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32ND STREET BRIDGE OVER THE ARIZONA CANAL
DIVERSION CHANNEL
MARICOPA COUNTY FLOOD CONTROL DISTRICT
FCD 88-38
PARADISE VALLEY, ARIZONA
PHOENIX, ARIZONA

A118.969

REVIEWED BY:

Registered Professional Engineer (Civil)
CERTIFICATE NO. 22719
David Preston Hayes
Date Signed 7/13/89
ARIZONA, U.S.A.

David P. Hayes, P.E.
Executive Vice President

REPORT OF

GEOTECHNICAL INVESTIGATION

FOR

CREEGAN & D'ANGELO

ATL JOB NO: 189036

July 13, 1989

PROJECT

32ND STREET BRIDGE OVER THE ARIZONA CANAL
DIVERSION CHANNEL
MARICOPA COUNTY FLOOD CONTROL DISTRICT
FCD 88-38
PARADISE VALLEY, ARIZONA
PHOENIX, ARIZONA

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JUL 19 1989
CREEGAN + D'ANGELO

ATL TESTING LABORATORIES
GEOTECHNICAL AND MATERIALS CONSULTANTS

July 13, 1989

Creegan & D'Angelo
650 North Second Avenue
Phoenix, Arizona 85003

Attention: Mr. Harold G. Gerdin, P.E.

Subject: Geotechnical Investigation
32nd Street Bridge Over
The Arizona Canal Diversion Channel
FCD 88-38
ATL Job No: 189036

Gentlemen:

This report presents the results of a geotechnical investigation of the subject site. Presented are the results of our field exploration, laboratory tests, and geotechnical engineering analysis. Our work was done in accordance with ATL Proposal Number P89012.

Plate No. 1 presents the guidelines in the use and interpretation of this report. ATL has appreciated the opportunity to be of service to you on this project and look forward to a continued association on this and future projects. Should any questions arise, please do not hesitate to contact us at your earliest convenience.

Very truly yours,
ATL TESTING LABORATORIES

James D. Rose
Senior Geotechnical Engineer

REVIEWED BY:

David R. Hayes, P.E.
Executive Vice President

JDR/DPH/bs

TABLE OF CONTENTS


| | | Page |
|---|---|---|
| 1.0 | PROJECT DESCRIPTION | 1 |
| 2.0 | SCOPE OF WORK | 3 |
| 3.0 | FIELD INVESTIGATION | 3 |
| | 3.1 Location | 3 |
| | 3.2 Site Description | 4 |
| | 3.3 Field Testing | 4 |
| 4.0 | LABORATORY TESTING | 5 |
| 5.0 | SUMMARY SUBSURFACE CONDITIONS | 5 |
| 6.0 | DISCUSSION & RECOMMENDATIONS | 6 |
| | 6.1 Foundations - 32nd Street Bridge | 6 |
| | 6.2 Foundations- Temporary Bridge | 9 |
| | 6.3 35th Street Wash Conduit | 11 |
| | 6.4 Lateral Earth Pressures | 14 |
| | 6.5 Pavement Sections | 15 |
| | 6.6 General Construction Recommendations | 16 |
| 7.0 | ADDITIONAL SERVICES | 17 |

TABLE OF CONTENTS

- CONTINUED -


| | |
|---|---|
| PLATE NO. 1 | GUIDELINES IN THE USE AND INTERPRETATION OF THIS REPORT |
| PLATE NO. 2 | VICINITY MAP |
| PLATE NO. 3 | BORING PLAN |
| APPENDIX A | LOGS OF BORING |
| APPENDIX B | TEST RESULTS |

| | Page |
|---|---|
| RESISTIVITY TEST RESULTS | B1 |
| MOISTURE-DENSITY RELATIONS OF SOIL | B2 |
| SOLUBLE SULFATES | B3 |
| TABULATION OF INDEX RESULTS | B4 |


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REPORT OF

GEOTECHNICAL INVESTIGATION

FOR

CREEGAN & D'ANGELO

ATL JOB NO: 189036

July 13, 1989

PROJECT

32ND STREET BRIDGE OVER THE ARIZONA CANAL
DIVERSION CHANNEL
FCD 88-38
PARADISE VALLEY, ARIZONA
PHOENIX, ARIZONA

## 1.0 PROJECT DESCRIPTION

The 32nd Street Bridge over the Arizona Canal Diversion Channel (ACDC) project begins west of the existing 32nd Street Bridge, extends southeast down Stanford Drive approximately 400 feet and runs east approximately 570 feet to a grouted stone basin at the terminus of the 35th Street Wash. The Maricopa County Flood Control District (FCD) plans to relocate utilities, construct a bridge at 32nd Street, build road approaches and detours, provide an inlet structure and conduits for the proposed ACDC.

The proposed bridge will have a forty (40) foot clear span with a width equal to the existing bridge crossing the Arizona Canal plus two eight (8) foot wide sidewalks. The proposed bridge structure will be skewed twenty six (26) degrees right.

To intercept surface water flow from the 35th Street Wash, a grouted stone basin with wingwalls has been proposed along with a covered box culvert or pipe conduit extending 550 feet to the west intersecting the ACDC.

It is anticipated that the City of Phoenix will provide street section design requirements and the Corps of Engineers will produce the design of the ACDC under Stanford Drive.

Elevations of the existing 32nd Street surface at the existing Arizona Canal Bridge is approximately 1249 feet. The bottom of the ACDC excavation at 32nd Street will be approximately at elevation 1221.

From information supplied by Creegan & D'Angelo, these estimated loads will need to be designed for:

| | |
|---|---|
| 32nd Street Bridge Abutments | 17 kips/lineal foot along abutments |
| Temporary Bridge over Arizona Canal | 24.8 kips/lineal foot along abutments |

## 2.0 SCOPE OF WORK

The general purpose of this investigation is to present test results and conclusions regarding subsurface soil and groundwater conditions, and to present our geotechnical engineering recommendations for the bridge abutment drilled piers and spread footings for the temporary bridge.

The specific tasks of this investigation include the following:

1) Drilled pier size, capacity, and founding depth for 32nd Street Bridge.

2) Spread footing size, capacity, and founding depth for the temporary bridge over Arizona Canal.

3) Ease of excavation for on-site soils, safe slope for open cuts at the wingwalls and channel.

4) Lateral earth pressures.

## 3.0 FIELD INVESTIGATION

### 3.1 Location

The site is located at the Arizona Canal at 32nd Street in Phoenix, and extends southeast along Stanford Drive into the town of Paradise Valley. The proposed conduit composed

of three (3) 7 by 7.5 feet box culverts then departs from Stanford Drive extending east through private property approximately 500 feet in length to the inlet structure. The inlet structure is located at the terminus of the 35th Street Wash.

### 3.2 Site Description

The inlet structure at the terminus of the 35th Street Wash is located on residential property within Paradise Valley. Mesquite trees, cacti, native grasses, and man-introduced grasses exist in the proposed location of the inlet structure and box culvert conduit. Existing Stanford Drive is a paved two lane city street paralleling the existing Arizona Canal. The Arizona Canal runs in a northwest direction crossing under 32nd Street at the City Limits of Phoenix.

### 3.3 Field Testing

At seven locations, eight-inch-diameter test borings were drilled with a Mobile B-50 drill rig using continuous flight auger and Halco downhole pneumatic hammer. Borings were extended to maximum depths of 16.5 to 55 feet below existing grades.

Thirty-nine (39) Standard Penetration Tests (SPT) were performed at selected depths and locations in accordance with ASTM Test Designation D-1586. The SPT sampler was driven with a 140-pound hammer falling thirty inches. Our field representative logged the borings and sampled the different soils encountered. The locations of the seven borings are shown on the Site Plan, Plate No. 3. The field information is summarized on the boring logs presented in Appendix 1.

## 4.0 LABORATORY TESTING

Soil samples were returned to our laboratory for further examination. Visual classifications were supplemented by index tests as sieve analyses and Atterberg Limits on representative samples. Moisture tests were also performed. Results of the sieve analyses, Atterberg Limits, and moisture tests are presented in Appendix 2.

## 5.0 SUMMARY SUBSURFACE CONDITIONS

Borings numbers 1, 2, and 3 revealed that the top three to seven feet of the subsurface consisted of a light brown loose to medium dense, silty sand. Below this layer, medium dense to dense, clayey sand and gravel with weak to moderate cementation was encountered.

In boring numbers 4 through 7, silty, clayey sand and gravel was encountered from surface to depths of approximately thirty (30) feet. In boring numbers 4 and 5, dense to very dense, cemented, sandy, clayey gravel was encountered from approximately thirty (30) feet of depth to the bottom of the boring at a depth of fifty-five (55) feet. A pneumatic downhole hammer was used to penetrate the formation from thirty to fifty-five feet of depth. This formation is composed of highly weathered, clayey granitic gravel and cobbles.

The appended boring logs present a detailed description of the subsurface conditions at each location explored.

## 6.0 DISCUSSION & RECOMMENDATIONS

### 6.1 Foundations - 32nd Street Bridge

At the location of the 32nd Street Bridge, ATL's test borings encountered at approximately 30 feet of depth, granitic gravel and cobbles requiring penetration with a pneumatic downhole hammer. The proposed ACDC invert elevation is approximately elevation 1223 feet with depth of excavation to approximately elevation 1221 feet. Groundwater was encountered at approximately 26 to 32 feet of depth below existing grade.

In boring numbers 4 through 7, silty, clayey sand and gravel was encountered from surface to depths of approximately thirty (30) feet. In boring numbers 4 and 5, dense to very dense, cemented, sandy, clayey gravel was encountered from approximately thirty (30) feet of depth to the bottom of the boring at a depth of fifty-five (55) feet. A pneumatic downhole hammer was used to penetrate the formation from thirty to fifty-five feet of depth. This formation is composed of highly weathered, clayey granitic gravel and cobbles.

The appended boring logs present a detailed description of the subsurface conditions at each location explored.

## 6.0 DISCUSSION & RECOMMENDATIONS

### 6.1 Foundations - 32nd Street Bridge

At the location of the 32nd Street Bridge, ATL's test borings encountered at approximately 30 feet of depth, granitic gravel and cobbles requiring penetration with a pneumatic downhole hammer. The proposed ACDC invert elevation is approximately elevation 1223 feet with depth of excavation to approximately elevation 1221 feet. Groundwater was encountered at approximately 26 to 32 feet of depth below existing grade.

Given these conditions, deep foundations extending below the excavation line for the ACDC are necessitated for support of the bridge. When the excavation for the ACDC is made, the deep foundations are subjected to lateral loads from the retained soil. The lateral loads require embedment of the foundation element to a depth offering sufficient lateral support capability as well as sufficient axial load capacity.

Further, ATL's assumptions for use of a deep foundation system such as drilled piers include the bridge deck offering lateral restraint at the top of the piers as ATL does not consider tie backs or rock anchors to be practical for providing lateral constraint.

The weakly to moderately cemented soils lack sufficient point anchorage strength in the upper 30 feet for the use of tie backs or rock anchors.

Therefore, ATL recommends the use of drilled piers embedded a minimum of seven (7) feet below the ACDC excavation line at approximately elevation 1221 feet. Following the excavation for the ACDC, the soil between piers is anticipated to "arch" since the soil is moderately cemented and dense in condition. Additionally, ATL's small diameter bore holes stood open without casing and below

groundwater during drilling operations, lending creedance to the probability of arching.

Consultation with an experienced drilling contractor indicated that the cemented, granitic gravel and cobbles can be drilled with large diameter auger (1.5' to 3') with moderate to difficult resistance to the auger down to depths of 40 feet. As noted on the boring logs for the hole Nos. 4 and 5, standard penetration resistance and hammer time both typically increased with depth.

The following table presents recommendations for drilled piers:

TABLE 1

| Diameter (Ft) | Depth Below Grade (Ft) | Tip Elevation (Ft.) | Allowable Load (Kips) |
|---|---|---|---|
| 1.5 | 37 | 1211.7 | 53 |
| 2 | 37 | 1211.7 | 94 |
| 3 | 37 | 1211.7 | 211 |
| 1.5 | 40 | 1208.7 | 76 |
| 2 | 40 | 1208.7 | 135 |
| 3 | 40 | 1208.7 | 301 |

A minimum spacing of 3 pier diameters on center between piers is recommended for the above listed allowable loads.

At the embedded zone of the drilled pier, the passive resistance of the granite gravel and cobbles is calculated to be an average of 2650 psf of projected pier area for an embedment of 7 feet below the ACDC excavation line. An average of 3785 psf of passive resistance may be used at 10 feet of embedment below the excavation line. These passive resistances are based upon Rankin assumptions, an internal angle of friction of 45 degrees, a unit weight of 130 pcf, and an equivalent fluid pressure of 757 pcf.

Cutoff walls have been proposed for use at the northwest corner of the north bridge abutment and the southeast corner of the south bridge abutment. In order to provide vertical and lateral support for the proposed cutoff walls, ATL recommends using a drilled pier under each cutoff wall. The drilled piers should be the same diameter and length as these supporting the adjacent abutment.

The drilled piers should be spaced no greater distance from the end piers under the abutments than the selected pier spacing in order to maintain "arching" of the soil.

6.2 Foundations - Temporary Bridge

The temporary bridge over the Arizona Canal may be founded on shallow spread footings. The temporary bridge will be composed of box girders having an estimated load on

the supporting footing including stem weight of 24.8 kips per lineal foot along the abutment.

Shallow spread footings shall be founded on recompacted light brown, clayey, gravelly sand. Allowable soil contact pressures are given in Table 2.

TABLE 2

| Founding Elevation (ft.) | Allowable Soil Contact Pressure |
|---|---|
| 1244.7 | 1400 psf |
| 1242.7 | 1625 psf |
| 1240.7 | 4000 psf |
| 1238.7 | 7000 psf |

The top 6 inches of native bearing soils shall be recompacted to 90 percent of maximum dry density as determined by ASTD D-698 in order to avoid any soft, loose, spots beneath the temporary foundation.

As an alternate to spread footings for support of the abutments, drilled piers may be used to support the temporary bridge. The drilled piers shall penetrate into the very dense clayey, gravelly sand a minimum of 15 feet from existing grade at both sides of the Arizona Canal.

Allowable load capacities are given in Table 3.

Table 3

| Diameter (ft.) | Length Below Grade (ft.) | Allowable Loads (kips) |
|---|---|---|
| 3.0 | 15 | 155 |
| 4.0 | 15 | 276 |

A minimum spacing of 3 pier diameters center-to-center between piers is necessary for the above listed allowable loads.

6.3 35th Street Wash Conduit

For the covered conduit, several box type conduits and round pipe conduits are being considered. A single span box structure, two 12' by 7' boxes or three 7.5' by 7' boxes may be used. Alternatively, two 11' diameter coated galvanized corrugated metal pipe (CMP) or two 12' diameter reinforced concrete pipe (RCP) are also being considered.

Resistivity test results obtained from soil samples from borings 1 and 2 exceed the threshold value of 1500 ohms/cm allowing the use of coated galvanized CMP without cathodic protection. Refer to the Appendix for a tabulation of resistivity test results.

Following clearing, grubbing and excavation for the selected type of conduit the top 1 foot of the select bedding material shall be compacted to 90 percent of maximum dry density as established by AASHTO T-99.

The bedding material shall be select material meeting Maricopa Association of Governments (MAG) Section 601 requirements.

Lateral earth pressures for backfill placed adjacent to the sides of the conduit can be approximated by the following equivalent fluid pressure (EFP) using an internal angle of friction of 35 degrees and a material unit weight of 115 pcf.

| Type of Earth Pressure | EFP Value (PCF) |
|---|---|
| Active | 31 |
| At-Rest | 49 |
| Passive | 424 |

Light weight compaction equipment should be used adjacent to walls to minimize lateral loading due to surcharge effect.

Compaction of the top 2 feet of backfill above the conduit under Stanford Drive shall be compacted to a minimum of 100 percent of maximum dry density as established by AASHTO T-99.

The area under the dike shall be cleared, grabbed, scarified and recompacted to a minimum of 95 percent of maximum dry density as established by AASHTO T-99. Fill material for the dike should be on-site clayey sand and gravel placed in 6 inches maximum thickness lifts to a minimum of 95 percent of maximum dry density established by ASTM D 698. Moisture content should be within ± 2 percent of optimum moisture content.

Use of on-site excavated sand and gravel with clayey fines for the dike is necessitated by the need for fines with some cohesiveness in order to have long term stability of slopes with no erosion. The slopes on either side of the dike should be limited to 1.75 horizontal to 1 vertical (H:V).

Riprap to be used in the grouted stone basin shall meet the requirements of Section 703 of the Uniform Standard Specification for Public Works Construction of the Maricopa Association of Governments (MAG).

## 6.4 Lateral Earth Pressures

The lateral earth pressures behind bridge abutments, wingwalls, and piers from surface to 15 feet of depth can be approximated by the following equivalent fluid pressure (EFP) for the native soils.

An internal friction angle of 35 degrees and a soil unit weight of 115 pcf are used in the determinations:

| Type of Earth Pressure | EFP Value (pcf) |
|---|---|
| Active | 31 |
| At-Rest | 49 |
| Passive | 424 |

The lateral earth behind piers can be approximated by the following equivalent fluid pressures (EFP) for native soil to approximately 15 to 30 feet of depth based upon an internal friction angle of 40 degrees and a unit weight of soil to be 120 pcf are used in the determinations:

| Type of Earth Pressures | EFP Value (pcf) |
|---|---|
| Active | 26 |
| At-Rest | 43 |
| Passive | 551 |

## 6.5 Pavement Sections

On the north side of the proposed bridge, the existing asphaltic pavement section of 32nd Street consisting of 5.0 inches of asphaltic concrete (AC) over 4.0 inches of aggregate base course (ABC) over 6.0 inches of select material shall be used in the reconstructed area. The AC shall meet requirements of the City of Phoenix Standard Specifications No. 558 (C-3/4). The ABC shall consist of material conforming to the City of Phoenix Standard Specifications No. 556 and 557.

For the area between the existing bridge and the proposed bridge, a portland cement concrete pavement (PCCP) is recommended. The pavement section should consist of a minimum of 8.5 inches PCCP over a minimum of 4.0 inches of ABC over compacted native subgrade. The PCCP shall be of minimum flexural strength of 650 psi at 28 days.

Temporary pavement is anticipated on the 32nd Street detour and bridge approach. The existing subgrade is typically a silty sand or a silty gravel which has good support for the selected pavement section. ATL recommends a minimum pavement section consisting of a minimum 2.0 inches AC over a minimum of 4.0 inches of compacted ABC. The AC and ABC shall meet the same requirements as stated above.

## 6.6 General Construction Recommendations

Installation of the bridge foundations, wingwalls, channel earthwork should be performed in accordance with Maricopa Association of Government Uniform Standard Specifications for public works construction, Section 601 and applicable City of Phoenix supplements.

Backfill material consisting of native soils behind bridge abutments shall be compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D 698. The moisture content shall be at optimum moisture content ± 2 percent.

Fill to be placed for the anticipated ramp-up at the south end of the temporary bridge shall be placed to a minimum of 95 percent of maximum dry density as determined by ASTM D 698. Compaction of select material within the pavement section shall be to a minimum of 95 percent of maximum dry density as determined by ASTM D 698. Compaction of ABC shall be to a minimum of 100 percent of maximum dry density as determined by ASTM D 698. Moisture content of fill, select material, ABC shall be at optimum moisture content ± 2 percent.

Open cut slopes of 3/4:1 (H:V) are recommended for the top five (5) feet at the wingwalls excavations with cut slopes of 1/2:1 recommended from depths of five (5) to thirty (30) feet.

## 7.0 ADDITIONAL SERVICES

It is recommended that ATL Testing Laboratories be retained to provide geotechnical services during construction. This is to observe compliance with design concepts, specifications or recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

Open cut slopes of 3/4:1 (H:V) are recommended for the top five (5) feet at the wingwalls excavations with cut slopes of 1/2:1 recommended from depths of five (5) to thirty (30) feet.

## 7.0 ADDITIONAL SERVICES

It is recommended that ATL Testing Laboratories be retained to provide geotechnical services during construction. This is to observe compliance with design concepts, specifications or recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

# Guidelines in the Use and Interpretation of This Geotechnical Report

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

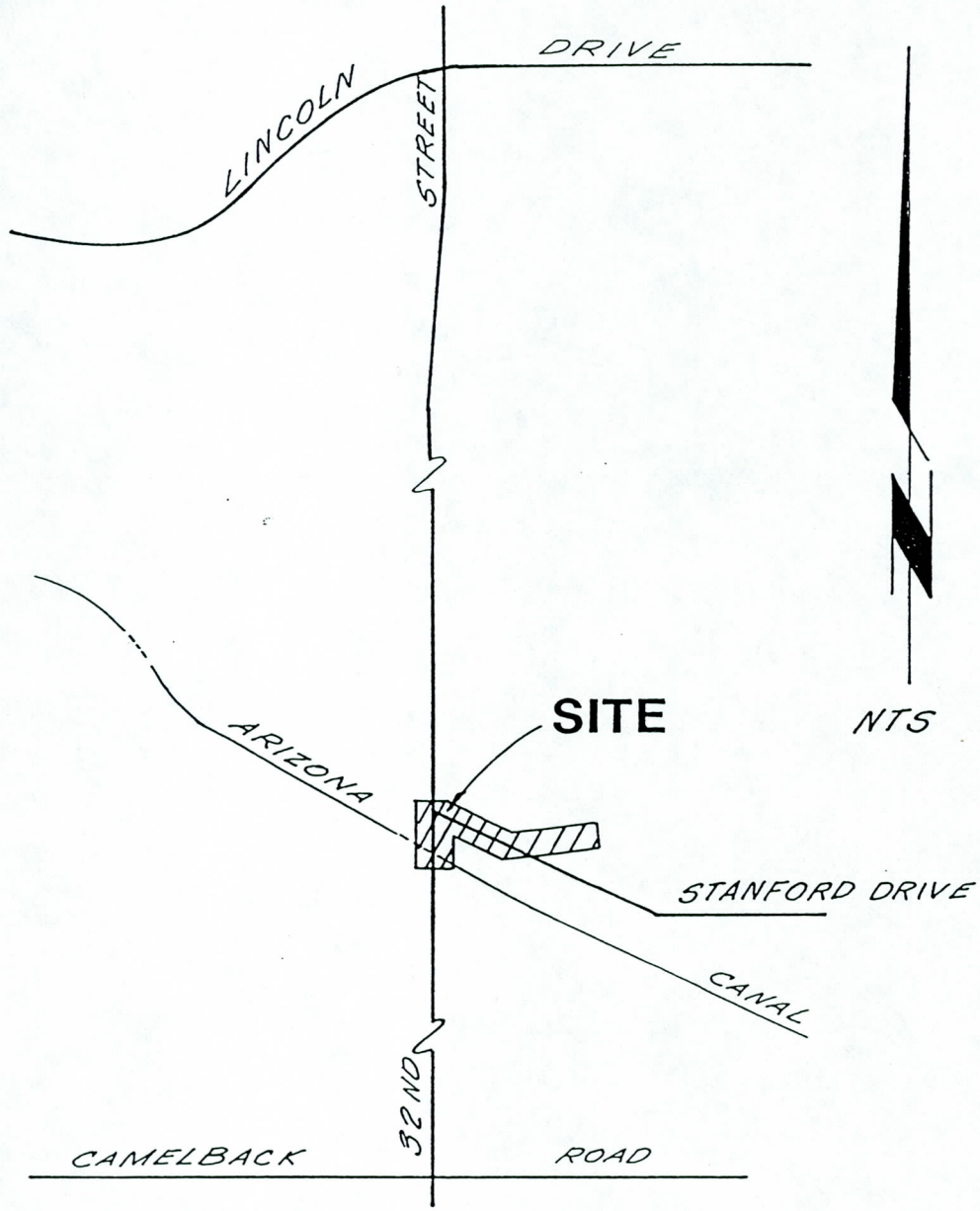
The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.

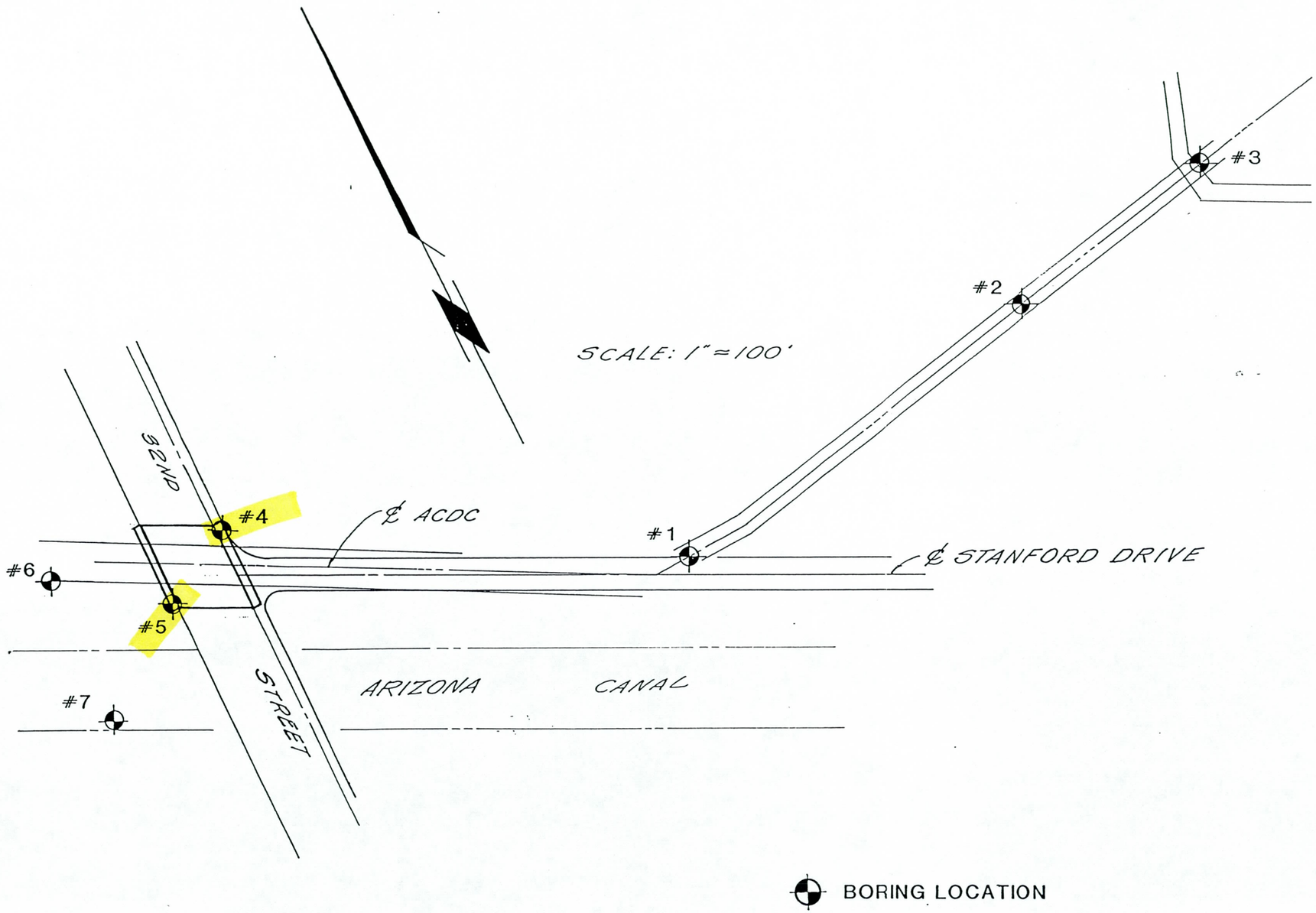



ATL Testing Laboratories

# VICINITY MAP

ACDC CANAL-32ND STREET

ATL JOB NO. 189036




ATL Testing Laboratories

**SITE PLAN**

ACDC CANAL–32ND STREET

ATL JOB NO. 189036

# APPENDIX A

# BORING LOGS

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 1

LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-29-89

ELEVATION OF BORING: 1247.43

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK

FIELD ENGINEER: MARK REISIG

REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (Feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | 4 IN. ASPH. CONCRETE-7 IN. AGGR. BASE | | | | | |
| | | LIGHT BROWN SANDY GRAVEL WITH SOME SILT. (GM). SLIGHTLY MOIST | | | | | |
| | | TAN BROWN TO TAN GRAY SANDY GRAVEL WITH SOME CLAY. (GC). SLIGHTLY MOIST. WEAK CEMENTATION | | 50/3" | | | |
| | 5 | | | | | | |
| | | WEAK TO MODERATE CEMENTATION FROM 8 FT TO 26.5 FT DEPTH | | | | | |
| | 10 | | | 50/3" | | | |
| | 15 | | | 50/3" | | | |
| | 20 | | | 50/4" | | | |
| | 25 | | | | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 1 (CONT)
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-29-89
ELEVATION OF BORING: 1247.43

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | 50/3" | | | |
| | 30 | | | | | | |
| | 35 | | | | | | |
| | 40 | | | | | | |
| | 45 | | | | | | |
| | 50 | | | | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 2
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-26-89
ELEVATION OF BORING: 1245.60

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | LIGHT BROWN TO BROWN SILTY SAND. (SM). SLIGHTLY MOIST WEAK CEMENTATION | | | | | |
| | | NOTE: WATER ADDED AT EACH SPT TEST | | | | | |
| | 5 | | | 30 | | | |
| | | BROWN SANDY GRAVEL WITH SOME CLAY. (GC). SLIGHTLY MOIST. WEAK CEMENTATION | | | | | |
| | 10 | | | 32 | | | |
| | 15 | | | 50/3" | | | |
| | 20 | | | 29 | | | |
| | 25 | | | | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 2 (CONT)
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-26-89
ELEVATION OF BORING: 1245.60

| GRAPHICAL LOG | DEPTH (Feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | 52/6" | | | |
| | 30 | | | | | | |
| | 35 | | | | | | |
| | 40 | | | | | | |
| | 45 | | | | | | |
| | 50 | | | | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 3
LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-26-89
ELEVATION OF BORING: 1247.50

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (Feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | BROWN SILTY SAND, (SM), SLIGHTLY MOIST, WEAK CEMENTATION | | | | | |
| | 5 | BROWN GRAVELLY SAND WITH SOME CLAY, (SC), SLIGHTLY MOIST, WEAK CEMENTATION | | 18 | | | |
| | 10 | | | 50/2" | | | |
| | 15 | | | 50/5.5" | | | |
| | 20 | | | 55 | | | |
| | 25 | | | 50/4" | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 3 (CONT)
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-26-89
ELEVATION OF BORING: 1247.50

| GRAPHICAL LOG | DEPTH (Feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | 52/6" | | | |
| | 30 | | | | | | |
| | 35 | | | | | | |
| | 40 | | | | | | |
| | 45 | | | | | | |
| | 50 | | | | | | |

BORING STOPPED AT 26.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 4

LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-24-89

ELEVATION OF BORING: 1249.65

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK

FIELD ENGINEER: MARK REISIG

REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | HAMMER MIN/FT | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | LIGHT BROWN SANDY GRAVEL WITH SOME CLAY. (GC). SLIGHTLY MOIST. | | | | | |
| | | NOTE: WATER ADDED EACH SPT DEPTH | | | | | |
| | 5 | | | 50/3" | | | |
| | | GRAYISH GREEN SANDY GRAVEL. (GP-GW). SLIGHTLY MOIST. WEAK CEMENTATION | | | | | |
| | 10 | | | 50/5 | | | |
| | 15 | | | 50/3" | | | |
| | | GRAYISH GREEN SANDY GRAVEL. (GC). SLIGHTLY MOIST. WEAK CEMENTATION | | | | 8.0 | |
| | 20 | ENCOUNTERING RESISTANCE. DRILLING RATE SLOWING | | 50/4" | | | |
| | 25 | | | | | | |

BORING STOPPED AT 55.0 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| 26 FT | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 169036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 4 (CONT)

LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-24-69

ELEVATION OF BORING: 1249.65

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK

FIELD ENGINEER: MARK REISIG

REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | HAMMER MIN/FT | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | | | | |
| | 30 | AUGER REFUSAL AT 30 FT. CHANGED TO HALCO DOWN HOLE HAMMER . CLAYEY SANDY GRAVEL, HIGHLY WEATHERED. GRANITIC COBBLES PRESENT IN MATRIX | 1.15 | | | | |
| | 35 | | | | | | |
| | 40 | | 1.75 | 50/5" | | | |
| | 45 | | 1.88 | 50/1" | | | |
| | 50 | | 3.68 | 50/0" | | | |

BORING STOPPED AT 55.0 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| 26 FT | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 5

LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-24-89

ELEVATION OF BORING: 1248.67

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK

FIELD ENGINEER: MARK REISIG

REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (Feet) | SOIL DESCRIPTION | HAMMER MIN/FT | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | LIGHT BROWN SANDY GRAVEL WITH SOME CLAY. (GC). SLIGHTLY MOIST. WEAK CEMENTATION. VERY DENSE | | | | | |
| | 5 | GRAYISH GREEN GRAVELLY SAND WITH SOME CLAY. (SC). SLIGHTLY MOIST. VERY DENSE | | 50/4" | | | |
| | | NOTE: WATER ADDED AT EACH SPT DEPTH | | | | | |
| | 10 | | | 72+ | | | |
| | 15 | | | 50/4" | | | |
| | 20 | | | 50/4" | | | |
| | 25 | | | | | | |

BORING STOPPED AT 55.0 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 5 (CONT)
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-24-89
ELEVATION OF BORING: 1248.67

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | HAMMER MIN/FT | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | 52/4" | | | |
| | 30 | AUGER REFUSAL AT 28 FT. CHANGED TO HALCO DOWN HOLE HAMMER. CLAYEY SANDY GRAVEL. HIGHLY WEATHERED. GRANITIC COBBLES PRESENT IN MATRIX | | 50/3" | | | |
| | | | 1.44 | | | | |
| | 35 | | | 50/0" | | | |
| | | | 1.85 | | | | |
| | 40 | NO RECOVERY ON SPT DRIVES | | 50/0" | | | |
| | | | 2.28 | | | | |
| | 45 | | | 50/0" | | | |
| | | | 2.12 | | | | |
| | 50 | | | 50/0" | | | |

BORING STOPPED AT 55.0 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| 33 FT | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
# ACDC

BORING NUMBER: 5 (CONT)
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-24-89
ELEVATION OF BORING: 1248.67

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | HAMMER MIN/FT | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | CONTINUED FROM PREVIOUS PAGE | | | | | |
| | | | 2.55 | | | | |
| | 55 | | | 50/0" | | | |
| | 60 | | | | | | |
| | 65 | | | | | | |
| | 70 | | | | | | |
| | 75 | | | | | | |

BORING STOPPED AT 55.0 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| 33 FT | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 6
LOCATION OF BORING: SEE SITE PLAN

DATE OF BORING: 5-23-89
ELEVATION OF BORING: 1248.66

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | LIGHT BROWN GRAVELLY SAND WITH SOME SILT. (SM). SLIGHTLY MOIST. MEDIUM DENSE TO VERY DENSE | | | | | |
| | | NOTE: WATER ADDED AT EACH SPT TEST | | 18 | | | |
| | 5 | | | | | | |
| | 10 | LIGHT BROWN CLAYEY SAND AND SOME GRAVEL. (SC). SLIGHTLY MOIST. MODERATE CEMENTATION. VERY DENSE | | 67 | | | |
| | 15 | | | | | 0.8 | |
| | | | | 50/2" | | | |
| | 20 | | | | | | |
| | 25 | | | | | | |

BORING STOPPED AT 16.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

ATL TESTING LABORATORIES

ATL JOB NUMBER: 189036

# 32nd STREET BRIDGE
## ACDC

BORING NUMBER: 7
LOCATION OF BORING: SEE SITE PLAN

DRILLING EQUIPMENT: MOBILE B-50 DRILL RIG WITH 6 INCH OUTSIDE DIAMETER HOLLOW STEM AUGER

DRILLER: TOM KULIK
FIELD ENGINEER: MARK REISIG
REVIEWED BY: ERIC STANFORD

DATE OF BORING: 5-23-89
ELEVATION OF BORING: 1250.30

| GRAPHICAL LOG | DEPTH (feet) | SOIL DESCRIPTION | BULLNOSE | SPT NO. | RING NO. | WATER CONTENT % | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | LIGHT BROWN SANDY GRAVEL WITH SOME SILT. (GC). SLIGHTLY MOIST. MEDIUM DENSE TO VERY DENSE | | | | | |
| | | NOTE: WATER ADDED AT EACH SPT TEST | | | | | |
| | 5 | | | 14 | | | |
| | | BROWN GRAVELLY SAND WITH SOME CLAY. (GC). SLIGHTLY MOIST. VERY DENSE MODERATE CEMENTATION. | | | | | |
| | 10 | | | 89 | | | |
| | 15 | | | | | | |
| | | | | 84 | | | |
| | 20 | | | | | | |
| | 25 | | | | | | |

BORING STOPPED AT 16.5 FEET BELOW EXISTING GRADES

| GROUNDWATER | | |
|---|---|---|
| DEPTH | HOUR | RATE |
| | | |

THE ABOVE DATA FOR DESIGN PURPOSES ONLY

# APPENDIX B

# TEST RESULTS

CLIENT: Creegan & D'Angelo

DATE: 5-15-89

PROJECT: 32nd Street Bridge - ACDC

ATL JOB NO.: 189036

## RESISTIVITY TEST RESULTS

| BORING NO. | DEPTH (FT.) | RESISTIVITY (OHMS/CM) |
|---|---|---|
| 1 | 17-25 | 4637 |
| 2 | 20-25 | 7392 |
| 4 | 15-25 | 3293 |

CLIENT: Creegan & D'Angelo

DATE: 5-15-89

PROJECT: 32nd Street Bridge - ACDC

ATL JOB NO.: 189036

SAMPLE: Boring 6, 5-10 ft.

MOISTURE - DENSITY RELATIONS OF SOIL
(ASTM D-698A)

| MAXIMUM DRY DENSITY | OPTIMUM MOISTURE PERCENT |
|---|---|
| 127.1 pcf | 9.5 |

CLIENT: Creegan & D'Angelo

DATE: 5-15-89

PROJECT: 32nd Street Bridge - ACDC

ATL JOB NO.: 189036

## SOLUBLE SULFATES

| BORING NO. | DEPTH (FT.) | SOLUBLE SULFATE PPM |
|---|---|---|
| 1 | 17-25 | 85 |
| 2 | 20-25 | 160 |
| 4 | 15-25 | 130 |
| 7 | 0-8 | 140 |

ATL TESTING LABORATORIES

ATL
TESTING LABORATORIES

PROJECT: ACDC Canal - 32nd Street DATE: 5-15-89

LOCATION: Phoenix, Arizona

MATERIAL: Subsurface Soil DATE OF SAMPLE:

REQUESTED BY: ATL/J. Rose

| LOG | DEPTH | MOISTURE | USCS | LL | PI | SIEVE ANALYSIS-PERCENT PASSING | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 200 | 100 | 50 | 40 | 30 | 16 | 10 | 8 | 4 | 1/4 | 3/8 | 1/2 | 3/4 | 1 | 1 1/2 |
| 1 | 17-25 | 13.8 | GC | 34 | 11 | 19 | 22 | 25 | 27 | 29 | 35 | 41 | 44 | 51 | 63 | 78 | 87 | 96 | 97 | 100 |
| 2 | 20-25 | 13.5 | GC | 35 | 15 | 22 | 25 | 27 | 28 | 29 | 32 | 35 | 37 | 48 | 65 | 68 | 83 | 94 | 98 | 100 |
| 3 | 10-15 | 7.9 | SC | 29 | 9 | 21 | 26 | 30 | 32 | 35 | 40 | 46 | 48 | 62 | 70 | 82 | 91 | 97 | 99 | 100 |
| 4 | 15-25 | 7.2 | GC | 27 | 8 | 18 | 21 | 24 | 25 | 27 | 32 | 38 | 40 | 51 | 62 | 77 | 86 | 93 | 98 | 100 |
| 5 | 15-25 | 8.0 | SC | 36 | 13 | 22 | 26 | 29 | 31 | 33 | 39 | 47 | 50 | 65 | 73 | 86 | 93 | 96 | 98 | 100 |
| 6 | 5-10 | 0.8 | SM | | NP | 15 | 19 | 22 | 24 | 26 | 31 | 35 | 36 | 44 | 49 | 58 | 68 | 84 | 92 | 98 |
| 7 | 0-8 | 4.0 | GM | | NP | 14 | 18 | 22 | 24 | 26 | 32 | 37 | 40 | 50 | 57 | 69 | 78 | 89 | 96 | 100 |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |