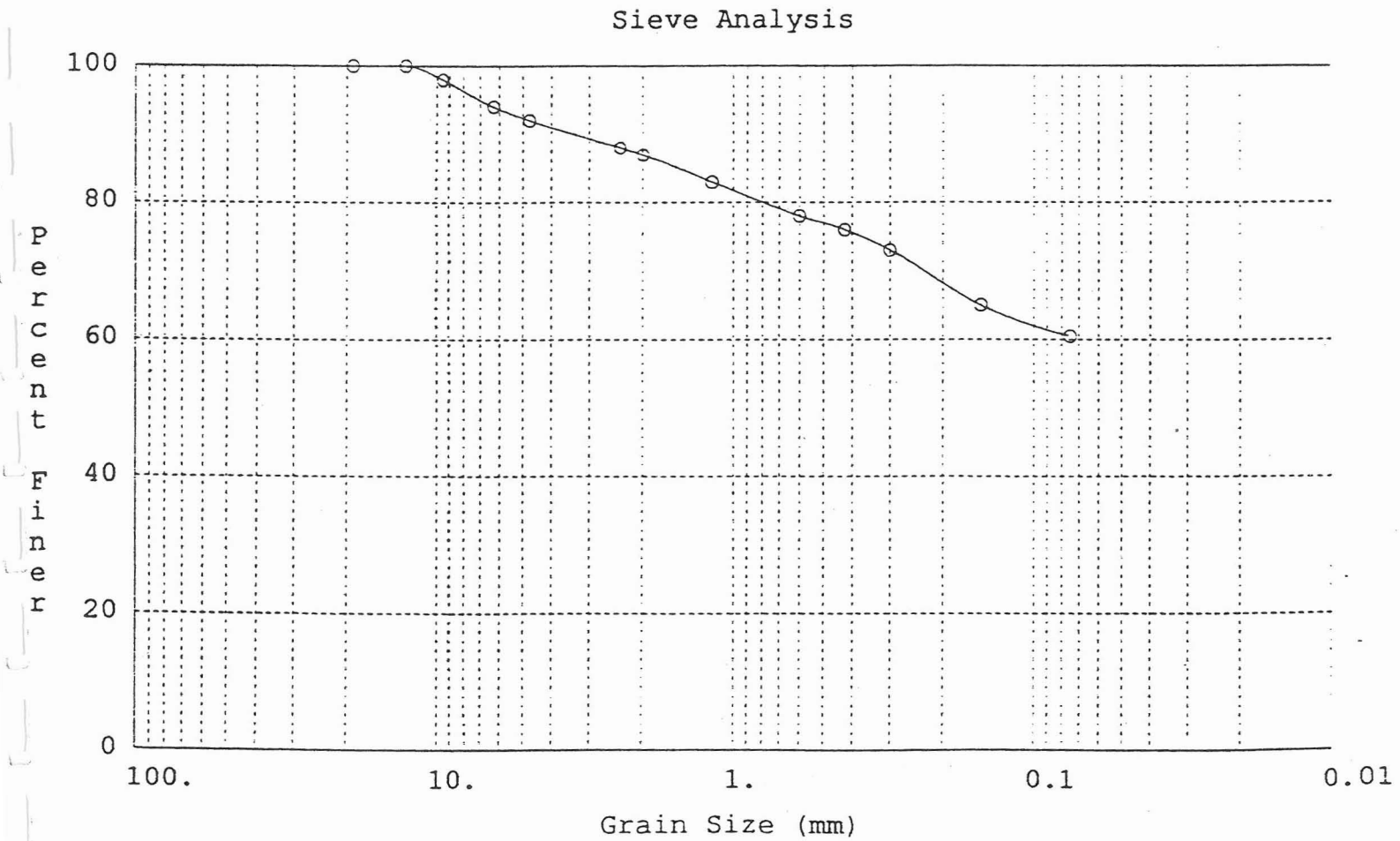
Project Number = 199027 Client: DMJM
Location = Bethany Home Outfall Channel
Date = 11/15/99
Tested By = Kirby P.
Boring Number = 1
Depth = 0 - 5'
Sample Number = 99-936
Description = Brown, clayey SAND(SC) with gravel
Dry Sample Weight (g) = 100

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
1"	25.400	0.00	0.00	0.00	100.00
3/4"	19.050	4.00	4.00	4.00	96.00
1/2"	12.700	2.00	2.00	6.00	94.00
3/8"	9.500	6.00	6.00	12.00	88.00
1/4"	6.300	8.00	8.00	20.00	80.00
#4	4.750	4.00	4.00	24.00	76.00
#8	2.370	5.00	5.00	29.00	71.00
#10	2.000	1.00	1.00	30.00	70.00
#16	1.180	5.00	5.00	35.00	65.00
#30	0.600	6.00	6.00	41.00	59.00
#40	0.425	3.00	3.00	44.00	56.00
#50	0.300	5.00	5.00	49.00	51.00
#100	0.150	11.00	11.00	60.00	40.00
#200	0.075	6.40	6.40	66.40	33.60
Pan	0.000	0.00	0.00	66.40	33.60



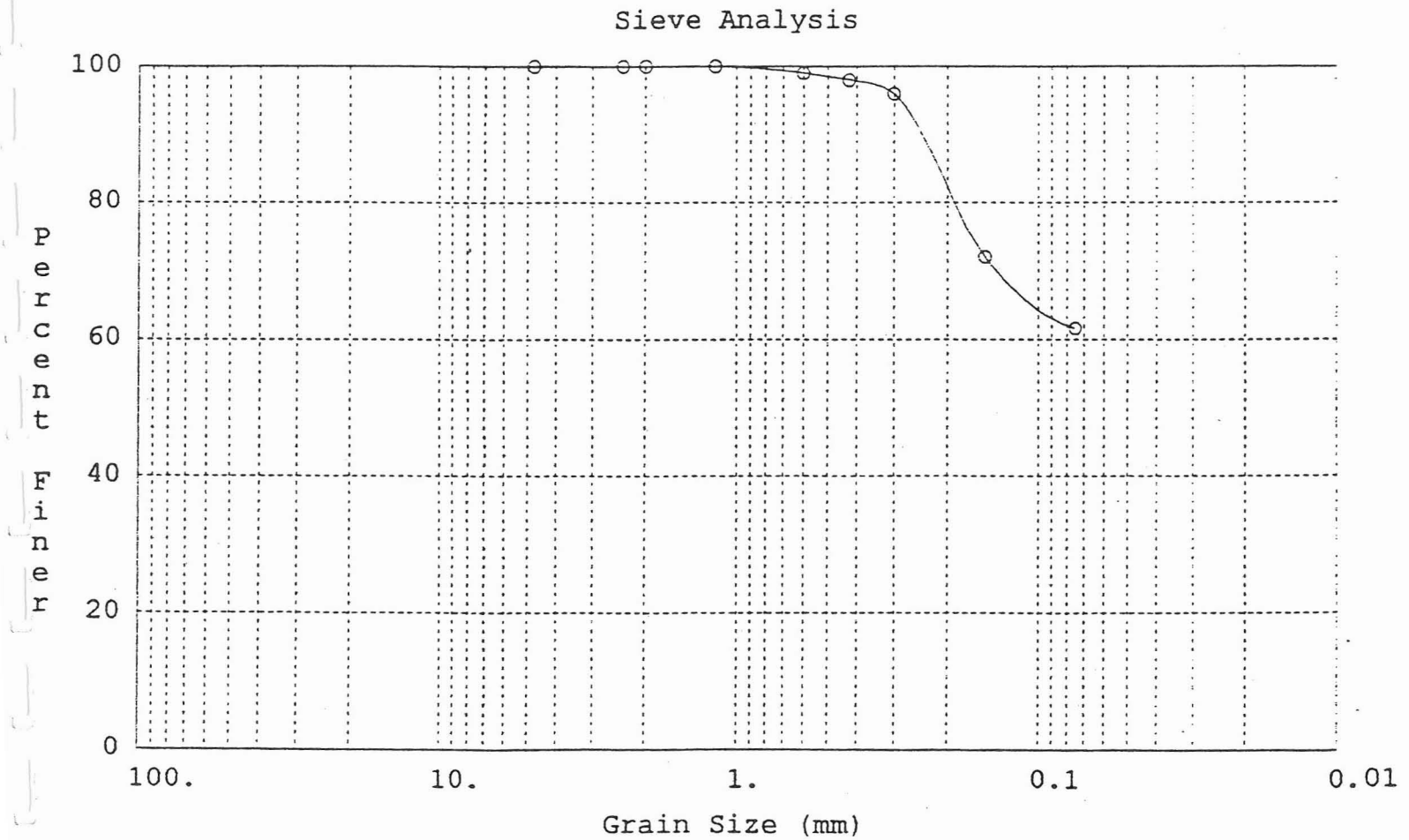
Project Number = 199027 Client: DMJM
Location = Bethany Home Outfall Channel
Date = 11/15/99
Tested By = Kirby P.
Boring Number = 2
Depth = 10 - 15'
Sample Number = 99-940
Description = Brown, sandy lean CLAY(CL)
Dry Sample Weight (g) = 100

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
3/4"	19.050	0.00	0.00	0.00	100.00
1/2"	12.700	0.00	0.00	0.00	100.00
3/8"	9.500	2.00	2.00	2.00	98.00
1/4"	6.300	4.00	4.00	6.00	94.00
#4	4.750	2.00	2.00	8.00	92.00
#8	2.370	4.00	4.00	12.00	88.00
#10	2.000	1.00	1.00	13.00	87.00
#16	1.180	4.00	4.00	17.00	83.00
#30	0.600	5.00	5.00	22.00	78.00
#40	0.425	2.00	2.00	24.00	76.00
#50	0.300	3.00	3.00	27.00	73.00
#100	0.150	8.00	8.00	35.00	65.00
#200	0.075	4.50	4.50	39.50	60.50
Pan	0.000	0.00	0.00	39.50	60.50



Project Number = 199027 Client: DMJM
Location = Bethany Home Outfall Channel
Date = 11/15/99
Tested By = Kirby P.
Boring Number = 3
Depth = 5' - 10'
Sample Number = 99-943
Description = Brown, sandy, silty CLAY(CL-ML)
Dry Sample Weight (g) = 100

SIEVE NUMBER	SIEVE OPENING (mm)	RETAINED WEIGHT (g)	PERCENT OF WEIGHT RETAINED	CUMULATIVE PERCENT RETAINED	PERCENT FINER (%)
#4	4.750	0.00	0.00	0.00	100.00
#8	2.370	0.00	0.00	0.00	100.00
#10	2.000	0.00	0.00	0.00	100.00
#16	1.180	0.00	0.00	0.00	100.00
#30	0.600	1.00	1.00	1.00	99.00
#40	0.425	1.00	1.00	2.00	98.00
#50	0.300	2.00	2.00	4.00	96.00
#100	0.150	24.00	24.00	28.00	72.00
#200	0.075	10.40	10.40	38.40	61.60
Pan	0.000	0.00	0.00	38.40	61.60



BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II
FCD 98 - 46
PRE-DESIGN STAGE
ATL JOB NO. 199027

DRY UNIT WEIGHT

Boring No.	USCS	Sample Depth (ft.)	Dry Unit Weight (pcf)
1	SC	2.5 - 3	98.8
3	CL	2.5 - 3	93.2

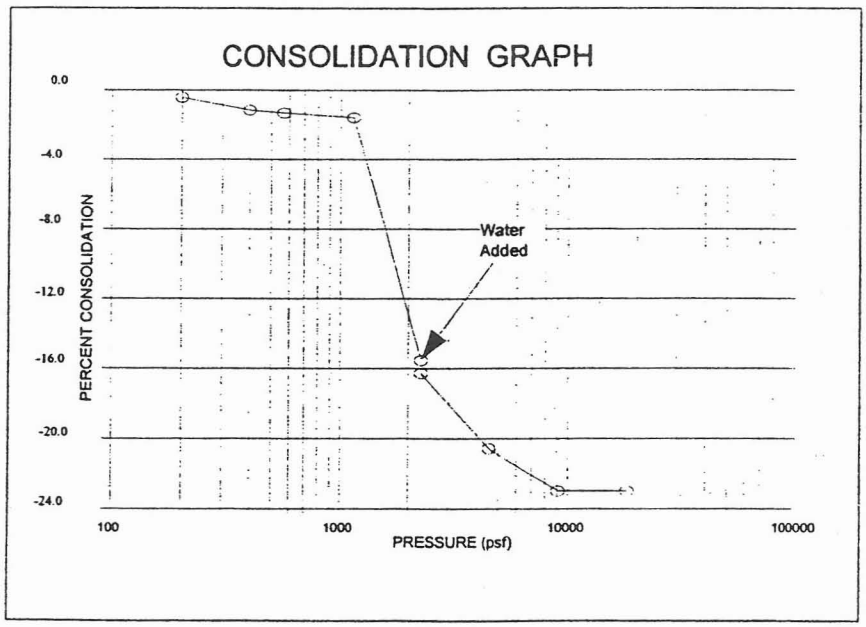
ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

PHOENIX – CORPORATE OFFICE
2912 W. Clarendon • Phoenix, AZ 85017
(602) 241-1097 • Fax (602) 277-1306

CONSOLIDATION TEST
(ASTM D-2435)

Client:	DMJM	**Lab No.:**	99-1104
Project Name :	Bethany Home Outfall Channel	**Test Date:**	12/22/99
Project No. :	199027	**Sample Location:**	Boring No.: 2
Initial Reading:	0.2000		Depth:2.5' - 3.0'
Dry Density:	98.8 pcf	**Soil Description:**	Brown, clayey SAND(SC) with gravel
Moisture Content:	Before: 4.01 % After: 13.8 %		

LOAD (tsf)	LOAD (psf)	DIAL READING	PERCENT CONSOLIDATION
0.05	100	0.2024	-0.24
0.10	200	0.2042	-0.42
0.20	400	0.2115	-1.15
0.29	570	0.2128	-1.28
0.57	1140	0.2157	-1.57
1.14	2280	0.3552	-15.52
1.14	2280	0.3627	-16.27
2.28	4560	0.4054	-20.54
4.56	9120	0.4296	-22.96
9.12	18240	0.4296	-22.96
4.56	9120	0.4296	-22.96



TUCSON (520) 623-4547 Fax (520) 623-4603
FLAGSTAFF (520) 522-0347 Fax (520) 522-0350
GLOBE (520) 425-8999 Fax (520) 425-9597
HUACHUCA CITY (520) 456-0087 Fax (520) 456-0089
PRESCOTT VALLEY (520) 759-2238 Fax (520) 759-2239
LAS VEGAS (702) 871-0492 Fax (702) 871-3643

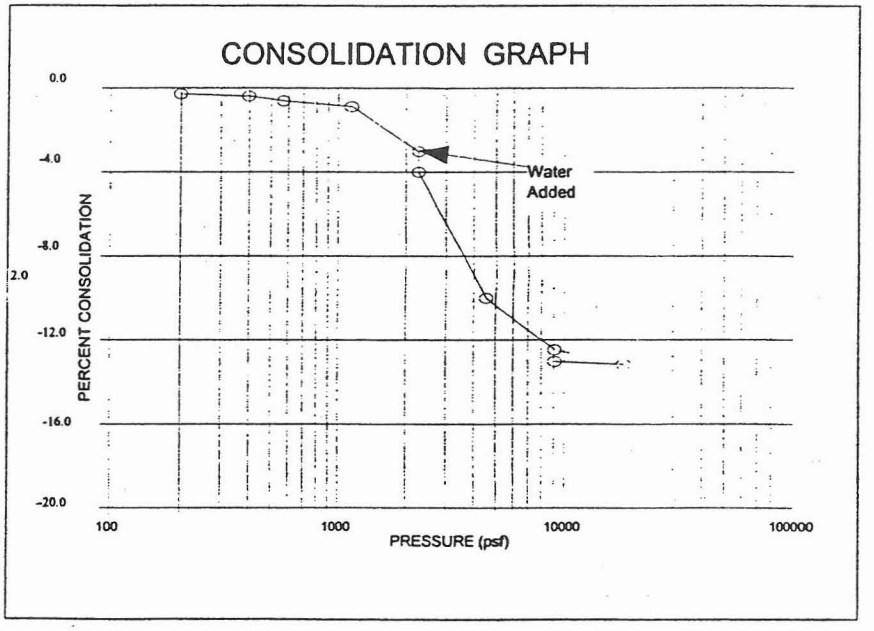
ATL, INC.
CONSTRUCTION QUALITY CONTROL
GEOTECHNICAL CONSULTANTS

PHOENIX – CORPORATE OFFICE
2912 W. Clarendon • Phoenix, AZ 85017
(602) 241-1097 • Fax (602) 277-1306

CONSOLIDATION TEST
(ASTM D-2435)

Client:	DMJM	**Lab No.:**	99-1103
Project Name :	Bethany Home Road Outfall Channel	**Test Date:**	12/22/99
Project No. :	199027	**Sample Location:**	Boring No.: 1
Initial Reading:	0.2000		Depth:20.5' - 21.0'
Dry Density:	111.7 pcf	**Soil Description:**	Dark brown, sandy lean CLAY(CL)
Moisture Content:	Before: 3.15 % After: 15.7 %		

LOAD (tsf)	LOAD (psf)	DIAL READING	PERCENT CONSOLIDATION
0.05	100	0.2013	-0.13
0.10	200	0.2027	-0.27
0.20	400	0.2038	-0.38
0.29	570	0.2060	-0.60
0.57	1140	0.2088	-0.88
1.14	2280	0.2302	-3.02
1.14	2280	0.2400	-4.00
2.28	4560	0.3000	-10.00
4.56	9120	0.3245	-12.45
9.12	18240	0.3315	-13.15
4.56	9120	0.3300	-13.00



BETHANY HOME ROAD OUTFALL CHANNEL - PHASE II
FCD 98-46
PRE-DESIGN STAGE
ATL JOB NO. 199027

pH AND RESISTIVITY TESTS

Boring No.	Depth (Ft)	USCS	pH	Soil Resistivity (ohms - cm)
1	0 - 5	SC	8.28	2917
2	0 - 5	SC	8.05	530
3	0 - 5	CL	7.92	398