

## 2020 CIP WATER MAINS

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Section 00 73 00

SUPPLEMENTARY CONDITIONS

SCOPE. These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract and other provisions of the Contract Documents as indicated herein. All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

1. DEFINITIONS (SEC. G.01).

1.01. Defined Terms. Delete and replace the definitions for Director and Project Engineers in Section G.01 of the General Conditions with the following:

DIRECTOR, The Director of the Forsyth County Department of Water and Sewer.

PROJECT ENGINEER, unless otherwise notified by Owner, the Department of Water and Sewer is the Project Engineer.

End of Section

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## PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally described as the:

**Construction of new transmission mains described as follows: Hurt Bridge CIP: approximately 3,905 feet of 36-inch diameter water main along Hurt Bridge Road and Keith Bridge Road CIP 2 and 3: approximately 15,402 feet of 36-inch diameter water main along Keith Bridge Road.**

- The County is negotiating a permanent easement for certain areas of Hurt Bridge Road and Keith Bridge CIPs. The Contractor shall not work on these areas until approved by Owner once easement acquisition has been finalized. For purposes of compliance with the contract completion timeframe, it shall be assumed that the easement acquisition will be finalized at least sixty (60) days prior to contract completion.
- For existing connections, the Contractor shall coordinate with Forsyth County Department of Water and Sewer Engineer to locate existing valves and coordinate the connections for the proposed pipeline.
- Owner will provide nine (9), 36-inch American Flow Control Gate Valves with Flex Ring Bell joint connection. At Gate Valve and Pipe connections the contractor is responsible to provide appropriate pipe ends to match American Flex Ring Restrain Joint.

2. UNITS OF MEASUREMENT. Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

3. SUBSTITUTES AND "OR-EQUAL" ITEMS. Whenever a material or article is specified or described by using the name of a proprietary product or the name of a particular manufacturer or vendor, the specified item shall be understood as establishing the type, function, and quality desired. Requests for review of equivalency will not be accepted from anyone except Contractor, and such requests will not be considered until after the Contract has been awarded. Other manufacturers' products may be accepted, provided sufficient information is submitted to allow Engineer to determine that the products proposed are equivalent to those named. Such items shall be submitted for review by the procedure set forth in the Submittals Procedures section.

4. PREPARATION FOR SHIPMENT. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

5. EASEMENTS AND RIGHTS-OF-WAY. Contractor shall confine its construction operations within the limits indicated on the Drawings. Contractor shall use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies in order to avoid damage to property and interference with traffic. Construction work across private property will not be permitted.

6. OPERATION OF EXISTING FACILITIES. The existing water distribution, telephone, cable, or gas facilities must be kept in continuous operation throughout the construction period. No interruption will be permitted which adversely affects the degree of service provided. Provided permission is obtained from Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands.

Contractor shall provide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

7. NOTICES TO OWNERS AND AUTHORITIES. Contractor shall, as provided in the General Conditions, notify owners of adjacent property and utilities when prosecution of the Work may affect them.

When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

Utilities and other concerned agencies shall be notified at least 24 hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

8. LINES AND GRADES. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.

Existing basic horizontal and vertical control points are indicated on the Drawings and shall be used as datums for the Work. All additional survey, layout, and measurement work shall be performed by Contractor as a part of the Work.

Contractor shall provide an experienced instrument person, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, Contractor shall furnish, without charge, competent persons and such tools, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking survey, layout, and measurement work performed by Contractor.

Contractor shall keep Engineer informed, a reasonable time in advance, of the times and places at which it wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by Engineer may be done with minimum inconvenience to Engineer and minimum delay to Contractor.

Contractor shall remove and reconstruct work which is improperly located.

9. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

10. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine its operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

11. HAZARDOUS ENVIRONMENTAL CONDITIONS AT SITE. No Hazardous Environmental Conditions at the Site in areas that will be affected by the Work are known to the Owner.

12. CLEANING UP. Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish. Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

13. REFERENCE STANDARDS. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of opening of Bids (or on the effective date of the Contract or Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to Owner, Engineer, or any of Engineer's Consultants, agents, or employees, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

14. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

Contractor and its superintendent.

Principal Subcontractors.

Representatives of principal Suppliers and manufacturers as appropriate.

Engineer and its Resident Project Representative.

Representatives of Owner.

Government representatives as appropriate.



Others as requested by Contractor, Owner, or Engineer .

Unless previously submitted to Engineer, Contractor shall bring to the conference a preliminary schedule for each of the following:

Progress Schedule.

Procurement schedule.

Schedule of Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

Contractor's preliminary schedules.

Transmittal, review, and distribution of Contractor's submittals.

Processing Applications for Payment.

Maintaining record documents.

Critical Work sequencing.

Field decisions and Change Orders.

Use of premises, office and storage areas, security, housekeeping, and Owner's needs.

Major equipment deliveries and priorities.

Contractor's assignments for safety and first aid.

Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

15. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Engineer or required by progress of the Work. Contractor, Engineer, and all Subcontractors active on the Site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

Contractor shall preside at the meetings. Meeting minutes shall be prepared and distributed by Contractor. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

16. SITE ADMINISTRATION. Contractor shall be responsible for all areas of the Site used by it and by all Subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except Owner's employees) to observe the same regulations as Contractor requires of its employees.

17. GPS LOCATION OF TRANSMISSION MAINS. Contractor shall record the horizontal and vertical GPS location of the transmission mains at each fitting and 100 foot maximum intervals as the pipe is installed. GPS information shall be collected with survey-grade GNSS GPS equipment and submitted on a weekly basis to the Engineer as text files with (x,y,z) coordinates. Accuracy of data shall be within 7/10 inch horizontally and 0.15 in vertically.

Survey of the transmission main after backfill to gather GPS information will not be allowed.

18. WORK HOURS. Contractor shall comply with UDC Chapter 10-1.13 Outside Construction to limit work hours to between the hours of 7:00 AM to 7:00 PM Monday to Friday, 8:00 AM to 6:00 PM Saturday, and no outside construction on Sunday.

End of Section



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## Section 01 29 77

### MEASUREMENT AND PAYMENT

1. SCOPE. This section covers methods of measurement and payment for items of Work under this Contract.

When both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

2. GENERAL. The Contract Price shall cover all Work required by the Contract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction materials, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the unit and lump sum prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.

3. ESTIMATED QUANTITIES. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the Work and (b) for the purpose of comparing the Bids submitted for the Work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefore.

4. MOBILIZATION AND DEMOBILIZATION. Except where otherwise specified, the unit or lump sum price bid for each item of Work which involves mobilization and demobilization shall include all costs for such Work, including all costs in fuel, rental or equipment transport fees. One mobilization and one demobilization will be allowed unless approved in writing by the Owner.

Payment will be lump sum not to exceed 3% of the total price of the project as estimated by the Contractor. Payment will constitute full compensation for all costs associated with mobilization and demobilization of equipment and Contractor's field offices as directed by the Engineer for the project. No additional or separate payment will be made for mobilization or demobilization for the purposes of contract renewal or extension.

5. PIPELINES. Ductile iron pipelines which are to be paid for on a unit price basis shall be measured for payment on a horizontal plane after installation of the pipe. Where lines are laid to conform to stationed profiles, payment shall be made on linear quantities based on the pipeline stationing as determined by surveys made after installation.

The measurement of the length of each line or run of pipe of each size will begin and end at:

- a. The end of the pipe where connected to an existing pipe, fitting, factory welded on outlet, or valve; or at the end of a dead-end run.
- b. The center line intersection of run and branch on tees, crosses, or laterals where a branch line connecting therewith is constructed under this Contract. Where a branch fitting is installed under this Contract, and the branch or connecting line is to be constructed by others at some future date or under another contract, the pay measurement will include the entire laying length of the branch or branches of such fitting.
- c. The measurement of each line of pipe of each size which is to be paid for on a unit price basis will be continuous through, and shall include the full laying lengths of, all fittings and valves installed between the ends of each line; except that the laying lengths of reducers and increasers will be divided equally between the connected pipe sizes.
- d. Payment for restrained joints shall be based on the required length of restrained joints indicated on the Drawings. The costs for restrained joints shall be included in the overall unit price bid.

5.01. Connections to Existing Water Mains. Connections to existing water mains will be paid for at the lump sum prices bid. Each lump sum price named for a connection shall include all costs incurred for making the connection over and above the price of the connecting piping in place and concrete blocking which will be paid for separately. Each lump sum price shall include furnishing and installing the couplings and fittings; all excavation and backfilling work; cutting of existing main, disposing of excess materials, disinfection and cleaning; and all other costs not included under other bid items. Valves associated with connections to existing mains shall be paid for under item 5.02 Isolation Valves.

5.02. Isolation Valves. Isolation valves in water mains will be paid for at the unit price bid for each size. The valves will be gate valves with flex rings bell joints. The Owner will provide nine (9), 36-inch valves. The unit price shall include all costs incurred in completing the isolation valve installation over and above the

amount paid for piping in place. The unit price shall include furnishing of valves not provided by Owner and installing the isolation valve, valve box, markers, and appurtenances; excavation and backfill not included under piping; and all other costs not included under other bid items.

No separate payment will be made for fire hydrant auxiliary gate valves or tapping valves.

5.03. Fire Hydrants. Fire hydrants will be paid for at the unit price bid. The unit price named for each fire hydrant installation shall include all costs incurred in furnishing and installing the fire hydrant; auxiliary gate valve, accessories, and appurtenances; concrete blocking behind and under the fire hydrant; drainage facilities; and all other costs not included under other bid items.

5.04. Combination Air Valve Assemblies. Combination Air Valve Assemblies will be paid for at the unit price bid. The unit price named for each Combination Air Valve Assembly installation shall include all costs incurred in furnishing and installing the Combination Air Valve Assembly; air valve, accessories, manhole, cover, and appurtenances; drainage and vent facilities; and all other costs not included under other bid items.

5.05. Blowoffs. Blowoffs will be paid for at the unit price bid. The unit price named for each blowoff installation shall include all costs incurred in furnishing and installing the blowoff assembly; auxiliary gate valve (and valve box), accessories, and appurtenances; concrete blocking behind and under the blowoff; drainage facilities; and all other costs not included under other bid items.

5.06. Hurt Bridge Road Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the jack and bore installation including steel casing pipe, the excess cost of installing pipe in steel casing pipe above the amount bid for the pipe laid in open trench, casing insulators or supports, jointing materials, boring and receiving pits, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.07. Watson Road Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.08. Bridgeshaw Drive Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with

the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.09. Aaron Sosebee Road Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.10. Leland Drive Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.11. English Drive Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.12. Cantrell Circle Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.13. Millwood Road Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.14. Mayfield Drive Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in



connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.15. Grindle Crossing. The road crossing shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.16. Sixmile Creek Crossing at STA 8+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.17. Sixmile Creek Crossing at STA 43+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.18. Sixmile Creek Crossing at STA 62+50 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.19. Sixmile Creek Crossing at STA 77+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.20. Sixmile Creek Crossing at STA 93+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench

installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.21. Sixmile Creek Crossing at STA 106+50 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.22. Fourmile Creek Crossing at STA 123+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the jack and bore installation including steel casing pipe, the excess cost of installing pipe in steel casing pipe above the amount bid for the pipe laid in open trench, casing insulators or supports, jointing materials, boring and receiving pits, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.23. Fourmile Creek Crossing at STA 144+00 +/- (Keith Bridge Road). The creek crossing on Keith Bridge Road shall be paid for as a lump sum. The lump sum bid for the crossing shall include all costs in connection with the open trench installation the pipe including steel casing pipe, casing insulators or supports, jointing materials, end closures, vents, and all other work for and in connection with the crossing as indicated on the Drawings, in the Specifications, or required, not paid for separately.

5.24. Corrosion Protection. No separate payment shall be made in connection with corrosion protection or polyethylene tube protection as specified or required. All costs for corrosion protection and polyethylene tube protection shall be included in the unit cost of the pipeline work.

5.25. Traffic Control. Traffic Control for all pipelines as indicated on the drawings shall be paid for as a lump sum.

6. EROSION CONTROL. Except where otherwise specified, the unit or lump sum price bid for each item of work which involves excavation, trenching, or any activity that disturbs existing site conditions shall include all costs for erosion and sedimentation control work. No separate payment shall be made for erosion control, other than silt fence and sodding.

6.01. Silt Fence. The unit price for silt fence bid shall include all costs of materials and labor involved in furnishing and installation of the silt fence in accordance with the Drawings.

6.02. Sodding. The unit price for sodding shall include all costs in connection with sodding in accordance to the drawings. Payment for Work completed may be withheld if sodding is not keeping pace with the progress of the Work.

7. PAVEMENT REMOVAL AND REPLACEMENT. Pavement removal and replacement shall be measured for payment horizontally along the center line of the pipe, through manholes, and to the edge of the existing pavement; or, where the edge of the existing pavement is not clearly defined, to the edge of the pavement replacement. The width of pavement replacement will not be measured or taken into account in payment. Refer to Forsyth County Standards Detail No 35 on the Drawings.

The unit prices bid for pavement removal and replacement shall include all costs in connection therewith, including cutting, removal, and disposal of old pavement; construction of new pavement; and all extra compaction effort required for backfill beneath pavement.

8. DRIVEWAY, SIDEWALK, CURB AND GUTTER REMOVAL AND REPLACEMENT. The unit price per square yard bid for driveway, sidewalk, curb and gutter removal and replacement shall include all costs involved in cutting and removing the driveways, sidewalks, curbs and gutters and all labor and materials required to replace the driveways, sidewalks, curbs and gutters and concrete culvert pipe, where required. Refer to Details No 36 and 37 on the Drawings.

Measurement for payment of driveway and, sidewalk removal and replacement shall be on a square yard basis and shall include only the area actually removed and replaced, between joints, over the pipeline trench. Measurement for payment of curb and gutter removal and replacement shall be on linear foot basis and shall include only the area actually removed and replaced over the pipeline trench.

Gravel driveway replacement thickness shall match the original driveway thickness unless the existing driveway thickness is less than 6 inches. In that case, the driveway replacements shall be 6 inches thick.

All costs for repairing or removal and replacement of existing driveways, sidewalks, curbs and gutters outside the specified pay limits, where damaged by construction operations, shall be considered a subsidiary obligation of Contractor and shall be borne by him.

9. MISCELLANEOUS CONCRETE. Concrete for encasement or blocking of pipe and fittings not included as parts of manholes and other structures will be measured for payment as the actual volume of concrete placed within the limits as indicated or specified.

Concrete for total encasement shall be computed using the maximum allowable trench width (or pipe OD plus 24 inches where no maximum is specified), the minimum clear depth below the pipe, and the minimum cover over the pipe, less the volume occupied by the pipe itself.

Concrete for thrust blocks, except blocking behind and under fire hydrants, shall be computed using the dimensions indicated on the drawings for such blocking, unless otherwise authorized by Engineer. Direct payment shall not be made for blocking behind and under fire hydrants.

Unless otherwise authorized by Engineer, all additional concrete for encasement or blocking required outside the specified pay limits will be considered a subsidiary obligation of Contractor and no direct payment shall be made therefor.

All concrete which is required in connection with manholes or structures, pavement or sidewalk replacement, and other pay items shall be included in the lump sum or unit price bid for the pay item.

The unit price bid for miscellaneous concrete shall include concrete, reinforcing steel, forms, finishing, curing, and all other work or materials required to complete the concrete work.

10. REMOVAL AND REPLACEMENT OF UNSUITABLE MATERIAL. If adequate subgrade material is not encountered at the elevations indicated on the Drawings, that material shall be deemed unsuitable and shall be removed. The unit price bid per cubic yard for removal and replacement of unsuitable material shall include cost of the removal of the unsuitable material to a depth of at least 2 feet below the trench bottom times the full width of the trench and replacement with compacted granular fill as specified, as directed by the Engineer. The unit price bid per cubic yard shall also include disposal of the unsuitable material offsite. All pay quantities shall be based on the volume of the unsuitable material in its original and undisturbed condition.

11. EIGHT OUNCE FILTER FABRIC. The unit price per square yard shall include all costs for furnishing and *placement of eight ounce filter fabric in areas where unsuitable material is encountered, as* directed by Engineer.

12. PIPELINE MARKER BALLS. *The unit price shall include all costs for furnishing and placement of markers, installation, assembly, and marker locator.*

13. Temporary Barrier Fence. The unit price for temporary barrier fence bid shall include all costs of materials and labor involved in furnishing and installation of the temporary barrier fence in accordance with the Drawings.

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Section 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

1. GENERAL.

1.01. Units of Measurement. When both inch-pound (English) and SI (metric) units of measurement are specified herein, the values expressed in inch-pound units shall govern.

2. SCHEDULE OF PAYMENTS. Within 30 days after award of contract, Contractor shall furnish to Engineer a schedule of estimated monthly payments. The schedule shall be revised and resubmitted each time an Application for Payment varies more than 10 percent from the estimated payment schedule.

3. SURVEY DATA. All field books, notes, and other data developed by Contractor in performing surveys required as part of the Work shall be available to Engineer for examination throughout the construction period. All such data shall be submitted to Engineer with the other documentation required for final acceptance of the Work.

4. LAYOUT DATA. Contractor shall keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Copies of such data shall be furnished to the Engineer for use in checking Contractor's layout as provided in the project requirements section. All such data considered of value to Owner will be transmitted to Owner by Engineer with other records upon completion of the Work.

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## CONSTRUCTION PROGRESS SCHEDULE

1. GENERAL OVERVIEW. A Progress Schedule shall be used to control the Work and to provide a definitive basis for determining project progress. The Progress Schedule shall be prepared, maintained and updated by Contractor and historical dates agreed monthly with Engineer. Contractor shall submit a preliminary Progress Schedule and a Progress Schedule for acceptance by Engineer. These schedules shall be Contractor's working schedules and shall be used to plan, organize and execute the Work, record and report actual performance and progress, and show how Contractor plans to complete all remaining Work as of the end of each progress report period.

The Progress Schedule shall comprise all the detailed construction-related activities using the critical path method (CPM). The Progress Schedule shall provide sufficient detail and clarity to reflect the intricacies and interdependencies of activities so Contractor can plan, schedule, monitor, control and report on the progress of his work. In addition, it shall provide Engineer and Owner a tool to monitor and follow the progress for all phases of the Work.

2. PRE-CONSTRUCTION SCHEDULING CONFERENCE. Engineer will conduct a pre-construction scheduling conference with Contractor to review requirements for the schedules including cost-loading and schedule configuration. The conference shall be conducted sufficiently early to allow Contractor to submit the preliminary Progress Schedule within ten days of the Effective Date of the Contract.

At this meeting, Contractor shall explain in detail the procedure to be used to develop the schedule activity cost-loading or Schedule of Values and cash flow. This procedure is subject to the review and acceptance of Engineer.

3. PRELIMINARY PROGRESS SCHEDULE. Following the pre-construction scheduling conference but within ten calendar days after the Effective Date of the Contract, Contractor shall submit a preliminary Progress Schedule for review by Engineer. The preliminary Progress Schedule shall show detailed construction-related activities for the first 30 days of the project. The remainder of the Contract activities shall be shown as summary bars within the milestones of the Work. If Engineer has comments on the preliminary Progress Schedule, Contractor shall make the necessary changes and resubmit it within ten calendar days. No progress payments will be made during the period specified above for the preliminary Progress Schedule until the preliminary Progress Schedule has been accepted by Engineer.

The preliminary Progress Schedule shall:

- a. Illustrate a feasible schedule for completion of the Work within the Contract Times and Milestones specified.
- b. Provide an elementary example of the schedule in the format to be used for the Progress Schedule.
- c. Include the activity code structure as described in Paragraph 19 of this specification.

3.01. Preliminary Progress Schedule Submittal Format: Contractor shall submit two compact disks of the preliminary Progress Schedule. Compact disks shall be read-write and enable the use of the schedule as an executable file as described herein. A brief narrative shall accompany the submittal, describing Contractor's scheduling approach to the project. The narrative shall include a description of the Contract milestones, approach for construction activities during the period of the preliminary Progress Schedule, description of the general approach of the activities for the work beyond the preliminary Progress Schedule period, a description of the project's critical path, identification of critical long-lead submittals, and planned outages. The narrative shall also incorporate activity codes, calendars, weather days, milestone constraints, and work breakdown structure in accordance with the requirements specified herein.

4. PROGRESS SCHEDULE The Progress Schedule comprises all the construction-related activities for the Work and shall show the order in which Contractor proposes to carry out the work. Contractor shall include milestones, coordination necessitated by limited access and available work areas, and the availability and use of manpower, material and equipment. Contractor shall use the Progress Schedule to plan, schedule and coordinate the Work including activities of subcontractors, equipment vendors, and suppliers.

The Progress Schedule shall be to the level of detail acceptable to Engineer, and shall include the following:

- a. Organization and structural breakdown of the Project;
- b. Milestones and completion dates;
- c. Type of work to be performed and the labor trades involved;
- d. Purchase, manufacture and delivery activities for major materials and equipment;
- e. Preparation, submittal, and acceptance of shop drawings and material samples;

- f. Deliveries of owner-furnished equipment and/or materials;
- g. Acceptances required by regulatory agencies and/or other third parties;
- h. Assignment of responsibility for each activity;
- i. Access requirements to work areas;
- j. Identification of interfaces and dependencies with preceding, concurrent and follow-on contractors;
- k. Tests, submittal of test reports and acceptance of test results;
- l. Planning for phased or total acceptance by Owner; including start up and commissioning;
- m. Identification of any manpower, material and equipment restrictions.
- n. Sequence of construction to maintain plant operations;
- o. Planned outages.

The activities included in the Progress Schedule shall be defined in work days. Durations shall be based on the labor (crafts), equipment, and materials required to perform each activity on a normal workday basis. Activity durations shall be 20 working days or less except in the case of non-construction activities such as procurement of materials, delivery of equipment, and concrete curing. All durations shall be the result of definitive manpower and resource planning by Contractor to perform the Work, in consideration of contractually defined on-site work conditions and Contractor's planned means and methods.

When the Progress Schedule is accepted by Engineer, Engineer will save a copy of the Progress Schedule as the baseline schedule, and will use it for analysis of Contractor's progress.

Contractor shall update the Progress Schedule monthly.

5. ELECTRONIC PROGRESS SCHEDULE FORMAT AND REPORTING. The Progress Schedule shall be created using Primavera P6 scheduling software. Contractor shall use Engineer's file-naming format throughout the project.

- a. Electronic schedule files shall be saved with .XML or .XER file extensions.

- b. Primavera Project Manager settings for “Baseline Type” shall be used in the following manner:
  - i. Select <None> as the baseline type for the preliminary Progress Schedule submittal.
  - ii. Once the preliminary and Progress Schedule are accepted, the baseline type shall be named <Initial Plan>.
  - iii. Each subsequent Progress Schedule update shall set the baseline type to <Last Performance Update>.
- c. The data date for schedule calculation in the preliminary Progress Schedule and Progress Schedule shall be set as the date of the Notice to Proceed unless otherwise specified by Engineer.

6. COST-LOADING. Except for manufacturer lead-time, each Progress Schedule activity that has an actual cost shall have a cost value assigned to it. Equipment or material delivery activities bearing cost shall be separate activities. Each activity’s assigned cost shall consist of all costs associated with that activity including all project management, superintendence, overhead and profit costs. The sum of all activity costs shall be equal to the current Contract Price at all times, including approved change orders. Contractor shall certify that the costs are not unbalanced and that the value assigned to each activity represents Contractor’s total cost to perform that activity.

If Engineer or Owner determines cost data does not meet the requirements for a balanced bid breakdown, Contractor shall submit documentation substantiating any cost allocation questioned. Cost allocations will be considered unbalanced if activity on the Progress Schedule has been assigned a disproportionate allocation of direct costs, overhead and profit. If documentation of the cost data does not, in the opinion of Engineer substantiate cost allocations, the Progress Schedule will be returned to Contractor for action.

Unit Price items required to be paid on a unit cost basis as identified in the Bid and the Measurement and Payment section shall be incorporated into the Progress Schedule and measured and updated as specified herein and as specified in the Measurement and Payment section.

Contractor shall produce Cash Flow Projection reports and graphics from the Primavera P6 application.

Cost-loaded data shall be the basis for monthly payment applications and shall be included with monthly updates of the Progress Schedule.

7. RESOURCE-LOADING. Contractor shall build a resource (manpower) library within Primavera P6 and assign resources to each applicable Progress Schedule activity. Resource-loading shall determine the activity duration based on the assigned resource. Contractor shall submit a resource analysis report produced from Primavera P6 in the form of a series of graphics showing the principal trades. The report shall show the number of man-days of effort for each month over the life of the Contract. The manpower requirements forecast shall be updated monthly and shall include the actual manpower used by trade as of the current report period and the manpower required to complete the Work.

8. COORDINATING PROGRESS SCHEDULE WITH OTHER CONTRACT SCHEDULES. Where work is to be performed under this Contract concurrently with or contingent upon work performed on the same facilities or area under other contracts, the Progress Schedule shall be coordinated with the schedules of the other contracts. Owner will provide the schedules of other contracts for preparation and updating of the Progress Schedule. Contractor shall revise the Progress Schedule as required by changes in schedules of other contracts.

In case of interference between the operations of different contractors, Owner will determine the work priority of each contractor and the sequence of work necessary to expedite the completion of the entire project. In all such cases, the decision of Owner shall be accepted as final.

9. SUBMITTALS. The Progress Schedule and associated reports shall be submitted to Engineer for acceptance within the period of the preliminary Progress Schedule specified herein. If the Progress Schedule is not submitted, no progress payments will be made after the due date until the Progress Schedule has been submitted.

Printouts and electronic layouts required as part of the Progress Schedule submittal and monthly updates are as follows:

- a. Summary Schedule: one page milestone and summary schedule, sorted by total Float, early-start, early-finish;
- b. Detailed Project Schedule: organized by Work Breakdown Structure (WBS) or area of work; sorted by total Float, early-start, early-finish;
- c. Critical Path Schedule: sorted based on the total Float, early-start, early-finish;
- d. 60-Day Look Ahead Schedule: sorted by total Float, early-start, early-finish;

- e. Activities in Progress: organized by WBS or area of work; sorted by total Float, early-start, early-finish;
- f. Cash Flow Trending Report: presented in an S-Curve format based on original planned early start and late start forecasted expenditures. In addition, the historical actual data point(s) are to be graphed within the S-Curve graphic report;
- g. Monthly payment projections;
- h. Out-of-sequence Report: tabular report showing work performed out-of-sequence.

Contractor shall submit additional layouts if directed by Engineer.

The submittal shall include the following:

- a. Narrative report summarizing the milestones, critical path, project approach including phasing or use of crews, significant submittal and fabrication items, coordination or interface requirements, Owner-provided items, and list of subcontractors and vendors.
- b. Graphic reports including critical path report (longest path), summary schedule report, total Float report by early-start early-finish, look-ahead report grouped by work breakdown structure or project phasing, and cash flow projection. Cash flow projections include estimated cumulative cost curves based on early and late start dates and projection of monthly payments over the life of the project

The schedule, critical path, and look-ahead schedules shall be submitted on E (34"x44") size paper or 36" wide plots;

The Progress Schedule file shall be submitted in an executable format, using Primavera Project Manager (P6) format on a read-write compact disk.

The narrative and graphic reports shall be provided on 8"x11" paper and E-size plots respectively.

Contractor shall submit 4 copies of each deliverable.

**10. MONTHLY SCHEDULE UPDATES.** Monthly Progress Schedule updates shall be submitted for the duration of the Contract on a date agreed to by Owner, Engineer, and Contractor. If monthly Progress Schedule updates are not submitted by the due date, progress payments will be withheld until the required information is submitted.

The updated schedule shall be reviewed each month in a meeting with Engineer to verify:

- a. Actual start dates,
- b. Actual completion dates,
- c. Activity percent completion,
- d. Revised logic (as-built and projected) and changes in activity durations, cost assigned,
- e. Cost influence of change orders, if any,
- f. Revisions due to extension of time.

Prior to each meeting, Contractor shall prepare a complete and accurate report of current procurement and construction progress through the end of the update period, and a depiction of how Contractor plans to continue the Work to meet all contract completion dates. All network changes and status data agreed to during each update meeting shall be considered as accepted by both parties unless written notice of any exceptions is given within five calendar days after the meeting.

For major network changes that cannot be agreed to during an updating meeting, Contractor shall submit the proposed changes for Engineer's acceptance prior to inserting such changes into the network. Submittals may be in the form of marked-up networks, fragnets, or schedule abstracts, provided they are submitted with a letter of transmittal. A fragnet is defined as a sequence of new activities and/or activity revisions that are proposed to be added to the existing schedule to demonstrate how project events have an impact on the schedule.

11. DATA DATE. The data date is the re-settable date in P6 that serves as the end of a reporting period. The reporting period will be recorded on a monthly basis, e.g., January 1st through January 31st with the 31st as the data date. If required for coordination purposes by Owner, Engineer will provide specific data dates to be used by Contractor.

12. REVIEW PROCESS. Engineer will review Contractor's preliminary Progress Schedule and full Progress Schedule submittals within 15 calendar days after receipt of all required information.

At the request of Owner or Engineer, Contractor shall participate in any meetings necessary to reach a mutual agreement and acceptance of the preliminary Progress Schedule, Progress Schedules, or Cash Flow Projections.

If any of the required submittals are returned to Contractor for corrections or revisions, they shall be resubmitted within ten calendar days after the return mailing date. Resubmittals shall include all information and media included in the first submittal. Review and response by Engineer will be given within 10 calendar days after receipt of each resubmittal.

Schedules shall show contract completion of the Work on the Contract completion date and with zero or positive total Float even if Contractor plans to finish early. In no event shall acceptance of the Progress Schedule be a basis for a claim for delay against Owner or Engineer by Contractor for an early finish. A Progress Schedule containing activities with negative Float or that extend beyond the date that the Work is completed and ready for final payment will not be acceptable.

Acceptance of the Progress Schedule by Engineer does not relieve Contractor of responsibility for accomplishing the Work by the Contract completion date. Omissions and errors in the accepted Progress Schedule shall not relieve Contractor of obligations under the Contract. Acceptance by Engineer in no way makes Engineer or Owner an insurer of the Progress Schedule's success or liable for time or cost overruns. Engineer and Owner hereby disclaim any obligation or liability by reason of acceptance of the Progress Schedule by Engineer.

13. RESPONSIBILITY FOR SCHEDULE COMPLIANCE. Whenever it becomes apparent from the current Progress Schedule that the critical path is delayed and the contract completion date will not be met, Contractor shall mitigate the delay by taking some or all of the following actions at no additional cost to Owner.

- a. Increase construction manpower in such quantities and crafts as will bring the project back on schedule within the completion dates and milestones.
- b. Increase the number of working hours per shift, shifts per day, working days per week, and the amount of construction equipment, or any combination of the foregoing, to substantially eliminate the backlog of work.
- c. Re-schedule activities to achieve maximum practical concurrence of activities and to comply with the schedule date(s).

Within ten calendar days of Engineer's request, Contractor shall submit a recovery schedule and written statement of the steps intended to remove or arrest the delay to the critical path in the schedule. If Contractor fails to submit the required information or should fail to take measures acceptable to Engineer, Engineer with Owner concurrence may direct Contractor to increase man-power,



equipment and scheduled work hours to remove or arrest the delay to the critical path and Contractor shall promptly provide such level of effort at no additional cost to Owner.

In the event Contractor fails to follow the updated or revised recovery schedule, Owner may elect to withhold progress payments until Contractor complies with the revised schedule.

Should Contractor's efforts not remove or arrest the delay to the critical path of the accepted schedule, then Owner shall be entitled to supplement Contractor's work-force and equipment to remove and arrest any delay, and shall be entitled to deduct all costs and expenses associated therewith from payments due to Contractor. If insufficient Contract funds remain, Owner may recover such funds from Contractor and its Surety.

14. CHANGES IN THE WORK, DELAYS, AND EXTENSIONS OF TIME. When changes in the Work or delays are experienced by Contractor and Contractor requests an extension of time, Contractor shall submit a written time impact analysis to Engineer illustrating the influence of each change or delay to the current Contract Times. Each time impact analysis shall include a fragnet incorporating the change or delay into the Progress Schedule to demonstrate how Contractor was delayed.

Each time impact analysis shall demonstrate the estimated time impact based on the events of the change or the delay; the date the change was given to Contractor or the delay incurred, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the Progress Schedule or as adjusted for the events of delay.

Three copies of the time impact analysis and an electronic copy on compact disk shall be submitted within seven calendar days of delay occurrence or direction to proceed with a change is given to Contractor. No time extensions will be considered if the time impact analysis is not submitted within the specified time.

Engineer will review Contractor's time impact analysis. Contractor shall furnish such justification and supporting evidence as Engineer deems necessary to determine whether Contractor is entitled to an extension of time. Engineer's review of each time impact analysis will be made within five working days of receipt of the time impact analysis and additional information as required by Engineer, unless subsequent meetings and negotiations are necessary.

The Contract Times will be adjusted only for causes specified in paragraph 15. Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining Float along the critical path at the time of actual delay. Delays in activities which

are not on the critical path and do not affect Contract Times, will not be considered for an extension of time.

15. CAUSES FOR EXTENSIONS OF TIME. Additional positive total Float in the Progress Schedule generated by efficiencies of Owner or Contractor is a shared commodity to be reasonably used by either party, and belongs exclusively to the Project. Contractor is not entitled to any additional compensation for completion of the project prior to expiration of the Contract Times.

15.01. Owner-Initiated Changes. Owner initiated changes to the Work that absorb Float time will not be considered for an extension of time. Owner-initiated changes that affect the critical path of the Progress Schedule shall be grounds for extending or shortening completion dates. Use of Float time for Contractor initiated changes will require Owner's concurrence. Contractor's changes, however, shall give way to Owner-initiated changes competing for the same Float time.

15.02. Outside Contractor's Control. Events outside of Contractor's control that affect the critical path of the Progress Schedule will be considered for an extension or reduction of the Contract Times.

15.03. Weather Delays. Engineer will obtain weather data during construction from a reputable source, and will maintain weather records.

Engineer will determine Contractor's entitlement to an extension of the Contract Times as a result of weather delays, based on the data included in Tables 1 and 2. Extensions of time will be granted at the discretion of Engineer for circumstances not covered by the flow chart.

Any weather-related extension of Contract Times shall be non-compensable. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather days is less than expected, shall contribute to the project Float and shall not affect the Contract Times.

Application for a weather related extension of time shall be submitted to Engineer, and shall state the extension requested and be supported by the relevant weather data.

Table 1 Average Monthly Precipitation (inches) 10 year average 2004 – 2013 NOAA National Data Center, Annual Climatological Summaries											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

5.04	4.68	5.10	3.99	4.34	4.78	6.31	5.20	4.19	3.83	3.75	5.91
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<p>Table 2 Average Number of Calendar Days with Precipitation of <math>\geq 0.50</math> Inches or More in a Single 24-hour Period 10 year average 2004 – 2013 NOAA National Data Center, Annual Climatological Summaries</p>											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
3	3	3	3	3	3	4	3	3	2	2	4

16. AS-BUILT SCHEDULE. As a condition precedent to release of final payment, the last update to the Progress Schedule submitted shall be identified by Contractor as the “As-Built Schedule”. The “As-Built Schedule” shall reflect the exact manner in which the project was actually constructed (including actual start and completion dates, activities, sequences, and logic) and shall be signed and certified by Contractor’s project manager.

17. SCHEDULING SOFTWARE APPLICATION. Scheduling software shall be Primavera Project Manager (P6) without exception.

18. SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS: Contractor shall consult with Engineer for acceptable Primavera Project Manager software settings and restrictions. The following shall apply unless otherwise directed by Engineer.

- a. Schedule Options:
  - i. Shall be defined only to “Use expected finish dates”;
  - ii. Scheduling progressed activities to be set to “Use only retained logic”, not progress override option;
  - iii. Critical Path activities defined as total Float less than or equal to zero;
  - iv. Calculating start-to-start lag from “early start” dates; and computing total Float as “finish Float = late finish – early finish”;
  - v. Calendar to be set for scheduling relationship lag as “Predecessor Activity Calendar.”

- b. Activity progress shall be shown using Remaining Duration. Date format shall be DDMMYY.
- c. Default activity type shall be set to “Independent Task”.
- d. Date/time activity constraint(s), other than those required by the Contract, will not be allowed unless accepted by Engineer. Contractor shall identify proposed constraints and explain the constraint purpose in the Narrative Report.
- e. Lags shall not be used in the creation of an activity that will perform the same function, e.g., concrete cure time. Lag durations contained in the Progress Schedule shall not have a negative value. Contractor shall identify any lag proposed and explain the purpose of the lag in the Narrative Report.
- f. Actual Start and Finish dates shall not be automatically updated by default mechanism that may be included in the CPM scheduling software system. Actual Start and Actual Finish dates on the CPM schedule shall be updated by actual work progression.

19. ACTIVITY CODES. The Primavera (P6) activity codes and work breakdown structure (WBS) to be confirmed or revised by Engineer are listed below. Confirmation or revision of the activity codes and WBS will be provided to Contractor within three workdays of the Effective Date of the Contract. Use of Engineer prescribed activity codes and WBS is mandatory.

“Project Codes” as defined by Primavera P6 is reserved for Owner. Only “Activity Codes” at Project Level will be permitted for Contractor use.

<u>Activity Code</u>	<u>Code Value</u>	<u>Description</u>
Phase	0005	Construction Phase
Construction Phase	A	Milestones
	BC	Administrative
	D	Submittals
	E	Construction Activities
		Closeout Phase
Submittals	SUB	Submittals
	R&A	Review & Approve
	F&D	Fabricate & Deliver

*Other Codes to be prescribed by Engineer or requested by Contractor for project specific criteria.*

20. ACTIVITY RELATIONSHIPS. Relationships between activities shall be identified with the following information:

- a. Predecessor and successor activity ID.
- b. Relationship types:
  - i. FS - Finish to start
  - ii. SS - Start to start
  - iii. FF - Finish to finish
  - iv. SF - Start to finish – This relationship is not allowed, unless authorized by Engineer.

21. PROJECT CALENDARS. Project Calendars shall use workdays and calendar days as the planning unit for the schedule. Use of Global Calendars is reserved for Owner. Each calendar shall be set to start on Mondays with holidays in accordance with Owner policy. The following calendars shall be used for each activity except as otherwise accepted by Engineer:

- a. 5-Day x 8 Hour Workweek (with holidays) shall be used for 5-day 40-hour workweek activities: Monday through Friday. All holidays and non-work days shall be assigned to this calendar. This calendar shall be used for all normal work activities, submittals, and

fabricate and delivery activities. This calendar shall be the default calendar for the project unless otherwise specified.

- b. 5-Day x 10-Hour Workweek (with holidays) shall be used for 5-day 50-hour workweek activities: Monday through Friday. All holidays and non-work days shall be assigned to this calendar.
- c. 6-Day x 10-Hour Workweek (with holidays) shall be used for 6-day 60-hour workweek activities. Monday through Saturday. All holiday and non-work days shall be assigned to this calendar.
- d. 7-Day Calendar (no holidays) shall be used for 7-day workweek activities. No non-work days shall be entered into this calendar.
- e. Additional Calendars may be assigned depending on need. However, Contractor shall consult with Engineer before other calendars are entered and/or used in the Progress Schedule.

The work day to calendar day correlation shall be based on a single shift and 5-day work week with adequate allowance for holidays, adverse weather and all other special requirements of the Work. Contractor may, at his option, propose alternate baseline calendars to allow a second shift and/or a single shift on Saturdays subject to the concurrence and acceptance of Owner. Under no circumstances will a schedule be accepted which allows regularly scheduled work on Sundays.

The holidays observed by Owner are as follows:

New Year's Day  
Martin Luther King Day  
Memorial Day  
Independence Day  
Labor Day  
Veteran's Day  
Thanksgiving Day and the following Friday  
Christmas Day and the following day

22. FLOAT. Contractor shall not use Float suppression techniques, including preferential sequencing (arranging critical path through activities more susceptible to Owner caused delay); lag logic restraints; zero total or free Float constraints; extended activity times; or imposing constraint dates other than as required by the Contract. Float suppression will be cause for rejection of the preliminary Progress Schedule or full Progress Schedule and its updates.

23. MANDATORY MILESTONES. The Contract duration shall be equal to the time period between the Notice to Proceed and the completion of the Work in readiness for final payment. The following milestones are mandatory.

- a. Notice to Proceed
- c. Milestones, if any, as indicated in Contractor's Bid
- c. Substantial Completion as indicated in Contractor's Bid
- d. Completion and readiness for final payment, as indicated in Contractor's Bid

The following additional milestones are to be considered and incorporated into the Progress Schedule in accordance with the Contract, if applicable.

- a. Permit constraints
- b. Facility shut down or outage milestone requirements
- c. Applicable phasing milestones
- d. Other milestones deemed appropriate by Engineer

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## Section 01 32 34

### CONSTRUCTION PHOTOGRAPHS

1. CONSTRUCTION PHOTOGRAPHS BY CONTRACTOR. Contractor shall be responsible for the production of construction photographs as provided herein. Engineer shall designate the subject of each photograph.

1.01. Pre-Construction Photographs. Photographs shall be taken along the route of each pipeline before the commencement of Work, and promptly submitted to Engineer. The photographs shall be at intervals of 100 feet.

1.02. Post-Construction Photographs. The same views captured in the pre-construction photographs shall be rephotographed upon completion of construction activities on any section of the pipeline, and submitted with Contractor's Application for Payment for Work on that section.

1.03. Intermittent Construction Photographs. During the installation of pipe, manholes, and interconnections, Contractor shall take a reasonable number of photographs to document the progress of the Work.

Intermittent photographs shall be submitted with Contractor's application for progress payment.

2. PHOTOGRAPH FORMAT AND ORGANIZATION. Photographs shall be taken in color and shall be taken and submitted to the Engineer in digital format.

2.01. Resolution. All photographs shall be JPEG (Joint Photographic Experts Group) with a minimum resolution of 1024x768 pixels and a maximum resolution of 1280x1024 pixels.

2.02. Filenames. All photographs filenames shall follow a syntax of

YYYY-MM-DD\_STA\_DESC.jpg

Where,

YYYY = the four-digit year.

MM = the two-digit month.

DD = the two-digit day.

STA = the pipeline station where the photograph was taken.

DESC = a general description of the subject of the photograph.

2.03. Media. Contractor shall submit the photographs electronically on CD-ROM or DVD-ROM. Files may be grouped into descriptive folders as necessary. The

surface of each disc shall be labeled with the project name and date range wherein the photographs were taken.

3. SUBMITTALS. Two (2) copies of each disc shall be submitted to the Engineer in accordance with the provisions of the Submittals Procedures section. Discs shall be submitted in paper sleeves.

End of Section

## Section 01 33 00

### SUBMITTAL PROCEDURES

#### 1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, per Figure 1-013300, is a representation to Engineer that Contractor accepts sole responsibility for determining and verifying all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto, and that Contractor has reviewed and coordinated each submittal with other Shop Drawings and with the requirements of the Work and the Contract Documents.

All deviations from the requirements of the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal using Figure 2-013300. Such submittals shall, as pertinent to

the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

The Contractor shall submit shop drawings electronically. All submittals made by any other method will be returned without review.

Drawings and the necessary data shall be submitted electronically to Engineer as specified below. Submittal documents shall be in color to facilitate use of red line markups. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Use of higher resolution is acceptable with Owner and Engineer approval. Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

The opening view for each PDF document shall be as follows:

Initial View: Bookmarks and Page

Magnification: Fit In Window

The file shall open to Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.

PDF document properties shall include the submittal number for the document title and Contractor's name for the author.

Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.

Contractor shall post submittals and retrieve Engineer's submittal review comments through the Project website accessible through the Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.

Facsimiles (fax) will not be acceptable. Submittals will not be accepted from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

1.02. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be 28 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

When the drawings and data are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as instructed by Engineer. Resubmittals by facsimile will not be accepted. When the drawings and data are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer.

1.03. Resubmittal of Shop Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal. Resubmittals shall be in an organized and consistent format.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

2. OPERATION AND MAINTENANCE DATA AND MANUALS. Not Used.

End of Section

SUBMITTAL No. \_\_\_\_\_

SECTION \_\_\_\_\_

Do not combine multiple sections together  
unless required by specifications.

(Contractor's Letterhead)

## **SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT**

**DATE:** \_\_\_\_\_ **COPIES** \_\_\_\_\_ **DRAWING SHEET NO.** \_\_\_\_\_

Description submittal contents: \_\_\_\_\_

Location: \_\_\_\_\_

Manufacturer \_\_\_\_\_

Subcontractor or Supplier (Optional) \_\_\_\_\_

**REMARKS:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### **CONTRACTOR'S APPROVAL**

( \_\_\_\_\_ Construction Company ) has reviewed and coordinated the submitted documentation and verifies that the equipment and material meet the requirements of the Work and the Contract Documents. We accept sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data contained in the submittal as required by the Contract Documents.

**Deviations:** ☐ None ☐ Yes (See attached Figure 2-01 33 00 for written description)

Approved By: \_\_\_\_\_ Date: \_\_\_\_\_

This approval does not release subcontractor / vendor from the contractual responsibilities.

Black & Veatch  
Project No. \_\_\_\_\_ Phase \_\_\_\_\_  
Contract No. \_\_\_\_\_  
Project Description: \_\_\_\_\_  
\_\_\_\_\_

**FIGURE 1-01 33 00**





Section 01 42 13

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Abbreviations for standards and organizations used in the Contract Documents are defined as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association now recognized as the ABMA
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHRI	Air-Conditioning, Heating and Refrigeration Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
APA	Engineered Wood Association (formerly American Plywood Association)
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	ASTM International
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association

BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
Fed Spec	Federal Specification
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	International Society of Automation
LEED	Leadership in Energy and Environmental Design
MHI	Materials Handling Institute
MIL	Military Specification

MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBS	See NIST
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEII	National Elevator Industry, Inc.
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly National Sanitation Foundation)
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Door Institute
SFPA	Southern Forest Products Association
SI	Système International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association

SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSFI	Scaffolding, Shoring & Forming Institute, Inc
SSPC	SSPC: The Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
USGBC	U.S. Green Building Council
WEF	Water Environment Federation

End of Section

Section 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1. TESTING SERVICES. Testing services shall be provided in accordance with Forsyth County Standard Terms and Conditions. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer and/or Authority Having Jurisdiction excluding testing as specified to be conducted directly by Contractor. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Owner are for the sole benefit of Owner and/or as required by the governing building code; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

1.01. Testing Services Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

Any Work or part thereof specifically to be inspected, tested or approved by an employee or representative of an Authority Having Jurisdiction. Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals. Contractor shall pay all costs associated for these activities and shall provide the required certificates of inspection or approval.

Any inspections, tests or approvals required for Owner or Engineer acceptance of materials or equipment to be incorporated in the Work. This includes any items required for acceptance of materials, concrete mix designs or equipment submitted for approval prior to Contractor's purchase for incorporation in the Work.

Testing, adjusting and balancing of mechanical, electrical and other equipment and systems as specified to be incorporated into the Work. This includes services required by manufacturers of equipment or other products such as concrete repair products, pipe, coatings, linings and roof membranes furnished under the Contract Documents.

Tightness testing of containment structures and pressure or leakage testing of piping as specified.

Any Work (or part thereof) required by the Contract Documents to be approved by Owner, Engineer or other designated individual or entity.

Contractor shall assume full responsibility for arranging and obtaining such approvals, pay all costs in connection therewith and submit to Engineer the required certificates of approval.

Excluding those conducted directly by an Authority Having Jurisdiction or expressly specified to be conducted directly by Contractor, inspections and tests shall be performed by independent inspectors, approved agencies or other qualified individuals or entities acceptable to Owner and Engineer.

1.02. Testing Services and Special Inspections Provided by Owner. Unless otherwise specified, Owner shall employ and pay for the services of an independent testing laboratory, approved agency or other qualified individual or entities for inspections, tests or approvals required by the Contract Documents for field quality control. These include items indicated as Owner provided in the following:

***033053 Miscellaneous Cast-in-Place Concrete***

***312333 Trenching and Backfilling***

***331313 Cleaning and Disinfection of Water Pipelines***

Contractor shall provide access to the site and Work in accordance with the Forsyth County Standard Terms and Conditions. Contractor shall give timely notice of the readiness of the Work for inspection, tests or approvals and shall cooperate with the inspection and testing personnel to facilitate the required tests and inspections. Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no Claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by Engineer or Agency personnel, Contractor shall furnish personnel and facilities to assist in the activities as required.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

The Approved Agency retained by Owner will furnish five (5) copies of a written report of each test. Two (2) copies of each test report will be transmitted to the Resident Project Representative, one copy to the Special Inspector, one copy to Engineer and one copy to Contractor, within 3 days after each test is completed or as directed by the Statement of Special Inspections as applicable.

End of Section

MATERIALS TESTING

PART 1 - GENERAL:

1-1. SCOPE:

1-1.1. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.

1-1.2. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications, i.e., concrete strength and slump testing, soil compaction, etc.

1-1.3. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer, e.g., testing of pipe.

1-1.4. The testing laboratory or laboratories will be selected by the Owner. The testing laboratory or laboratories will work for the Owner.

1-2. PAYMENT FOR TESTING SERVICES:

1-2.1. Testing services provided by the Owner will be paid by the Owner through the County's annual material testing contract. Testing services provided by the Contractor will be from the County's approved list but paid by the Contractor according to the annual materials testing contract rates.

1-2.2. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.

1-2.3. The cost of retesting any item that fails to meet the requirements of these Specifications shall be paid for by the Contractor. Retesting shall be performed by the testing laboratory working for the Owner.

1-3. LABORATORY DUTIES:

1-3.1. Cooperate with the Owner, Engineer and Contractor.

1-3.2. Provide qualified personnel promptly on notice.

1-3.3. Perform specified inspections, sampling and testing of materials.

1-3.3.1. Comply with specified standards, ASTM, other recognized authorities, and as specified.

1-3.3.2. Ascertain compliance with requirements of the Contract Documents.

1-3.4. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.

1-3.5. Promptly submit three (3) copies (two (2) copies to the Engineer and one (1) copy to the Contractor) of report of inspections and tests in addition to those additional copies required by the Contractor with the following information included:

- Date issued

- Project title and number

- Testing laboratory name and address

- Name and signature of inspector

- Date of inspection or sampling

- Record of temperature and weather

- Date of test

- Identification of product and Specification section

- Location of Project

- Type of inspection or test

- Results of test

- Observations regarding compliance with the Contract Documents

1-3.6. Perform additional services as required.

1-3.7. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

#### 1-4. CONTRACTOR RESPONSIBILITIES:

1-4.1. Cooperate with laboratory personnel; provide access to Work and/or manufacturer's requirements.

1-4.2. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.

1-4.3. Furnish copies of mill test reports.

1-4.4. Furnish required labor and facilities to:

- Provide access to Work to be tested;

- Obtain and handle samples at the site;

- Facilitate inspections and tests;



Provide a clear, level and unobstructed location for placement of concrete curing box(es) adjacent to the work area as agreed upon with the testing laboratory and the Engineer. Provide power and lighting at the curing box location.

1-4.5. Furnish climatically controlled curing box(es) for field storage of cast concrete cylinders or other samples. Multiple boxes shall be furnished when concrete placement activities are being performed at multiple locations across the project site. Curing box shall be manufactured and marketed for the specific purpose described herein and shall meet standards ASTM C31, C192 and C511. Curing box shall be used to maintain temperature and humidity of the concrete cylinder specimens for 48 hours. Cure box shall feature a digital thermometer, heat/cool indicator lights; temperature set buttons and a capacity of 22 standard 6" x 12" cylinders. Use of field constructed curing boxes will not be acceptable.

1-4.6. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

1-4.7. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.

1-4.8. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1-5. QUALITY ASSURANCE:

1-5.1. Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1-6. PRODUCT HANDLING:

1-6.1. Promptly process and distribute all required copies of test reports and related instructions to insure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1-7. FURNISHING MATERIALS:

1-7.1. The Contractor shall be responsible for furnishing all materials necessary for testing.

1-8. CODE COMPLIANCE TESTING:

1-8.1. Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

1-9. CONTRACTOR'S CONVENIENCE TESTING:

1-9.1. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1-10. SCHEDULES FOR TESTING:

1-10.1. Establishing Schedule

1-10.1.1. The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

1-10.1.2. Provide all required time within the construction schedule.

1-10.2. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.

1-10.3. When the testing laboratory is ready to test according to the determined schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1-11. TAKING SPECIMENS:

1-11.1. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1-12. TRANSPORTING SAMPLES:

1-12.1. The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

End of Section

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Section 01 50 00

TEMPORARY FACILITIES AND CONTROLS

1. UNITS OF MEASUREMENT. When both inch-pound (English) and SI (metric) units of measurement are specified herein, the values expressed in inch-pound units shall govern.
2. OFFICE AT SITE OF WORK. Not Used.
3. WATER. All water required for and in connection with the Work to be performed shall be provided by and at the expense of Contractor. No separate payment for water used or required will be made and all costs in connection therewith shall be included in the Bid.
4. POWER. Contractor shall provide all power for heating, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor.
5. VOICE AND DATA SERVICES. Not Used.
6. SANITARY FACILITIES. Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project.

Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 persons. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

7. MAINTENANCE OF TRAFFIC. Contractor shall conduct its work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

In making open-cut street crossings, Contractor shall not block more than one-half of the street at a time. Whenever possible, Contractor shall widen the shoulder on the opposite side to facilitate traffic flow. Temporary surfacing shall be provided as necessary on shoulders.

7.01. Temporary Bridges. Contractor shall construct substantial bridges at all points where it is necessary to maintain traffic across pipeline construction. Bridges in public streets, roads, and highways shall be acceptable to the authority having jurisdiction. Bridges erected in private roads and driveways shall be adequate for the service to which they will be subjected. Bridges shall be provided with substantial guardrails and with suitably protected approaches. Foot bridges shall be at least 4 feet wide, provided with handrails and uprights of dressed lumber. Bridges shall be maintained in place as long as the conditions of the Work require their use for safety of the public. When necessary for the proper prosecution of the Work in the immediate vicinity of a bridge, the bridge may be relocated or temporarily removed for such period as Engineer may permit.

7.02. Detours. Where required by the authority having jurisdiction that traffic be maintained over any construction work in a public street, road, or highway, and the traffic cannot be maintained on the alignment of the original roadbed or pavement, Contractor shall, at its own expense, construct and maintain a detour around the construction work. Each detour shall include a bridge across the pipe trench and all necessary barricades, guardrails, approaches, lights, signals, signs, and other devices and precautions necessary for protection of the Work and safety of the public.

8. BARRICADES AND LIGHTS. All streets, roads, highways, and other public thoroughfares which are closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or street on each side of the blocked section.

All open trenches and other excavations shall have suitable barricades, signs, and lights to provide adequate protection to the public. Obstructions, such as material piles and equipment, shall be provided with similar warning signs and lights.

All barricades and obstructions shall be illuminated with warning lights from sunset to sunrise. Material storage and conduct of the Work on or alongside public streets and highways shall cause the minimum obstruction and inconvenience to the traveling public.

All barricades, signs, lights, and other protective devices shall be installed and maintained in conformity with applicable statutory requirements and, where within railroad and highway rights-of-way, as required by the authority having jurisdiction.

9. FENCES. All existing fences affected by the Work shall be maintained by Contractor until completion of the Work. Fences which interfere with construction

operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

On completion of the Work across any tract of land, Contractor shall restore all fences to their original or to a better condition and to their original locations.

10. PROTECTION OF PUBLIC AND PRIVATE PROPERTY. Contractor shall protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by its construction operations. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod and shrubs in yards, parkways, and medians, shall be restored to their original condition, whether within or outside the easement. All replacements shall be made with new materials.

No trees shall be removed outside the permanent easement, except where authorized by Engineer. Trees left standing shall be adequately protected against damage from construction operations.

Contractor shall be responsible for all damage to streets, roads, highways, shoulders, ditches, embankments, culverts, bridges, and other public or private property, regardless of location or character, which may be caused by transporting equipment, materials, or workers to or from the Work or any part or site thereof, whether by Contractor or its Subcontractors. Contractor shall make satisfactory and acceptable arrangements with the owner of, or the agency or authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage.

All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.

11. TREE AND PLANT PROTECTION. All trees and other vegetation which must be removed to perform the Work shall be removed and disposed of by Contractor; however, no trees or cultured plants shall be unnecessarily removed unless their removal is indicated on the Drawings. All trees and plants not removed shall be protected against injury from construction operations.

12. SECURITY. Contractor shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

No Claim shall be made against Owner by reason of any act of an employee or trespasser, and Contractor shall make good all damage to Owner's property resulting from Contractor's failure to provide security measures as specified. Security measures shall be at least equal to those usually provided by Owner to protect Owner's existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the Site.

13. ACCESS ROADS. Contractor shall establish and maintain temporary access roads to various parts of the Site as required to complete the Project. Such roads shall be available for the use of all others performing work or furnishing services in connection with the Project.

14. PARKING. Contractor shall provide and maintain suitable parking areas for the use of all workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, Owner's operations, or construction activities.

15. NOISE CONTROL. Contractor shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

During construction activities on or adjacent to occupied buildings, and when appropriate, Contractor shall erect screens or barriers effective in reducing noise in the building and shall conduct its operations to avoid unnecessary noise which might interfere with the activities of building occupants.

16. DUST CONTROL. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing dust.

Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

17. TEMPORARY DRAINAGE PROVISIONS. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site, and adjacent property.



Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect Owner's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

18. EROSION CONTROL. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from its construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation shall be preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

19. POLLUTION CONTROL. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes shall be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance shall be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

20. PORTABLE FIRE EXTINGUISHERS. Contractor shall supply portable fire extinguishers during construction in accordance with all NFPA, International First Code Section, and OSHA regulations.

End of Section

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Section 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 – GENERAL

1. SCOPE. This section covers packaging and shipping of materials and equipment.
2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

3. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

End of Section

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## Section 01 66 00

### PRODUCT STORAGE AND HANDLING REQUIREMENTS

#### PART 1 – GENERAL

1-1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.

1-2. DELIVERY. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified in this Contract. These requirements also apply to any sub-suppliers making direct shipments to the Site.

Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

1-3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of Engineer, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

1-4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

During handling, carbon steel constructed material including chains, straps, and forks on lifting equipment shall not directly contact any equipment or material constructed of stainless steel. It shall be the Contractor's responsibility to correct any carbon steel contamination of stainless steel.

PART 2 – PRODUCTS Not Used.

PART 3 – EXECUTION Not Used.

End of Section

## Section 02 41 00

### DEMOLITION

#### PART 1 - GENERAL

1-1. SCOPE. This section covers the demolition of existing service connection piping, existing fencing, driveways, culverts under driveways, and sitework and the salvage of existing materials as specified herein.

1-2. GENERAL. Contractor shall be responsible for all work under this section. Contractor shall provide 7 working days written notice to the Owner and property owners adjacent to the construction prior to beginning demolition activities.

Demolition and salvage work shall create minimum interference with Owner's operations and minimum inconvenience to Owner. Contractor shall provide protection and safety of all roadways, sidewalks, and all accessible areas during demolition activities.

Blasting will not be permitted.

#### PART 2 – PRODUCTS Not used.

#### PART 3 - EXECUTION

3-1. DEMOLITION. Removal shall include removal of all accessories, piping, wiring, supports, and all other appurtenances, unless otherwise directed. Existing materials and equipment removed, and not indicated to be reused as a part of the Work, shall become Contractor's property unless otherwise specified, and shall be removed from the Site.

Contractor shall conduct demolition activities in a manner that prevents damage to existing facilities which are indicated to remain and shall provide all necessary protection for existing facilities. Any remaining facilities damaged during demolition shall be repaired by Contractor to a condition equal to or better than the original condition.

When demolition is complete, all debris shall be removed from the Site and the Site graded to the lines and grades indicated on the Drawings.

3-1.01. Structure Demolition. Not used.

3-1.02. Piping and Equipment Demolition.

3-1.02.01 Existing Service Connections. Existing water service connections that conflict with the proposed transmission mains shall be disconnected and reassembled for new service to the existing distribution mains. Any removed material shall be disposed as specified herein.

3-1.02.02 Existing Storm Culvert Pipes. Existing culverts and headwalls that conflict with the proposed route of the transmission mains, debris, and unsuitable materials shall be demolished and disposed of by the Contractor.

3-1.03. Sitework Demolition. Sitework demolition shall include the following:

Removal of trees and shrubs indicated on the Drawings to be removed and as required to complete the work.

Removal of existing fencing within the limits indicated on the Drawings.

3-2. SALVAGE. Existing materials and equipment removed, and not reused as a part of the work, shall become Contractor's property unless otherwise specified, and shall be removed from the jobsite.

3-3. PROTECTION. The CONTRACTOR shall protect from damage all existing construction and utilities that are to remain in service and all equipment that is required to be salvaged and remain property of the OWNER.

End of Section



## Section 03 30 53

### MISCELLANEOUS CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

1-1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

1-2. SUBMITTALS. All submittals of drawings and data shall be in accordance with the Submittals Procedures section.

#### PART 2 - PRODUCTS

2-1. LIMITING REQUIREMENTS. Unless otherwise specified, concrete shall be controlled within the following limiting requirements:

Cement Content	At least 526 lbs per cubic yard [312 kg/m <sup>3</sup> ].
Maximum Water-Cement Ratio	The maximum water-cement ratio shall be 0.45 for structures and 0.65 for encasement on a weight basis, or, if fly ash is used, the combined mass of cement plus fly ash shall be used to determine the water-cementitious materials ratio.
Fly Ash Content	At the option of Contractor, fly ash may be substituted for up to 25 percent of the Portland cement, on the basis of 1.0 lbs of fly ash added for each lb of cement reduction.
Concrete Strength	4,000 psi [28 MPa] minimum compressive strength at 28 days.
Air Content	6 percent ±1.5 percent.
Coarse Aggregate	Maximum nominal coarse aggregate size, 1 inch [25 mm].

Admixtures	A water-reducing admixture and an air-entraining admixture shall be included in all concrete. No calcium chloride or admixture containing chloride from sources other than impurities in admixture ingredients will be acceptable.
Consistency	Workable, without segregation, with slump not more than 5 inches [125 mm] when concrete is placed.
Mixing	In accordance with ASTM C94.

## 2-2. MATERIALS.

Cement	ASTM C150, Type I or II , low alkali .
Fly Ash	ASTM C618, Class F, except loss on ignition shall not exceed 4 percent.
Fine Aggregate	Non-reactive, clean, natural sand, ASTM C33.
Coarse Aggregate	Non-reactive crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, class 4S, except that clay and shale particles shall not exceed 1 percent.
Water	Potable.
Admixtures	
Water-Reducing	ASTM C494, Type A or D.
Air-Entraining	ASTM C260.
Superplasticizing	ASTM C494, Type F or G.
Reinforcing Steel	
Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.

Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.
Mechanical Connector (Couplers or Form Savers)	Classified Type 2 per ACI 318. Use only where indicated on the drawings.
Form Coating	Nonstaining and nontoxic after 30 days. Product shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.
Evaporation Reducer	Dayton Superior "AquaFilm Concentrate J74", Euclid "Eucobar", L&M Chemical "E-Con", BASF "Confilm", or Sika "SikaFilm".
Membrane Curing Compound and Floor Sealer	ASTM C1315, Type I, Class A, minimum 25 percent solids, acrylic, non-yellowing, unit moisture loss 0.40 kg/m <sup>2</sup> maximum in 72 hours. Product shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.
Polyethylene Film	Product Standard PS17 or ASTM D4397, 6 mils [150 µm] or thicker.

2-3. PRELIMINARY REVIEW. Reports covering the source and quality of concrete materials and the concrete proportions proposed for the work shall be submitted to Engineer for review before any concrete is placed.

2-4. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment. Forms shall be thoroughly cleaned and coated before concrete is placed and shall not be removed until the concrete has attained sufficient strength to safely support all loads without damage.

2-5. REINFORCEMENT. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while the concrete is being placed and compacted. Reinforcement shall be free from dirt, loose rust, scale,

and contaminants. Mechanical connectors shall be used only as indicated on the drawings.

### PART 3 - EXECUTION

3-1. PLACEMENT. Concrete shall be conveyed to the point of final deposit and placed by methods which will prevent segregation or loss of the ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Unless otherwise authorized, compaction shall be by immersion-type vibrators. The use of "jitterbug" tampers to compact concrete flatwork will not be permitted.

3-1.01. Polyethylene Film. Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 [4.75 mm] sieve, such surfaces shall be covered with polyethylene film. Joints in the film shall be lapped at least 4 inches [100 mm] and taped.

3-2. FINISHING. Fins and other surface projections shall be removed from all formed surfaces, except exterior surfaces that will be in contact with earth backfill. Surface voids and recesses resulting from removal of form ties shall be filled with mortar.

Unless otherwise specified, unformed surfaces shall be given a float finish.

3-2.01. Application of Evaporation Reducer. Concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight may be protected with an evaporation reducer. The evaporation reducer shall form a continuous film on the surface of fresh, plastic concrete to reduce evaporation.

Immediately following screeding, evaporation reducer shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon, in accordance with the manufacturer's recommendations. The spray equipment shall have sufficient capacity to continuously spray the product at approximately 40 psi with a suitable nozzle as recommended by the manufacturer.

The sprayable solution shall be prepared as recommended by the manufacturer.

Under severe drying conditions, additional applications of evaporation reducer may be required following each floating or troweling, except the last finishing operation.

3-3. CURING. Concrete shall be protected from loss of moisture for at least 7 days by membrane curing or by water curing. Membrane curing compound

shall be applied as recommended by the manufacturer. Water curing shall be in accordance with ACI 308.1. Concrete shall be protected against freezing for at least 7 days following placement.

End of Section

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## Section 03 60 00

### GROUTING

#### PART 1 - GENERAL

1-1. SCOPE. This section covers procurement and installation of grout. Unless otherwise specified, only nonshrink grout shall be furnished.

1-2. SUBMITTALS. A letter of certification indicating the types of grout to be supplied and the intended use of each type shall be submitted in accordance with the Submittals Procedures section.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage of any kind. Materials shall be protected from moisture.

#### PART 2 - PRODUCTS

##### 2-1. MATERIALS.

Nonshrink Grout	Precision cementitious grout with demonstrated non-shrinking properties, minimum 28 day compressive strength of 9000 psi; L&M "Crystex", BASF "Masterflow 928", Sika "SikaGrout 328", or Dayton Superior "Sure-Grip High Performance Grout".
Water	Clean and free from deleterious substances.

2-2. CEMENTITIOUS GROUT. Cementitious grout shall be furnished factory premixed so that only water is added at the jobsite.

2-3. EPOXY GROUT. Epoxy grout shall be used in lieu of cementitious grout when required by the equipment manufacturer for performance or warranty requirements. Epoxy grout products and installation procedures shall be submitted to Engineer for approval.

#### PART 3 - EXECUTION

3-1. PREPARATION. The concrete foundation to receive nonshrink grout shall be saturated with water for at least 12 hours preceding grouting unless additional time is required by the grout manufacturer.

### 3-2. INSTALLATION.

3-2.01. Mixing. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

3-2.02. Placement. Unless otherwise specified or indicated on the Drawings, grout under baseplates shall be 1-1/2 inches thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the baseplates are completely filled without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

3-2.03. Edge Finishing. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate.

3-2.04. Curing. Nonshrink grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least 3 days and then an acceptable membrane curing compound shall be applied.

End of Section



Section 07 16 00

DAMPPROOFING

PART 1 – GENERAL

1-1. SCOPE. This section covers furnishing and installation of dampproofing for concrete.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials to be used shall be as follows:

Coal Tar Epoxy	Ameron “Amercoat 78HB Coal Tar Epoxy, Carboline “Bitumastic 300 M”, Tnemec “46H- 413 Hi-Build Theme-Tar”, or Sherwin-Williams “Hi-Mil Sher-Tar Epoxy”
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Emulsified asphalt shall be solvent free and made from asphalt emulsified with bentonite clay and water.

2-2. SURFACES TO BE DAMPPROOFED. Exterior wall surfaces which are poured against sheeting or undisturbed earth need not be dampproofed. The following concrete surfaces that are not in contact with treated or potable water shall be dampproofed:

- a. All exterior walls of air valve manholes.

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. When dampproofing is applied, concrete surfaces shall be clean and dry.

All dirt, dust, sand, grit, mud, oil, grease, and other foreign matter shall be removed in accordance with ASTM D4258 and the surface abraded when recommended by the manufacturer of the dampproofing material. Abrading shall be done in accordance with ASTM D4259. Prior to application of the coating, the surfaces shall be thoroughly washed, or cleaned by air blasting, to remove all dust and residue.

3-2. APPLICATION. Dampproofing materials shall not be thinned unless

recommended by the manufacturer. Dampproofing using coal tar epoxy shall be applied in at least two coats, with a total dry film thickness of at least 20 mils.

Surfaces not intended to be dampproofed shall be protected from contamination, discoloration, or other damage. Such surfaces shall be masked as necessary to protect uncoated areas and to confine the dampproofing to the intended limits.

Surfaces shall be dry and at recommended temperature when dampproofing is applied. Unless properly protected, coatings shall not be applied in wet, damp, or foggy weather or when windblown dust, dirt, or debris, or insects would collect on the coating. Dampproofing, other than low temperature membrane dampproofing, shall not be applied when the temperature of the air or the surface is below 50°F , unless approved by manufacturer. Low temperature membrane dampproofing may be applied at air and surface temperatures as low as 25°F if approved by manufacturer and acceptable to the Engineer.

Dampproofing shall be applied by brush, high pile rollers, or spray equipment complying with the manufacturer's recommendations. If blistering occurs, all blisters larger than 1/4 inch [6 mm] in diameter shall be broken before the subsequent coat is applied.

Emulsified asphalt shall be installed in accordance with manufacturer's recommendations and at the maximum coverage rate recommended by manufacturer that is acceptable to Engineer.

End of Section

## TRENCHING AND BACKFILLING

### PART 1 - GENERAL

1-1. SCOPE. This section covers clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching; tunneled (trenchless construction) crossings; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other appurtenant work.

1-2. GENERAL. With reference to the terms and conditions of the construction standards for excavations set forth in OSHA "Safety and Health Regulations for Construction", Chapter XVII of Title 29, CFR, Part 1926, Contractor shall employ a competent person and, when necessary based on the regulations, a licensed or registered professional engineer, to act upon all pertinent matters of the work of this section.

1-3. SUBMITTALS. Drawings, specifications, and data covering the proposed materials shall be submitted in accordance with the Submittals Procedures section.

At least 30 days before starting construction on the sheeting and shoring, and in accordance with the OSHA requirements identified above, the Contractor shall ensure that the sheeting and shoring design engineer shall complete and submit to Engineer the Protection System Design Certificate (Figure 1-31 23 33) and the Contractor shall use the sheeting and shoring design. If required by the OSHA requirements identified above or to protect existing facilities, the Contractor shall submit a separate certificate for each unique design. If required for protection of existing facilities or as required by the OSHA regulations identified above, the certificate(s) shall be signed and sealed by the registered professional engineer that designed the protection system.

1-3.01. Filter Fabric Data. Complete descriptive and engineering data for the fabric shall be submitted. Data submitted shall include:

- A 12 inch square sample of fabric.
- Manufacturer's descriptive product data.
- Installation instructions.

1-3.02 Embedment and Backfill Materials. Complete test results covering tests performed by an independent commercial testing laboratory retained by the

Contractor for all materials described in the Materials Testing Section shall be submitted.

1-3.03. Dewatering Subcontractor. Submit project experience for dewatering Subcontractor. Provide name of project and contact information for owner and general contractor.

#### 1-4. BASIS FOR PAYMENT.

1-4.01. Trench Sheet piling. No additional payment above the Contract Price will be made for trench sheet piling left in place.

1-5. INSURANCE. Professional liability insurance shall be provided as specified in the Supplementary Conditions section.

### PART 2 - PRODUCTS

#### 2-1. MATERIALS.

2-1.01. Filter Fabric. The fabric shall be provided in rolls wrapped with covering for protection from mud, dirt, dust, and debris.

2-1.01.01. Filter Fabric Type A. Filter fabric Type A shall be provided for installation at locations indicated on the Drawings and as specified herein. Filter Fabric Type A shall be a nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have the indicated properties:

<u>Property</u>	<u>Test Method</u>	<u>Unit</u>	<u>Minimum Average Roll Value</u> *
Fabric Weight	ASTM D3776	oz/ yd <sup>2</sup> [g/m <sup>2</sup> ]	5.7 [193]
Grab Strength	ASTM D4632	lb [N]	155 [689]
Grab Elongation	ASTM D4632	percent	50
Mullen Burst Strength	ASTM D3786	psi [MPa]	190 [1.3]
Apparent Opening Size	CW-02215	U.S. Standard Sieve Size	70 [212 μm]

\* Minimum average roll value in weakest principal direction.

2-1.01.02. Filter Fabric Type B. Not used.

2-1.02. Polyethylene Film. Polyethylene film beneath concrete slabs or slab base course material shall be Product Standard PS17, 6 mil [150 mm] minimum thickness.

2-1.03. Tunnel Materials. Not Used.

2-1.04. Backfill Materials.

2-1.04.01. Job Excavated Material. Job excavated material may be used for either uncompacted or compacted trench backfill when the job excavated material is finely divided and free from debris, organic material, cinders, corrosive material, and stones larger than 3 inches in greatest dimension. Masses of moist, stiff clay shall not be used.

2-1.04.02. Inundated Sand Fill. Not Used.

2-1.04.03 Graded Gravel Fill. Graded gravel for compacted trench backfill shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85 – 100
3/8 inch	50 – 80
No. 4	35 – 60
No. 40	15 – 30
No. 200	5 – 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2-1.04.04. Granular Fill. Granular fill material shall be crushed rock or gravel. Granular fill shall be free from dust, clay, and trash; shall be hard, durable, and non-friable; and shall be graded 3/4 inch to No. 4 as defined in ASTM C33 for No. 67 coarse aggregate. Granular fill shall meet the quality requirements for ASTM C33 coarse aggregate.

2-1.05. Controlled Low Strength Material (CLSM) Fill. Not used.

2-1.06. Pipe Embedment Material. Pipe embedment material shall be placed as indicated in Detail 33 on the Drawings.

2-1.06.01. Granular Embedment. Granular embedment shall consist of crushed rock and crushed gravel, meeting the quality and gradation requirements of coarse aggregate size number 7 of ASTM C33.

2-1.06.02. Hand Placed Embedment. Hand placed embedment shall be finely divided job excavated or imported material, free from organic materials, debris, and stones.

2-1.06.03. Compacted Embedment. Compacted embedment shall be finely divided job excavated material free from debris, organic material, and stones. Graded gravel may be substituted for compacted embedment. Granular embedment may be substituted for all or part of the compacted embedment at the option of the Contractor.

## 2-2. MATERIALS TESTING.

2-2.01. Preliminary Review of Materials. As stipulated in the Quality Control section, all tests required for preliminary review of materials shall be made by an acceptable independent testing laboratory at the expense of Contractor. Two initial gradation tests shall be made for each type of embedment, fill, backfill, or other material, and one additional gradation test shall be made for each additional 500 tons [450 Mg] of each material delivered to the site. In addition, one set of initial Atterberg Limits test shall be made for each fill materials containing more than 20 percent by weight passing the No. 200 sieve [75 :m]. One additional Atterberg Limits test shall be made for each additional 500 tons [450 Mg] of each material delivered to the site.

All material testing on CLSM shall be made by an independent testing laboratory at the expense of Contractor.

2-2.02. Field Testing Expense. All moisture-density (Proctor) tests and relative density tests on the materials, and all in-place field density tests, shall be made by an independent testing laboratory at the expense of Owner. Contractor shall provide access to the materials and work area and shall assist the laboratory as needed in obtaining representative samples.

2-2.03. Required Tests. For planning purposes, the following guidelines shall be used for frequency of field tests. Additional tests shall be performed as necessary for job conditions and number of failed tests. Test results shall be submitted as specified in the Submittals Procedures section.

- a. Two moisture density (Proctor) tests in accordance with ASTM D698 (or, when required, ASTM D1557), or two relative density tests in accordance with ASTM D4253 and D4254 for each type of general fill, designated fill, backfill, or other material proposed.
- b. In-place field density and moisture tests (ASTM D2922 and ASTM

- c. D3017) at intervals of 1000 feet [300 m] maximum along the trench. One in-place field density and moisture test (ASTM D2922 and ASTM D3017) for every 200 cubic yards [153 m<sup>3</sup>] of backfill.
- d. One in-place density and moisture test (ASTM D2922 and ASTM D3017) whenever there is a suspicion of a change in the quality of moisture control or effectiveness of compaction.
- e. Additional gradation, Proctor, and relative density tests whenever the source or quality of material changes.

### PART 3 - EXECUTION

3-1. CLEARING. All clearing shall be performed as necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

3-2. EXCAVATION. Excavations shall provide adequate working space and clearances for the work to be performed therein and for installation and removal of concrete forms. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Except where exterior surfaces are specified to be damp-proofed, monolithic concrete manholes and other concrete structures or parts thereof, which do not have footings that extend beyond the outside face of exterior walls, may be placed directly against excavation faces without the use of outer forms, provided that such faces are stable and also provided that a layer of polyethylene film is placed between the earth and the concrete.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than 6 inches [150 mm] clearance is provided for outside plastering.

3-2.01. Classification of Excavated Materials. Classification of excavated materials shall be made as follows:

- a. Rock. Rock is defined as being sandstone, limestone, flint, granite, quartzite, slate, hard shale, or similar material in masses more than 1 cubic yard [1 m<sup>3</sup>] in volume or in ledges 4 inches [100 mm] or more in thickness.

Should rock be encountered in two or more ledges, each ledge being not less than 3 inches [75 mm] thick and with interlying strata of earth, clay, or gravel not more than 12 inches thick in each stratum, the

entire volume between the top of the top ledge and the bottom of the bottom ledge will be classified as rock.

b. Earth. All material not classified as rock.

3-2.02. Preservation of Trees. No trees shall be removed outside excavated or filled areas, unless their removal is authorized by Owner. Trees left standing shall be adequately protected from permanent damage by construction operations.

For limits of tree removal along pipeline routes, see the Temporary Facilities section under "Protection of Public and Private Property".

3-2.03. Blasting. Blasting or other use of explosives for excavation will not be permitted.

3-2.04. Dewatering. Dewatering equipment shall be provided to remove and dispose of all surface water and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure or tunnel to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

The Contractor shall retain an experienced dewatering Subcontractor to design, install, and operate the dewatering system. The dewatering Subcontractor shall have experience on at least 5 pipeline projects with similar soil and groundwater conditions to the soil and groundwater conditions on this Project

All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level to the minimum depth of 36 inches beneath such excavations. The specified dewatering depth shall be maintained below the prevailing bottom of excavation at all times.

Surface water shall be diverted or otherwise prevented from entering excavations or trenches to the greatest extent possible without causing damage to adjacent property.

Contractor shall be responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipe or conduit shall be left clean and free of sediment.

Contractor shall obtain from the appropriate agencies and authorities, the dewatering and stormwater discharge permits required to remove and dispose of groundwater, surface water, and any other water used in Contractor's operations. The permits shall be obtained prior to start of construction.



3-2.05. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavations for structures and trenches shall be supported with steel sheet piling and shoring as necessary to prevent caving or sliding.

Sheet piling or other excavation support systems shall be installed as necessary to limit the extent of excavations for deeper structures and to protect adjacent structures and facilities from damage due to excavation and subsequent construction. Contractor shall assume complete responsibility for, and shall install adequate protection systems for prevention of damage to existing facilities.

Sheeting, shoring and excavation support systems shall be designed by a professional engineer registered in the state where the project is located.

Trench sheeting may be removed if the pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Trench sheeting shall not be pulled after backfilling. Where trench sheeting is left in place, it shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed. Trench sheeting shall be removed unless otherwise permitted by Engineer. Trench sheeting will not be removed, if in the opinion of Engineer, removal of the sheeting will cause damage to the facility it is protecting. If left in place, the sheeting shall cut off 12 inches below finished grade. The design of the support system shall be such as to permit complete removal while maintaining safety and stability at all times.

A movable trench support may be used, provided care is exercised in placing and moving the trench box or support bracing to prevent movement of the pipe or disturbance of the pipe bedding and backfill. Any voids left in the trench wall or embedment material by support removal shall be carefully filled with granular embedment material compacted as specified herein.

3-2.06. Stabilization. Sub-grades for concrete structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workers.

Sub-grades for concrete structures or trench bottoms which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with crushed rock or gravel as specified for granular fills. The stabilizing material shall be placed in a manner that no voids remain in the granular fill. All excess granular fill with unfilled void space shall be removed. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations indicated on the Drawings.

3-3. TRENCH EXCAVATION. No more trench shall be opened in advance of pipe laying than is necessary to expedite the work. One block or 400 feet [120 m], whichever is the shorter, shall be the maximum length of open trench on any line under construction.

Except where tunneling is indicated on the Drawings, is specified, or is permitted by Engineer, all trench excavation shall be open cut from the surface.

Prior to excavation, Contractor shall contact local underground alert hotlines, "Dig Safe" and/or individual utility owners for marking underground utilities. Once utilities are marked, Contractor shall hand dig or pothole to expose the existing utilities. A survey shall be made of the utility size, material, location, and elevation prior to trench excavation and information shall be recorded on the record Drawings maintained by the Contractor.

3-3.01. Alignment, Grade, and Minimum Cover. The alignment and grade or elevation of each pipeline shall be fixed and determined from offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the section covering installation of pipe.

Where pipe grades or elevations are not definitely fixed by the Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 48 inches over pipes below paved and graded streets and, of 48 inches over pipes in other locations. Greater pipe cover depths may be necessary on vertical curves or to provide adequate clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation, except where future surface elevations are indicated on the Drawings.

3-3.02. Maximum Trench Widths. Not used.

3-3.03. Minimum Trench Widths. Except when maximum trench width is required for certain conduits, trenches shall be excavated to the minimum trench widths indicated in the following table. Trenches shall be excavated to a width which will provide adequate working space and sidewall clearances for proper pipe installation, jointing, and embedment.

<u>Nominal Pipe Size</u>	<u>Minimum Trench Width</u>	<u>Clearance</u>
Less than 27 in [700 mm]	Pipe OD plus 24 in [600 mm]	12 in

27 in through 60 in [700 mm through 1,500 mm]	Pipe OD plus nominal pipe size	ID/2
Greater than 60 in [1,500 mm]	Pipe OD plus 70 in [1800 mm]	30 in
Clearance = Minimum sidewall clearance		
OD = Outside diameter (or span) of conduit		
ID = Inside diameter (or span) of conduit.		

Specified minimum sidewall clearances are not minimum average clearances but are minimum clear distances which will be required to the trench excavation or the trench protective system.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving shall be used only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits.

3-3.04. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, and that trench alignment is such that pipe, when accurately laid to specified alignment, will be centered in the trench with adequate sidewall clearance. Undercutting the trench sidewall to obtain sidewall clearance will not be permitted.

In locations where maximum trench widths are required for designated rigid conduits, mechanical equipment shall be operated so that uniform trench widths and vertical sidewalls are obtained at least from an elevation 12 inches above the top of the installed pipe to the bottom of the trench.

3-3.05. Cutting Concrete Surface Construction. Cuts in concrete pavement and concrete base pavements shall be no larger than necessary to provide adequate working space for proper installation of pipe and appurtenances. Cutting shall be started with a concrete saw in a manner which will provide a clean groove at least 1-1/2 inches [40 mm] deep along each side of the trench and along the perimeter of cuts for structures.

Concrete pavement and concrete base pavement over trenches excavated for pipelines shall be removed so that a shoulder not less than 6 inches [150 mm] in width at any point is left between the cut edge of the pavement and the top edge of the trench. Trench width at the bottom shall not be greater than at the top and

no undercutting will be permitted. Pavement cuts shall be made to and between straight or accurately marked curved lines which, unless otherwise required, shall be parallel to the center line of the trench.

Pavement removal for connections to existing lines or structures shall not exceed the extent necessary for the installation.

Where the trench parallels the length of concrete walks, and the trench location is all or partially under the walk, the entire walk shall be removed and replaced. Where the trench crosses drives, walks, curbs, or other surface construction, the surface construction shall be removed and subsequently replaced between existing joints or between saw cuts as specified for pavement.

3-3.06. Excavation Below Pipe Sub-grade. Except where otherwise required, pipe trenches shall be excavated below the underside of the pipe, as indicated on Detail 33 on the Drawings, to provide for the installation of granular embedment.

Bell holes shall provide adequate clearance for tools and methods used for installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.

3-3.07. Artificial Foundations in Trenches. Whenever unsuitable or unstable soil conditions are encountered, Contractor shall notify Engineer immediately. When authorized by the Engineer, trenches shall be excavated below grade and the trench bottom shall be brought to grade with suitable material. In such cases, adjustments will be made in the Contract Price in accordance with the provisions of the General Conditions.

3-3.08. Over-Excavation. Over-excavation carried below the grade, unless authorized by the Engineer, shall be backfilled to the required grade with material acceptable to the Engineer and compacted to the satisfaction of the Engineer, at no additional cost to the Owner.

3-4. PIPE EMBEDMENT. Embedment materials both below and above the bottom of the pipe, classes of embedment to be used, and placement and compaction of embedment materials shall conform to the requirements indicated on Detail 33 in the Drawings and to the following supplementary requirements.

Embedment material shall contain no cinders, clay lumps, or other material which may cause pipe corrosion.

3-4.01. Embedment for Ductile Iron, Steel, FRP, and PVC Pipelines. Granular embedment for ductile iron, coal tar coated steel, FRP, and PVC pipelines shall be crushed rock or crushed gravel with rounded or subrounded particles. Crushed rock or gravel with sharp edges which could cause significant scratching

or abrasion of the pipe or damage to the polyethylene tube protection shall not be used unless otherwise approved by Engineer and all damage is repaired to the satisfaction of Engineer.

### 3-4.03. Placement and Compaction.

3-4.03.01. Granular Embedment. Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof by shovel slicing or other suitable methods to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Placing and compaction of embedment material shall not damage the pipe coating or polyethylene encasement. Embedment material shall not be dumped directly on the pipe or polyethylene encasement unless a suitable temporary isolation layer such as a 60 mil HDPE sheeting, is used to cover the pipe and polyethylene encasement.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Granular embedment shall be placed in layers not more than 6 inches (150 mm) deep and compacted as specified.

Each lift of granular embedment material shall be vibrated with a mechanical probe type vibrator or shovel sliced during placement to ensure that all spaces beneath the pipe are filled. Granular embedment shall be placed in maximum lift thickness of 6 inches [150 mm] and compacted. Each lift of embedment material shall be compacted with three passes (round trip) of a platform type vibrating compactor and to at least 70 percent relative density as determined by ASTM D4253 and D4254.

Where indicated on the Drawings or where silt, fine sand, or soft clay soils are encountered below groundwater, migration of soil into the embedment material shall be prevented by installing filter fabric Type A, or by using graded gravel in place of granular embedment. Filter fabric shall be placed on the trench surfaces so that it completely surrounds the embedment material. Joints shall be lapped 12 inches.

3-4.03.02. Compacted Embedment. Compacted embedment shall be placed in uniform layers not more than 8 inches (203 mm) thick and compacted to not less than 85% maximum density as determined by ASTM D698.

3-4.03.03 Hand Placed Embedment. Hand placed embedment shall be placed by hand shovels or using methods that prevent dropping the material for more than 24 inches above the pipe. Hand placed embedment shall be lightly tamped using hand equipment. Care shall be taken so as to not damage the pipe or coating.

3-4.04. Groundwater Barrier. Continuity of granular embedment material shall be interrupted by low permeability groundwater barriers to impede passage of water through the embedment. Groundwater barriers shall be compacted soil, extending through any granular material, and meeting ASTM D2487 soil classification GC, SC, CL, or ML-CL and shall be compacted to at least 85 percent of maximum density with moisture content within 3 percent of the optimum moisture content (ASTM D698). Material may be finely divided, suitable job excavated material, free from stones, organic matter, and debris.

3-5. TRENCH BACKFILL. All trench backfill above pipe embedment shall conform to the following requirements.

A layer of backfill material not more than 8 inches [200 mm] deep may be placed over concrete arch encasement or concrete thrust blocking after the concrete has reached its initial set, to aid curing. No additional backfill shall be placed over arch encasement or blocking until the concrete has been in place for at least 3 days.

3-5.01. Compacted Backfill. Compacted backfill will be required for the full depth of the trench above the embedment in the following locations:

Where beneath pavements, surfacings, driveways, curbs, gutters, walks, or other surface construction or structures.

Where in street, road, or highway shoulders and right-of-way.

In established lawn areas.

The top portion of backfill beneath established lawn areas shall be finished with at least 12 inches of topsoil corresponding to, or better than that which is underlying adjoining lawn areas.

Trench backfill material shall be suitable job excavated material or graded gravel and shall be as specified herein.

3-5.01.01. Job Excavated Material. Job excavated materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Each layer of

material shall have the best possible moisture content for satisfactory compaction. The material in each layer shall be wetted or dried as needed and thoroughly mixed to ensure uniform moisture content and adequate compaction. Increased layer thickness may be permitted for noncohesive material if Contractor demonstrates to the satisfaction of Engineer that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe. Job excavated material shall be compacted to 95 percent of maximum density at a moisture content within 3 percent of the optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 percent relative density as determined by ASTM D4253 and D4254 when those tests are appropriate.

3-5.01.02. Inundated Sand. Not Used.

3-5.01.03. Graded Gravel. Gravel backfill shall be deposited in uniform layers not exceeding 12 inches in uncompacted thickness. The backfill shall be compacted with a suitable vibratory roller or platform vibrator to at least 70 percent relative density as determined by ASTM D4253 and D4254. Groundwater barriers specified under pipe embedment shall extend to the top of the graded gravel backfill.

3-5.02. Ordinary Backfill. Compaction of trench backfill above pipe embedment in locations other than those specified will not be required except to the extent necessary to prevent future settlement. Contractor shall be responsible for backfill settlement as specified.

Ordinary earth backfill material to be placed above embedments shall be free of brush, roots more than 2 inches [50 mm] in diameter, debris, cinders, and any corrosive material, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth.

Backfill material above embedments shall be placed by methods which will not impose excessive concentrated or unbalanced loads, shock, or impact on installed pipe, and which will not result in displacement of the pipe.

Compact masses of stiff clay or other consolidated material more than 1 cubic foot [0.03 m<sup>3</sup>] in volume shall not be permitted to fall more than 5 feet [1.5 m] into the trench, unless cushioned by at least 2 feet [600 mm] of loose backfill above pipe embedment.

No trench backfill material containing rocks or rock excavation detritus shall be placed in the upper 18 inches [450 mm] of the trench, nor shall any stone larger than 8 inches [200 mm] in its greatest dimension be placed within 3 feet [900 mm] of the top of pipe. Large stones may be placed in the remainder of the

trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

3-5.03. Water-Settled Earth Backfill. Settlement or consolidation of trench backfill using water jetting or ponding shall not be performed.

3-5.04. Structure Backfill. Backfill around manholes and small concrete vaults shall meet the requirements specified for compacted trench backfill.

3-5.05. Controlled Low Strength Material (CLSM). Not used.

3-6. TUNNEL EXCAVATION. Not used.

3-7. DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or watercourses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. All material deposited in roadway ditches or other watercourses crossed by the line of trench shall be removed immediately after backfilling is completed, and the original section, grades, and contours of ditches or watercourses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3-8. PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Not used.

3-9. FINAL GRADING AND PLACEMENT OF TOPSOIL. After other outside work has been finished, and backfilling and embankments completed and settled, all areas which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours. All cuts, fills, embankments, and other areas which have been disturbed or damaged by construction operations shall be surfaced with topsoil to a depth of at least 4 inches [100 mm]. Topsoil shall be of a quality at least equal to the existing topsoil in adjacent areas, free from trash, stones, and debris, and well suited to support plant growth. Topsoil required to provide the minimum thickness shall be imported and placed at no additional cost to the Owner.

Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and equivalent to manual methods. All surfaces shall be graded to secure effective drainage. Unless otherwise indicated, a slope of at least 1 percent shall be provided.

Final grades and surfaces shall be smooth, even, and free from clods and stones, weeds, brush, and other debris.



3-10. DISPOSAL OF EXCESS EXCAVATED MATERIALS. Disposal of excess material from trench excavation sites shall be as follows. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be installed in trench backfill, debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site.

Excess earth from excavations located in unimproved property may be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of 6 inches [150 mm] above the original ground surface elevation at and across the trench and sloping uniformly each way. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing, shall be a subsidiary obligation of Contractor and no separate payment will be made therefore.

3-11. RESODDING. All established lawn areas cut by the line of trench or damaged during the work shall be re-sodded, after completion of construction, to the complete satisfaction of the property owner and Owner. All sod used shall be the same type as removed or damaged, shall be best quality, and, when placed, shall be live fresh growing grass with at least 1-1/2 inches [40 mm] of soil adhering to the roots.

All sod shall be procured from areas where soil is fertile and contains a high percentage of loamy topsoil and from areas that have been grazed or mowed sufficiently to form a dense turf.

Sod shall be transplanted within 24 hours from the time it is harvested, unless stacked at its destination in a suitable manner. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing. In no event shall more than 1 week elapse between cutting and planting.

Before placing sod, all shaping and dressing of the areas shall have been completed. After shaping and dressing, commercial fertilizer of a type acceptable to Owner shall be applied uniformly in the manner and amounts recommended by the manufacturer, and harrowed lightly. Sodding shall follow immediately.

All sodding shall be done during the period from March 15 to October 1, unless written permission is given by Owner to extend the planting season.

3-12. SETTLEMENT. Contractor shall be responsible for all settlement of trench backfill which may occur within the correction period stipulated in the General Conditions.

Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from Engineer or Owner.

End of Section

**PROTECTIVE SYSTEM  
DESIGN CERTIFICATE**

I, the undersigned professional engineer registered in the state where the Project is located, hereby certify that the protection system for \_\_\_\_\_ (trench location) has been designed by me, is appropriate for the (trench location) as represented to me, and is in compliance with the Contract Documents.

Name: \_\_\_\_\_

State of Registration: \_\_\_\_\_

Signature: \_\_\_\_\_

P.E. Number \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_  
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CLEANING AND DISINFECTION OF WATER PIPELINES

PART 1 - GENERAL

1-1. SCOPE. This section covers cleaning and disinfection of all potable water pipelines installed under this Contract.

Pipeline pressure and leakage testing is covered in the Pipeline Pressure and Leakage section.

1-2. GENERAL.

1-2.01. Coordination. Contractor shall coordinate cleaning and disinfection work with adjacent work as necessary to preclude work interferences or duplication of effort and to expedite the overall progress of the work.

Contractor shall provide all necessary piping, piping connections, temporary valves, backflow preventers, flowmeters, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities necessary to complete the cleaning and disinfection work.

Water for cleaning and disinfection work will be provided as stipulated in the Temporary Facilities section.

In all cases where it is necessary to interrupt service, permission of Owner shall be obtained at least two days before the service will be interrupted. In all cases where it is necessary to interrupt service to water customers, permission of the Owner shall be obtained and each customer affected shall be notified of the proposed service interruption and its possible duration in accordance with the Project Requirements section.

Unless otherwise specified, final cleaning and disinfection work shall not be performed until after hydrostatic testing of the pipelines and any resulting repair work completed.

Contractor shall notify Owner prior to the work to allow their representatives to be present during cleaning and/or disinfection of the pipelines.

1-2.02. Related Work. Other sections directly related to work covered in this section are the Pipeline Pressure and Leakage Testing section and relevant Division 33 Specifications.

1-2.03. Governing Standard. All disinfection work shall conform to the requirements of ANSI/AWWA C651, and the requirements of Georgia EPD, except as modified herein. If any state or local requirements conflict with the provisions of this section, the state and local requirements shall govern.

Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of neutralized or diluted chlorinated water from the final flushing of pipelines and to identify acceptable locations for disposal of the flushing water. All requirements and costs associated with notification and obtaining any discharge permits shall be the responsibility of the Contractor.

1-2.04. Experience. The disinfection work shall be performed by a subcontractor specialized in such work, or with the permission of Engineer, Contractor may provide the necessary equipment and do the work with his own personnel. In either case, all work shall be done under the direct supervision of a competent and experienced specialist in such work.

Personnel performing the disinfection shall demonstrate a minimum of 5 years experience in the chlorination and dechlorination of similar pipelines.

### 1-3. SUBMITTALS.

1-3.01. Cleaning and Disinfection Plan. Unless otherwise specified, Contractor shall submit a detailed cleaning and disinfection plan to Engineer 14 days prior to starting any cleaning and disinfection work. The plan shall cover the method and procedure proposed, necessary coordination, qualification of personnel performing the disinfection work, sequence of operations, the limits of the pipelines to be cleaned and disinfected, the positions of all valves, location of temporary bulkheads, materials and quantities of each to be used, equipment to be used, manner of filling and flushing the pipelines, chlorine injection points, sample points, bacteriological testing location and schedule, potable water source, method of metering the water if required, neutralization and disposal of wasted water, and all other methods and procedures to be followed in performing the cleaning and disinfection work.

1-3.02. Testing. Bacteriological testing shall be performed by an independent testing laboratory furnished by Contractor. The proposed independent testing laboratory will be certified by the State of Georgia to collect samples and perform bacteriological and residual chlorine analyses for drinking water. Contractor shall submit the qualifications of the proposed independent testing laboratory for Owner approval prior to performing the specified bacteriological tests. Upon completion of each test, three copies of the test results shall be submitted to Engineer. The test results must be accompanied by the chains of custody for each sample.

Contractor shall provide all items of equipment, piping, and other facilities necessary to assist with the collection of the samples as required. Locations for bacteriological sampling shall be in accordance with the governing standards or as acceptable to the Owner.

The chlorine residual tests shall be performed by Contractor. The test logbook shall be made available to Owner or Engineer upon request and shall be submitted to Engineer upon completion of all chlorine residual testing.

#### 1-4. QUALITY ASSURANCE.

1-4.01. Chlorine Residual Tests. Contractor shall provide the necessary apparatus for making the chlorine residual tests by the drop dilution method in Appendix A of ANSI/AWWA C651. Test results shall be recorded in a logbook that includes for each test: the location, date, time, test results, and test kit manufacturer.

1-4.02. Bacteriological Tests. Sampling and testing of water in the pipelines shall be performed after final flushing in accordance with Section 5 of ANSI/AWWA C651. Two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected and standard heterotrophic plate counts measured for each sample.

1-4.03. Redisinfection. Should the bacteriological tests indicate the presence of coliform organisms at any sampling point, the pipelines shall be reflushed, resampled and retested in accordance with Section 5 of ANSI/AWWA C651. If check samples show the presence of coliform organisms, then the pipelines shall be rechlorinated until acceptable results are obtained.

## PART 2 - PRODUCTS

2-1. MATERIALS. All materials furnished by Contractor shall conform to the requirements of ANSI/AWWA C651 and shall be clean and free of debris which could infer questionable test results.

2-1.01. Liquid Chlorine. Liquid chlorine shall conform to AWWA B301.

2-1.02. Calcium Hypochlorite (Dry). Calcium hypochlorite shall conform to AWWA B300.

2-1.03. Sodium Hypochlorite (Solution). Sodium hypochlorite shall conform to AWWA B300.

2-1.04. Chlorine Residual Test Kit. Chlorine residual concentration shall be measured using an appropriate range, drop count titration kit or an orthotolidine

indicator comparator with wide range color discs. The color disc range shall be selected to match chlorine concentration limits. Test kits shall be maintained in good working order and available for immediate test of residuals at point of sampling. Test kits manufactured by Hach Chemical or Orbeco-Hellige are acceptable.

## PART 3 - EXECUTION

### 3-1. APPLICATION.

3-1.01. Cleaning. Pipelines, including all associated valves and fittings, shall be cleaned to the satisfaction of Owner and Engineer.

Small pipelines shall be cleaned by flushing with water at the maximum velocity which can be developed, but not less than 2.5 feet per second [0.76 m/s], unless otherwise permitted by Engineer. Flushing shall continue until the pipeline is free of dirt, debris, and other foreign materials. Cleaning shall precede disinfection.

Large pipelines may be flushed as specified for small pipelines, cleaned with a hose, or cleaned by other methods acceptable to Engineer. Flushing or other cleaning methods shall continue until the pipeline is free of dirt, debris, and other foreign materials. Cleaning shall precede disinfection.

Flushing shall be accomplished through the installed valves or fittings, blow-offs or through temporary flushing connections installed for that purpose and in accordance with any details indicated on the Drawings.

Booster pumps shall be used if needed to obtain the necessary volume or velocity of water. Pumping equipment installed under this Contract shall not be used for flushing, nor shall the flushing water be passed through them or other installed equipment; temporary bypass piping at each pump or installed equipment shall be provided as needed.

3-1.02. Disinfection Procedure. The pipelines shall be disinfected by the tablet method, continuous feed method, or slug method. Potable water shall be used in conjunction with the chlorination agent.

For the continuous feed or slug method, the chlorination agent shall be injected into the line at the supply end of each new pipeline or valved section thereof.

Admission of disinfectant solution into or the flushing thereof through existing piping shall be held to the minimum possible, and then only after adequate measures have been taken to prevent any such solution of chlorinated wastewater from entering branch service connections to water customers or other piping systems.



During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. Valves shall be operated such that the chlorine solution in the pipeline being chlorinated will not flow back into the supply line. Check valves shall be used if needed.

Existing pipelines which may become contaminated during work requiring connections to the new pipeline, involving either tapping or cutting into operations, shall be flushed and disinfected in accordance with Section 4 of ANSI/AWWA C651.

3-1.03. Final Flushing. Upon completion of chlorination, but before sampling and bacteriological testing, all heavily chlorinated water shall be removed from the lines by flushing with potable water until the chlorine residual in the lines is not higher than that generally prevailing in the adjacent existing system or as acceptable to the Owner.

Final flushing shall be accomplished as specified for cleaning of pipelines.

3-1.04. Disposal of Chlorinated Wastewater. All chlorinated wastewater to be discharged shall be neutralized (dechlorinated) by chemical treatment and disposed in accordance with Section 4 and Appendix C of ANSI/AWWA C651 and the requirements of the governing agency specified herein. Schedule, rates of flow, and locations of discharge of disinfection and flushing water shall be coordinated with Engineer and in accordance with all applicable rules and regulations.

End of Section

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## Section 33 14 00

### PIPELINE PRESSURE AND LEAKAGE TESTING

#### PART 1 - GENERAL

1-1. SCOPE. This section covers field hydrostatic pressure and leakage testing of piping. The term "piping" shall be used in this section to refer to piping systems, pipelines, or sections thereof.

Cleaning and disinfection of piping is covered in the Cleaning and Disinfection of Water Pipelines section.

1-2. GENERAL. Contractor shall coordinate pressure and leakage testing with adjacent work as necessary to preclude work interferences or duplication of effort and to expedite the overall progress of the work.

Contractor shall provide all necessary piping, piping connections, temporary valves, backflow preventers, and all other items of equipment or facilities necessary to complete the pressure and leakage testing.

In all cases where it is necessary to interrupt service, permission of Owner shall be obtained at least two days before the service will be interrupted. In all cases where it is necessary to interrupt service to water customers, permission of the Owner shall be obtained and each customer affected shall be notified of the proposed service interruption and its possible duration in accordance with the Project Requirements section.

Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of water used for pressure and leakage testing and to identify acceptable locations for disposal of the water. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

Engineer or Engineer's representative shall be present during testing and shall be notified of the time and place of testing at least 3 days prior to commencement of testing. All testing shall be performed to the satisfaction of Engineer, and in accordance with all governing standards and regulations.

1-2.01. Testing Schedule and Procedure. A testing schedule and procedure shall be submitted to Engineer for review and acceptance not less than 21 days prior to commencement of testing. The schedule and procedure shall include, but not be limited to the following information for each pipe section to be tested:

limits of each pipe test section;

proposed time and sequence;  
physical locations and set positions of all valves;  
locations of temporary bulkheads, stops, caps, restraints, supports, and  
other temporary equipment needed;  
manner of filling and source of water;  
method and location of metering volumes;  
method and location of gauging pressures; and  
method and location of disposal of test water.

1-2.02. Special Testing Requirements. Special testing requirements include the following:

Unless otherwise acceptable to Engineer, the general sequence of work for each pipeline, or valved or bulkheaded section thereof, shall be as follows:

Initial cleaning and flushing of pipeline.  
Filling pipeline.  
Hydrostatic pressure and leakage testing.  
Disinfection.  
Final flushing and neutralization of heavily chlorinated water.  
Bacteriological tests.

Unless otherwise acceptable, during testing of the pipeline, all valves, except for auxiliary hydrant valve(s), shall be in the open position.

Unless otherwise acceptable, temporary bulkheads shall be provided during testing so that the test pressure is not applied to existing or new valves and hydrants, or to existing water lines, or to any portion of water lines installed under this Contract that have already been put into service.

Unless otherwise acceptable, a temporary pressure gauge shall be installed at each end of the limits of the pipeline to be tested.

Unless otherwise acceptable, tests shall be conducted before connections are made to existing water lines, or to any portion of water lines installed under this Contract that have already been put into service.

Unless otherwise acceptable, upon completion of testing and disinfection, connections made to existing water lines or to any portion of water lines installed under this Contract that have already been put into service, and any other portion of the pipeline not subject to the pressure test, shall be visually inspected for leakage after placing the water line into service and before backfilling the connection.

1-2.03. Water. Water for testing shall be furnished as stipulated in the Temporary Facilities section. As a conservation measure, the water shall be collected for reuse in subsequent testing. Following completion of testing, the

water shall be disposed of in accordance with the requirements of regulatory agencies and in a manner acceptable to Engineer.

## PART 2 - PRODUCTS

2-1. TEST EQUIPMENT. All necessary connections between the piping to be tested and the water source, together with pumping equipment, water meter, pressure gauges, backflow prevention, and all other equipment, materials, and facilities required to perform the specified tests, shall be provided. All required blind flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall also be provided. All temporary sectionalizing devices shall be removed upon completion of testing. Vents shall be provided in test bulkheads where necessary to expel air from the piping to be tested.

Test pressure shall be applied by means of a force pump sized to produce and maintain the required pressure without interruption during the test.

Water meters and pressure gauges shall be accurately calibrated and shall be subject to review and acceptance by Engineer.

Permanent or temporary gauge connections shall be installed at each location where test gauges are connected to the piping during the required test. Drilling and tapping of pipe walls will not be permitted. Upon successful completion of testing, each permanent gauge connection shall be fitted with an isolation valve and a permanent gauge, and each temporary gauge connection, if used, shall be fitted with a permanent sealed plug or cap acceptable to the Engineer.

Permanent or temporary fill and vent connections shall be installed as needed for the required test. Drilling and tapping of pipe walls will not be permitted. Upon successful completion of testing, each permanent fill and vent connection shall be fitted with the permanent fill or vent piping, and each temporary fill and vent connection, if used, shall be fitted with a permanent sealed plug or cap acceptable to the Engineer.

## PART 3 - EXECUTION

3-1. FILLING AND VENTING. Before filling the piping with water, care shall be taken to ensure that all air release valves and other venting devices are properly installed and operating properly. Hand-operated vent valves shall not be closed until an uninterrupted stream of water is flowing from each valve. The rate of filling the piping with water must not exceed the venting capacity of the installed air vent valves and devices.

3-2. BLOCKING AND BACKFILLING. Piping shall be adequately blocked, anchored, and supported before the test pressure is applied. Piping may be tested after backfilling.

3-3. PRESSURE TESTING. After the piping to be tested has been filled with water, the test pressure shall be applied and maintained without interruption within plus or minus 5 psi of test pressure for 2 hours plus any additional time required for Engineer to examine all piping being tested and for Contractor to locate any defective joints and pipe materials. The test pressure shall be in accordance with the requirements specified for pipeline or plant piping.

3-3.01. Pipeline Test Pressure. Test pressure shall be in accordance to Forsyth County Water and Sewer Standards.

Pipe shall be properly and adequately flushed all air removed and then tested under a hydrostatic pressure of 200 psi as measured at the lowest part on the test section.

Pressure test shall be considered acceptable when test pressure has not varied by more than +/- 5 psi for a minimum period of two (2) hours.

3-3.02. Plant Piping Test Pressure. Not used.

3-4. PLANT PIPING LEAKAGE TESTING. Not Used.

3-5. PIPELINE LEAKAGE TESTING. The pipeline piping shall be subjected to a leakage test. Leakage testing may be conducted concurrently with pressure testing. The duration of the leakage test shall be 2 hours plus the additional time required for Engineer to make an accurate determination of leakage.

3-5.01. Leakage Test Pressure. The hydrostatic pressure maintained during the leakage test shall be equal to the pressure specified for pressure testing of the piping and shall be maintained within plus or minus 5 psi [35 kPa] during the entire time that leakage measurements are being performed.

3-5.02. Leakage Measurement. Measurement of leakage shall not be attempted until all trapped air has been vented, absorption of water by the pipe wall or lining has stabilized, and a constant test pressure has been established. After the pressure has stabilized, piping leakage shall be measured with a suitable water meter installed in the pressure piping on the discharge side of the force pump.

3-5.03. Allowable Leakage. The term "leakage", as used herein, refers to the total amount of makeup water which must be added into the piping during the test to maintain the test pressure.

No piping will be accepted if and while it exhibits a leakage rate in excess of that determined by the indicated formulas:

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$$Q = 0.00676DLN \text{ (using inch-pound units)}$$

Where

Q = allowable leakage in gallons per hour

D = nominal diameter of pipe in inches

L = length of section tested in thousand feet

N = square root of weighted average test pressure in pounds per square inch

The weighted average test pressure shall be equivalent to the arithmetic difference between the specified test pressure plane elevation in feet [meters] and the average elevation of the pipeline in feet [meters], multiplied by 0.433 to obtain psi [9.81 to obtain kPa]. The weighted average elevation of the pipeline shall be calculated by (1) breaking the pipeline into sections at each significant change in slope and multiplying the average elevation of each section by the length of each section, (2) then summing the products, and (3) dividing the sum by the total length of the pipeline.

Whenever the piping to be tested contains pipe of different diameters, the allowable leakage shall be calculated separately for each diameter and the corresponding length of piping. The resulting allowable leakage rates shall be added to obtain the total allowable leakage for the entire piping.

All joints in piping shall be free from visible leaks during the leakage test. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor regardless of the amount that the total leakage may have been below the specified allowable leakage rate during the leakage test.

If the leakage test indicates a higher than allowable leakage rate, Contractor shall locate and repair leaking joints and other defective work and repeat the test the until leakage rate is less than the allowable rate.

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## Section 40 05 19

### DUCTILE IRON PIPE

#### PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of ductile iron pipe. Ductile iron pipe shall be furnished complete with all fittings, specials, adapters, closure pieces, blowoffs, outlets, caps and plugs, temporary bulkheads, access manholes, jointing materials, pipe hangers and supports, anchors, blocking, encasement, appurtenances, and accessories specified and indicated on the Drawings, and as required for proper installation and functioning of the piping.

Piping furnished hereunder shall be complete with all joint gaskets, bolts, nuts and other jointing materials required for installation of any valves and equipment furnished by Owner or others for installation under this Contract.

Pipe hangers and supports, pressure and leakage testing, cathodic protection, and cleaning and disinfection are covered in other sections. Pipe trenching, embedment, and backfill are covered in the Trenching and Backfilling section.

1-2. GOVERNING STANDARDS. Except as modified or supplemented herein, all ductile iron pipe, fittings, and specials shall conform to the applicable requirements of the following standards and other standards named in this section:

ANSI/AWWA Standards	Title
C151	Ductile-Iron Pipe, Centrifugally Cast, For Water
C600	Installation of Ductile Iron Water Mains and Their Appurtenances
M41	Ductile Iron Pipe and Fittings - Manual of Water Supply Practices
C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings
C105	Polyethylene Encasement for Ductile Iron Pipe Systems
C110	Ductile-Iron and Gray-Iron Fittings
C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C115	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
C153	Ductile-Iron Compact Fittings

1-3. PIPE MANUFACTURER AND FIELD SERVICES. All ductile iron pipe, fittings, specials, bolts, gaskets, other jointing materials, and appurtenances shall be fabricated, lined, coated, and furnished under the direction and management of one pipe manufacturer. The pipe manufacturer responsibilities, which shall include, at a minimum; coordinating and furnishing all pipe materials, gaskets, bolts, and other jointing materials, and pipe appurtenances (except for furnished coupled joints and other similar products by a specified manufacturer) for a complete piping system that meets the specified test pressures and service conditions; ensuring and certifying that all pipe, fittings, specials, and other pipe materials, pipe gaskets and bolts specified herein, are being manufactured in full accordance with the Contract Documents; preparing and submitting all submittal information and shop drawings; and making any corrections that may be required to submittal information and shop drawings.

The pipe manufacturer's minimum required experience qualifications shall include manufacture of a pipeline at least 1 mile [1.6 km] in length, of a diameter equal to or larger than the pipe to be provided, with joints, lining, and coating suitable for the same or higher pressure rating, which has performed satisfactorily for the past 5 years.

All ductile iron pipe shall be installed in accordance with the pipe manufacturer's recommendations.

1-4. SUBMITTALS. Drawings, details, specifications, and installation schedules covering all ductile iron pipe and accessories shall be submitted in accordance with the Submittals Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Certification by manufacturer (affidavit of compliance) for each item furnished in accordance with the ANSI/AWWA Standards.

Restrained joints details.

Emergency Repair Manual, including names and telephone numbers of emergency contact persons.

Certification of gaskets by pipe manufacturer, certifying that gasket material is suitable for test pressures and services intended.

Certification that all materials in contact with treated or potable water are ANSI/NSF 61 approved.

Certification of joint lubricant.

Certification of proof-of-design tests for joints, including restrained joints.

Two samples of the polyethylene encasement, each sample clearly identified as required by the Governing Standards and test results from an independent third party laboratory of the

requirements specified in ANSI/AWWA C105/A21.5.

The method that the Contractor proposes to use for measuring deflection of pipe joints.

Submittal data shall clearly indicate the country of origin of pipe, fittings, flanges, restraining devices, and accessories.

1-4.01. Emergency Repair Manual. Contractor shall submit an emergency repair manual prepared and furnished by the pipe manufacturer. The manual shall include procedures for handling emergency calls and repairs; a list of stock replacement pipe sections, closures, and other parts needed for emergency repairs; names and emergency telephone numbers of pipe manufacturer's engineering staff and factory-trained field service representatives who can be contacted day or night during an emergency; response and delivery times; and installation instructions for the materials and methods used in making repairs.

1-5. SHIPPING, HANDLING, AND STORAGE. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section, and as specified herein.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Unpadded hooks, wire brushes or other abrasive tools shall not be permitted to come into contact with polyethylene lining if such lining is specified.

Contractor-furnished pipe and fittings in which the lining has been damaged shall be replaced by and at the expense of Contractor. With the concurrence of Engineer, small and readily accessible damaged areas may be repaired.

Contractor shall repair any damage to pipe coatings and linings before the pipe is installed.

## PART 2 - PRODUCTS

2-1. PIPE CLASS. The class of ductile iron pipe shall be as indicated in the following table for those services indicated in the Pipeline Schedule section. The specified class includes service allowance and casting allowance.

<u>Pipe Size (inches)</u>	<u>ANSI/AWWA Pressure Class</u>
4 thru 20	350
24 and above	200

## 2-2. MATERIALS.

Pipe	Ductile iron, ANSI/AWWA C151/A21.51
Gaskets – All Joint Types	Synthetic rubber unless otherwise specified; natural rubber will not be acceptable. All gaskets shall be furnished by the pipe manufacturer unless another manufacturer's product is indicated. Pipe manufacturer shall submit certificates of gasket suitability certifying that the gasket materials are compatible with the joints specified, are recommended for the specified field test pressure and service conditions. Gaskets for treated or potable water service shall be certified for chlorinated and chloraminated potable water. Gas and oil-resistant gaskets shall be made of Nitrile (NBR [Acrylonitrile Butadiene]) rubber. The name of the material shall be permanently marked or molded on the gasket. Gaskets shall also be certified as suitable where soils may be contaminated with gas and oil products.
Joint Lubricant	Vegetable-based lubricant recommended by the pipe manufacturer. Petroleum or animal-based lubricants will not be acceptable. Lubricants that will be in contact with treated or potable water shall be certified as being in compliance with ANSI/NSF 61.
Fittings	ANSI/AWWA C110/A21.10 (except shorter laying lengths will be acceptable for U.S. Pipe), or ANSI/AWWA C153/A21.53, minimum working pressure rating as follows, unless indicated otherwise on the Drawings.

<u>Fitting Size</u> in.		<u>Material</u>	<u>Type</u>	<u>Min. Working Pressure Rating,</u> psi
4 to 20		DI	Mechanical and Push-on joints	350
24 to 48		DI	All joints	200
All fittings shall be ductile iron and suitable for the rated working pressure plus a surge or test pressure allowance of 100 psi or 1.5 times rated working pressure, whichever is less, without leakage or damage.				
Push-on Joints			ANSI/AWWA C111/A21.11.	
	Restrained Push-on Joints, gaskets with stainless steel gripping segments, (4 inch through 12 inch), working pressure rating 350 psi .		American “Fast Grip”. U.S. Pipe "Field Lok 350 Gasket", or McWane Sure Stop 350 Gasket.	
	Restrained Push-on Joints, locking wedge type, (4 inch through 24 inch), working pressure rating 350 psi for 4 through 16 inch and at least 250 psi for 18 through 24 inch.		EBAA Iron "Megalug" Series 1700; U.S. Pipe “TR Flex Gripper Ring”; Star Pipe Products “StarGrip 3100P”; or American “Field Flex Ring”, without exception.	
	Restrained Push-on Joints, positive locking segments and/or rings, (4 inch through 24 inch), working pressure rating 350 psi.		American "Flex-Ring,;" U.S. Pipe or McWane "TR Flex"	
	Restrained Push-on Joints, positive locking segments and/or rings, (30 inch through 48 inch), working pressure rating at least 250 psi.		American "Flex-Ring," or "Lok-Ring"; U.S. Pipe or McWane "TR Flex"; U.S. Pipe HP LOK..	
Restrained push-on joints shall be suitable for a test or working pressure plus surge pressure of the rated working pressure plus 100 psi (680 kPa)				
Flanged Joints			ANSI/AWWA C115/A21.15.	
	Flanges			
	Class 250 identified	(Where on the	Ductile iron, flat faced, with ANSI/ASME B16.1, Class 250	

	Drawings)	diameter and drilling.
	All Others	Ductile iron, Class 125, ANSI/AWWA C115/A21.15.
	Flanges	All flanges shall be suitable for test pressure of 1.5 times rated pressure without leakage or damage.
	Bolts	ASTM A307, chamfered or rounded ends projecting 1/4 to 1/2 inch beyond outer face of nut.
	Nuts	ASTM A563, hexagonal, ANSI/ASME B18.2.2, heavy semifinished pattern.
	Gaskets	ASTM D1330, Grade I rubber, full face type, 1/8 inch thick unless otherwise required by pipe manufacturer and accepted by Engineer. Pipe manufacturer shall submit certification of gaskets furnished as indicated above under Gaskets - All Joint Types.
Insulated Flanges		
	Flanges	As specified herein, except bolt holes shall be enlarged as needed to accept bolt insulating sleeves.
	Insulation Kits	As manufactured by Advanced Products or Pipeline Seal and Insulator, Inc.
	Insulating Gaskets	Type E, G-10, 1/8 inch thick, with Nitrile or EPDM sealing element for water and air service and Viton sealing elements for wastewater service unless otherwise required by pipe manufacturer and accepted by Engineer. Pipe manufacturer shall submit certification of gaskets furnished as indicated above under Gaskets - All Joint Types.
	Bolt Insulating Sleeves	G-10, 1/32 inch thick.
	Insulating Washers	G-10, 1/8 inch thick, two for each flange bolt.
	Backing Washers	Steel, 1/8 inch thick, two for each flange bolt.
Mechanical Joints		ANSI/AWWA C111/A21.11., with ductile iron glands.

	Restrained Mechanical Joints (factory prepared spigot), (4 inch through 48 inch), working pressure rating at least 250 psi.	American "MJ coupled Joints", or Griffin "Mech-Lok".
	Restrained Mechanical Joints, (field cut spigot), (4 inch through 48 inch), working pressure rating 350 psi for 4 through 16 inch and at least 250 psi for 18 through 48 inch.	EBAA Iron "Megalug" Series 1100, Sigma "One Lok" SLDE series, or Star Pipe Products "StarGrip 3000" without exception.
	Restrained Mechanical Joints (36 in gate valve installation)	At Gate Valve and Pipe connections the contractor is responsible to provide appropriate pipe ends to match American Flex Ring Restrained Joint.
Restrained mechanical joints shall be suitable for a test or working pressure plus surge pressure of the rated working pressure plus 100 psi.		
	Mechanical Joints with Tie Rods	As indicated on the Drawings.
	Tie Rods	ASTM A307.
	Steel Pipe	ASTM A53, Schedule 40 or 80 as indicated on the Drawings.
	Washers	ANSI/ASME B18.22.1, plain steel.
Mechanical Couplings		
	Couplings	Dresser "Style 38"; Smith-Blair "411 Steel Coupling"; or Romac "Style 400" or "Style 501"; without pipe stop.
	Gaskets	Oil-resistant synthetic rubber gaskets shall be as recommended by the coupling manufacturer. Pipe manufacturer shall submit certification of gaskets furnished as indicated above under Gaskets - All Joint Types.
	Restrained Mechanical Couplings	American Pipe "Restrained Coupling Gland Joint" coordinated with mechanical couplings furnished.

Flanged Coupling Adapters		
	Restrained (4 inch through 12 inch) [100 mm through 300 mm]. Unless otherwise indicated on the Drawings, flanged coupling adapters shall be restrained.	Smith-Blair "Type 912" or Romac "Style FCA501", with anchor studs of sufficient size and number to withstand test pressures.
	Unrestrained (14 inch and larger) [350 mm and larger]	Smith-Blair "Type 913" or Romac "Style FC400".
Tapping Saddles		Ductile iron, with stainless steel straps and synthetic rubber sealing gasket, 250 psi pressure rating.
Shop Coating and Lining		
	Cement Mortar Lining with Seal Coat	ANSI/AWWA C104/A21.4.
	Protective Fusion-Bonded	ANSI/AWWA C116/A21.16.
	Universal Primer	Manufacturer's standard. If in contact with treated or potable water, certify as being in compliance with ANSI/NSF 61.
	Asphaltic Coating	Manufacturer's standard.
	Coal Tar Epoxy	Manufacturer's standard.
Anti-Seize Thread Lubricant		Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Bostik/Never-Seez "Pure Nickel Special" or Permatex "Nickel Anti-Seize".
Corrosion Protection		
	Polyethylene Encasement	Seamless, ANSI/AWWA C105/A21.5; LLDPE - 8 mil [200 µm] or HDCLPE - 4 mil [100 µm].
	Heat-shrinkable Coating and Primer (Shrink Sleeve)	ANIS/AWWA C216, cross-linked polyethylene sheeting precoated with adhesive; minimum 80 mils; type and recovery as recommended by Shrink Sleeve manufacturer; Canusa-CPS or Berry Plastics Water Wrap.
	Wax Tape and Primer	ANSI/AWWA C217, cold-applied petroleum wax primer and cold-applied petroleum wax tape; Trenton Wax-



		Tape and Primer.
	Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol."
	Zinc Coating	ISO 8179, Mass of 200 g/m <sup>2</sup>
	Marker Balls	3M Dynatrel Series EMS for water

2-3. OUTLETS. Where a 12 inch or smaller branch outlet is indicated on the Drawings and the diameter of the parent pipe is at least twice the diameter of the branch, a tee, a factory welded-on boss, or a tapping saddle will be acceptable.

Where a 4 inch or larger branch outlet is indicated on the Drawings and the diameter of the branch pipe for a given diameter of parent pipe is less than or equal to the maximum diameter listed herein, a factory welded-on outlet fabricated from centrifugally cast ductile iron pipe will be acceptable.

Parent Pipe Diameter Versus Maximum Branch Pipe  
Diameter for Welded-On Outlets

Parent Pipe Dia inches	Max Branch Pipe Dia inches	Parent Pipe Dia inches	Max Branch Pipe Dia inches
8	4	30	20
10	6	36	24
12	8	42	30
14	8	48	30
16	10	54	36
18	12	60	36
20	14	64	36
24	16		

All 30 inch and smaller branch pipe diameter welded-on outlets shall be rated for a working pressure of 250 psi, 36 inch branch diameter welded-on outlets shall be rated for a working pressure of 200 psi, and all outlets shall have a minimum factor of safety of 2.0. The pipe manufacturer shall provide test data and certification of proof of design. It is not necessary that these tests be performed on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design.

Welded-on outlets may be provided as a radial (tee) outlet, a tangential outlet, or a lateral outlet fabricated at a specific angle to the parent pipe (in 15 degrees [0.262 rad] increments between 45 degrees and 90 degrees [0.785 to 1.570 rad] from the axis of the parent pipe), as indicated on the Drawings. The fillet weld dimensions for welded-on outlets shall be as specified herein. Parent pipe and branch pipe shall meet hydrostatic test requirements in accordance with ANSI/AWWA C151/A21.51 prior to fabrication.

#### Welded-on Outlet Fillet Weld Dimensions for Specified Outlet Configurations

Radial and Lateral Outlets			Tangential Outlets		
Parent Pipe Dia inches	Branch Pipe Dia inches	Weld Fillet Size inches	Parent Pipe Dia inches	Branch Pipe Dia inches	Weld Fillet Size inches
24 and smaller	24 and smaller	1 x 1	8-30	24 and smaller	1-1/4 x 1-1/4
30-48	24 and smaller	1-1/4 x 1-1/4	36-54	24 and smaller	1-1/2 x 1-1/2
54-64	24 and smaller	2-1/4 x 2-1/2	60-64	24 and smaller	2-1/2 x 2-1/2
42-64	30	2-1/2 x 2-1/2	42-54	30	2-1/2 x 2-1/2
54-64	36	2-3/4 x 2-3/4	60-64	30	2-3/4 x 2-3/4

All joints on welded-on branch outlets shall be made in accordance with the latest revision of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15, as applicable. All outlets shall be fabricated from centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured and tested in accordance with ANSI/AWWA C151/A21.51. Ni-Rod FC 55® electrodes manufactured by International Nickel Corporation (or an electrode with equivalent properties) shall be used in the manufacture of the fillet welds. Carbon steel electrodes will not be acceptable. Special Thickness Class 53 pipe shall be used for all branch pipe and parent pipe in 4 to 54 inch sizes. Pressure Class 350 pipe shall be used for 60 inch and 64 inch parent pipe. After welding, each fabricated outlet shall be subjected to a 15 psi air test. A soap and water solution shall be applied during the testing procedure to inspect the weld for leakage. Any welds that show air seepage shall be refabricated and retested.

Welded-on outlets shall be fabricated by the pipe manufacturer at its production facilities. Manufacturers of welded-on outlets shall have at least 5 years of satisfactory experience in the manufacture and performance of these products. The manufacturer shall have a documented welding quality assurance system and shall maintain resident quality assurance records based on ANSI/AWS

D11.2, the Guide for Welding Iron Castings. The manufacturer shall also maintain appropriate welding procedure specifications (WPS) and procedure qualification (PQR), and welder performance qualification (WPQR) records.

The type of pipe end for the branch outlet shall be as specified or indicated on the Drawings. The maximum size and laying length of the welded-on branch outlet shall be as recommended by the pipe manufacturer and shall be acceptable to Engineer for the field conditions and the connecting pipe or valve.

At locations acceptable to Engineer, drilling and tapping of the pipe wall for 2 inch [50 mm] and smaller pipe connections will also be acceptable, provided that the wall thickness, minus the casting allowance, at the point of connection equals or exceeds the wall thickness required for 4-thread engagement in accordance with Table A.1, Appendix A of ANSI/AWWA C151/A21.51.

2-4. JOINTS. Joints in buried and tunnel locations shall be mechanical or push-on type unless otherwise indicated on the Drawings or where required to connect to existing piping or to valves. Bells on wall castings and wall sleeves shall be mechanical joint type, with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the Drawings.

Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11, Performance Requirements, as modified herein. The joint test pressure shall be not less than 2 times the working pressure rating of the joint. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design. Any new proof-of-design testing to meet the requirements for this project shall be independently verified and the Owner shall be given the opportunity to witness the testing.

Unless otherwise indicated on the drawings or acceptable to the Engineer, field closure pieces shall be located away from the bends or dead ends beyond the length over which joints are to be restrained.

The length of pipe having restrained joints shall be as indicated on the drawings or specified. All vertical bends and eccentric reducers shall have restrained joints.

Where acceptable to Engineer, grooved couplings may be used instead of flanges, provided that rigid grooving is used to preclude longitudinal pipe movement and angular deflection at joints. Fittings, valves, and equipment installed using grooved couplings shall be adequately supported and blocked or restrained to prevent rotation.

2-4.01 Flanged Joints. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

2-4.02. Flanged Coupling Adaptors. Not used.

2-4.03. Dismantling Joints. Not used.

2-4.04. Mechanical Couplings. The piping layout for mechanical couplings shall provide a space of at least 1/4 inch [6 mm], but not more than 1 inch [25 mm], between the pipe ends.

All surfaces, including the interior surfaces of the middle rings, shall be prepared for coating in accordance with instructions of the coating manufacturer and shall be shop coated with 16 mils liquid epoxy in accordance with ANSI/AWWA C210.

A ductile iron pipe factory spacer shall be provided for the piping where indicated on the drawings. The spacer shall be shop lined and coated with 16 mils of liquid epoxy. Piping surfaces within the coupling shall be shop coated with 16 mils of liquid epoxy.

Tie bolts shall be provided to restrain mechanical coupling connections where indicated on the Drawings. The connecting pipe shall be furnished with welded retainer rings as recommended by pipe manufacturer. The pipe manufacturer shall also coordinate the restrained connection with the pressure rating, length, and diameter dimensions of the mechanical coupling being furnished to assure proper clearance is provided for completing the restrained coupling installation.

2-5. REDUCERS. Reducers shall be concentric as indicated on the Drawings.

2-6. BLOWOFFS. Each blowoff shall be located and arranged as indicated on the Drawings.

2-7. ACCESS OPENINGS. Not used.

2-8. WALL AND FLOOR PIPES. Not used.

2-9. WALL AND FLOOR SLEEVES. Not Used.

2-10. SHOP COATING AND LINING. The interior of all pipe and fittings, unless noted otherwise, shall be cement mortar lined and seal coated.

2.11. MARKER BALLS: Marker balls shall be 3M Dynatel Series EMS ID Ball Markers Model # 1423-XR/ID for water. Contractor shall provide one locator unit; locator shall be 3M Dynatel 2250M-ID-UU-3W-RT. Location of marker balls shall be as identified in the Drawings.

## PART 3 – EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; pipe ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site.

3-2. PROTECTION AND CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign material prior to installation and shall be kept clean until the work is completed. Before jointing, all joint contact surfaces shall be wire brushed if necessary and wiped clean.

Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other objects shall not be placed in or allowed to enter the pipe.

Whenever pipe laying is stopped, the open end of the pipe shall be closed to prevent entry of dirt, mud, rodents, and other material. All water in the trench shall be removed prior to removing the closure.

3-3. CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a file or a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

All field cutting of existing gray cast iron pipe shall be done with mechanical pipe cutters, except where the use of mechanical cutters would be difficult or impracticable.

Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be acceptable.

Contractor shall use factory prepared pipe ends unless a field cut is required for connections.

3-4. ALIGNMENT AND GRADE. Buried piping shall be laid to the lines and grades indicated on the Drawings and as specified. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the values stipulated for full-length push-on joint pipe for full-length mechanical joint pipe of AWWA C600, unless specially designed bells and spigots are provided. Contractor shall submit his proposed methods to measure deflection of deflected joints in accordance with the Submittal section.

Whenever deflections would exceed the values stipulated in AWWA C600, either shorter pipe sections or fittings shall be installed where needed to conform to the alignment or grade indicated on the Drawings and as acceptable to the Engineer.

Unless otherwise specified or acceptable to Engineer, laser beam equipment, surveying instruments, or other suitable means shall be used to maintain alignment and grade. At least one elevation reading shall be taken on each length of pipe. If laser beam equipment is used, periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between the ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflections.

Additional requirements for alignment and grade are covered in the Project Requirements and Trenching and Backfilling sections and on the Drawings.

3-4.01. Tolerances. Each section of pipe shall be laid to the alignment and grade indicated on the Drawings and pipe laying schedule with pipe ends within the following tolerances;

- +/- 0.10 foot in grade at any point
- +/- 0.20 foot in alignment at any point

In addition, piping shall be visually straight or on a smooth curve between the points of deflection or curvature indicated on the Drawings. Stricter tolerances than specified above shall be used as necessary to maintain minimum cover, to maintain required clearances, to make connections to existing pipe, to maintain the correct slope to avoid high or low points along the pipeline other than at locations indicated on the Drawings, or to meet other restrictions as required or directed by the Engineer.

3-5. LAYING PIPE. Buried pipe shall be protected from lateral displacement by placing the specified pipe embedment material installed as specified in the Trenching and Backfilling section. Under no circumstances shall pipe be laid in water, and no pipe shall be laid under unsuitable weather or trench conditions. Pipe embedment material and trench backfill shall be placed and compacted under and around each side of outlets and fittings to hold the pipe in proper position and alignment during the subsequent pipe jointing, embedment, and backfilling.

Pipe shall be laid with the bell ends facing the direction of laying, except where reverse laying is specifically acceptable to Engineer.

Carrier pipe installation in tunnels shall be as indicated on the Drawings and as specified in the Trenching and Backfilling section. All carrier piping within

tunnels shall be restrained throughout, and adequately blocked before piping is pressurized to prevent movement. Carrier pipe in tunnels shall be pulled into place to keep the restrained joints extended.

The pipe laying schedule shall be annotated during the progress of the work to show all changes made during construction for record documentation. Upon completion of the installation of the piping, the annotated pipe laying schedule shall be submitted to Engineer in accordance with the Submittals Procedures section.

### 3-6. JOINTS.

Each joint, including restrained joints, shall be checked by Contractor as recommended by the pipe manufacturer to verify that the joint and the restraints are installed properly. Restrained joints shall be extended after they are assembled to minimize further take-up.

3-7. MECHANICAL JOINTS. Mechanical joints shall be carefully assembled in accordance with the pipe manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Over tightening of bolts to compensate for poor installation practice will not be acceptable.

The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top centerline for horizontal piping.

3-8. PUSH-ON JOINTS. The pipe manufacturer's instructions and recommendations for proper jointing procedures shall be followed. All joint surfaces shall be lubricated with a soap solution provided by the pipe manufacturer immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean. Each spigot end shall be suitably beveled to facilitate assembly.

Pipe ends for restrained joint pipe shall be prepared in accordance with the pipe manufacturer's recommendations.

3-9. FLANGED JOINTS. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually in a crisscross pattern and at a uniform rate, to ensure uniform compression of the gasket around the entire flange. All flange joint bolting procedures shall be in accordance with the pipe manufacturer's recommendations.

Special care shall be taken when connecting piping to any pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported to obtain accurate matching of bolt holes and uniform contact over the entire surface of flanges before any bolts are installed in the flanges.

Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened. Each pump shall be leveled, aligned, and wedged into position which will fit the connecting piping, but shall not be grouted until the initial fitting and alignment of the pipe, so that the pump may be shifted on its foundation if necessary to properly install the connecting piping. Each pump shall, however, be grouted before final bolting of the connecting piping.

After final alignment and bolting, the pump connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as needed and then the flanges bolted back together. The flange bolts shall then be loosened and the process repeated until no movement is observed.

3-9.01. Insulated Flanged Joints. Insulated flanged joints shall be installed where indicated on the Drawings. In addition to one full-faced insulated gasket, each flange insulating assembly shall consist of one full-length sleeve, two insulating washers, and two backing washers for each flange bolt. The insulating gasket ID shall be 1/8 inch [3 mm] less than the ID of the flange in which it is installed. The insulated flanged joint accessories shall be installed in accordance with the instructions and recommendations of the insulating kit manufacturer.

3-10. FLANGED COUPLING ADAPTERS. Not used.

3-11. DISMANTLING JOINTS. Not used.

3-12. MECHANICAL COUPLINGS. Mechanical couplings shall be installed in accordance with the coupling manufacturer's recommendations. A space of at least 1/4 inch [6 mm], but not more than 1 inch [25 mm], shall be left between the pipe ends. Pipe and coupling surfaces in contact with gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks, and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of Engineer.

3-13. GROOVED-END JOINTS. Not used.



3-14. GAS AND OIL-RESISTANT GASKETS. Gas and oil-resistant gaskets shall be installed where specified, indicated on the Drawings, or directed by Engineer where jointing gaskets may be subject to permeation when piping passes through areas where soil may be contaminated with gas or petroleum (oil) products or organic solvents or their vapors.

3-15. CORROSION PROTECTION.

3-15.01. Polyethylene Encasement. Buried pipe including all straight sections, bends, tees, adapters, closure pieces, and other fittings or specials, shall be provided with at least one wrap of polyethylene encasement as indicated on the Drawings. Where ductile iron pipe is also embedded or encased in concrete the polyethylene encasement shall be installed around the pipe for 5 feet extending into each end of the concrete encasement, except where ductile iron pipe is encased in concrete under structures. When ductile iron pipe is encased in concrete under structures, the polyethylene encasement shall extend 5 feet [1.5 m] into the concrete encasement as measured from the outside edge of slab or footing, unless otherwise indicated on the Drawings

Polyethylene tube protection shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A. Preparation of the pipe shall include, but shall not be limited to, removal of lumps of clay, mud, cinders, etc., prior to installation.

The terms "polyethylene tube protection" and "polyethylene encasement" are interchangeable and shall have the same meaning in these Contract Documents.

3-15.01.01. Inspection and Testing. Tests for preliminary acceptance of polyethylene encasement materials as required in the submittal paragraph shall be made at the expense of the Contractor.

At the Owner's expense, the Owner may obtain samples from the material supplied in the field and have test conducted of the requirements specified in ANSI/AWWA C105/A21.5 by an independent third-party laboratory,

3-15.02. Other Assemblies. All ferrous metal clamps, tie rods, bolts, and other components of buried joint harnesses, tapping saddles, or pipe reaction anchorages in contact with earth or other fill material and not encased in concrete, shall be protected by wrapping them with wax tape in accordance with ANSI/AWWA C217. A primer shall be applied prior to applying the wax tape. The application of the wax tape shall be as recommended by the wax tape manufacturer. There shall be no bare or unprotected ferrous metal surfaces.

Following the application of the wax tape, the entire assembly shall be encapsulated with two wraps of polyethylene encasement lapped a minimum of 12 inches with the polyethylene encasement of the piping on each side of the assembly as specified herein.

3-15.02. Surfaces Exposed in Manholes and Vaults. Unless otherwise specified, all uncoated surfaces exposed in manholes and vaults shall be cleaned and coated with two coats of medium consistency coal tar. The first coat shall be dry and hard before the second coat is applied. There shall be no unprotected, bare, or uncoated ferrous metal surfaces.

3-15.03. Zinc Coating. All ductile iron pipe and fittings shall be coated with a layer of Zinc to a mass of 200 g/m<sup>2</sup>. The Zinc spray shall be factory applied prior to the black asphaltic coating.

3-16. PROVISIONS FOR CATHODIC PROTECTION SYSTEMS. Not used.

3-17. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then all connections with potable water pipelines shall be cleaned and disinfected as specified in the Cleaning and Disinfection of Water Pipelines section.

3-18. CONCRETE ENCASEMENT. Concrete encasement shall be installed where indicated on the Drawings. A pipe joint shall be provided within 12 inches of each end of the concrete encasement. Concrete and reinforcing steel shall be as specified in the Cast-in-Place Concrete section. All pipe to be encased shall be suitably supported and blocked in proper position, and shall be anchored to prevent flotation.

3-19. REACTION ANCHORAGE AND BLOCKING. Concrete blocking shall be installed where indicated on the Drawings. Concrete and reinforcing steel shall be as specified in the Cast-in-Place Concrete section.

The blocking size shall be of the dimensions indicated on the Drawings, shall extend from the fitting to solid, undisturbed earth, and shall be installed so that all joints are accessible for repair. If adequate support against undisturbed ground cannot be obtained, restrained joints shall be installed to provide the necessary support. If the lack of suitable solid vertical excavation face is due to improper trench excavation, restrained joints shall be furnished and installed by and at the expense of Contractor.

Reaction blocking, anchorages, or other supports for fittings installed in fills or other unstable ground, installed above grade, or exposed within structures, shall be provided as indicated on the Drawings.

All ferrous metal clamps, rods, bolts, and other components of tapping saddles, reaction anchorages, or joint harness, subject to submergence or in contact with earth or other fill material and not encased in concrete, shall be protected from corrosion as specified in the Corrosion Protection paragraph of this section.

3-20. PRESSURE AND LEAKAGE TESTS. After installation, pipe and fittings shall be subjected to a pressure test and a leakage test in accordance with the Pipeline Pressure and Leakage Testing section.

3-21. CLEANING AND DISINFECTION. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean of any foreign matter until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

After installation, all potable water pipelines shall be cleaned and disinfected as specified in the Cleaning and Disinfection of Water Pipelines section.

End of Section

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## Section 40 05 51.13

### VALVE INSTALLATION

#### PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of new 8 inch valves purchased by Contractor and 36-inch valves purchased by the Owner as part of this Work under the valve specifications.

Cleaning, disinfection, pressure and leakage testing, insulation, and pipe supports are covered in other sections.

This section is applicable to the following types of valves to be installed:

- Resilient-Seated Gate Valves  
(Section 40 05 61.23)
- Air Valves (Standard Details  
20.0 and 21.0)
- Hydrants (Standard Details  
9.0 and 10.0)

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. Coordination. When manufacturer's field services or installation check services are provided by the valve manufacturer, Contractor shall coordinate the services with the valve manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services.

Mechanical joint connections to valves including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section. Valve ends shall match piping.

#### PART 2 - PRODUCTS Not Applicable.

#### PART 3 - EXECUTION

3-1. INSPECTION. All valves and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated

in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

### 3-2. INSTALLATION.

3-2.01. General. Valves shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the valve for in-place maintenance. Installation shall be in accordance with the valve manufacturer's recommendations.

3-2.02. Installation Checks. For installation checks, the manufacturer's field representative will inspect the valve installation immediately following installation by Contractor. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

3-2.03. AWWA Butterfly Valves. Not used.

3-2.04. Check Valves. Not used.

3-2.05. Plug Valves. Not used.

3-2.06. Resilient Seated Gate Valves.

3-2.06.01. Resilient Seated Gate Valves. Valves shall be handled and installed in accordance with the recommendations set forth in the Appendices to ANSI/AWWA C509 and C515 and with the recommendations of the manufacturer.

3-2.06.02. Double Disc Gate Valves. Not used.

3-2.07. Air Release and Combination Air Valves. The exhaust from each valve shall be piped to a suitable point acceptable to Engineer. Air release valve exhaust piping shall terminate at least 6 inches above the vault floor.

3-2.08. Hydrants.

3-2.08.01. Yard Hydrants. Not used.

3-2.08.02. Fire Hydrants. Hydrant installation shall conform to County Standard Details 9.0 and 10.0.

Immediately before installation of a fire hydrant, the following procedure shall be followed: (a) the hydrant shall be thoroughly inspected; (b) the hydrant interior shall be thoroughly cleaned; and (c) the hydrant shall be opened and closed as

many times as may be necessary to determine if all parts are in proper working order, with valves seating properly and the drain valve operating freely.

3-2.09. Valve Boxes. Valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After each valve box is placed in proper position, earth fill shall be placed and thoroughly tamped around the box.

3-3. VALVE ACTUATORS. Valve actuators and accessories shall be factory mounted on the valve, calibrated, and tested by the valve or actuator manufacturer.

#### 3-4. FIELD QUALITY CONTROL.

3.4.01. Field Testing. After installation, all valves shall be tested in accordance with the Pipeline Pressure and Leakage Testing section.

3-4.01.01. Pressure Tests. Pressure testing shall be in accordance with the Pipeline Pressure and Leakage Testing section.

3-4.01.02. Leakage Tests. All valves shall be free from leaks. Each leak that is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor. This requirement applies whether pressure testing is required or not.

3-5. ADJUSTING. Not used.

End of Section

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VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing manual valve and gate actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Actuators shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Except as modified or supplemented herein, cylinder and vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.

Except as modified or supplemented herein, manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

1-2.03. Power Supply. Not used.

1-2.04. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.05. Temporary Number Plates. Not Used.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the Submittal Procedures section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

Submittal drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

## PART 2 - PRODUCTS

### 2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by Engineer.

When valves are to be buried, submerged, or installed in vaults; the actuators and accessories shall be sealed to prevent the entrance of water. The design water depth shall be as indicated in the respective valve schedules but not less than 20 feet [6.1 m].

2-1.03. Gate Actuators. Not Used.

2-1.04. Limit Switches. Not Used

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of the applicable governing standard(s).

### 2-3. VALVE MANUAL ACTUATORS.

2-3.01. General. Manual actuators of the types listed in the valve specifications or schedules shall be provided by the valve manufacturer.

Unless otherwise indicated or specified, each geared manual actuator shall be equipped with an operating handwheel.

The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Actuators shall produce the required torque with a maximum pull of 80 lbs [356 N] on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 200 lbs [890 N] on the handwheel or chainwheel or an input of 300 foot-lbs [407 J] on the operating nut.

2-3.02. Handwheels. Not Used.

2-3.03. Chainwheels. Not Used.

2-3.04. Levers. Not Used.

2-3.05. Chain Levers. Not Used.

2-3.06. Wrench Nuts. Unless otherwise specified in the valve schedules or on the Drawings, wrench nuts shall be provided on all buried valves and on all valves that are to be operated through floor boxes. Unless otherwise directed by Owner, all wrench nuts shall comply with Section 4.4.13 of ANSI/AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

2-3.07. Operating Stands. Not Used.

2-3.08. Wall Brackets. Not Used.

2-4. GATE MANUAL ACTUATORS. Not used.

2-5. INTELLIGENT ELECTRIC ACTUATORS. Not used.

2-6. STANDARD ELECTRIC ACTUATORS. Not used.

2-7. HYDRAULIC CYLINDER ACTUATORS. Not used.

2-8. AIR CYLINDER ACTUATORS. Not used.

2-9. VANE TYPE PNEUMATIC ACTUATORS. Not used.

2-10. AIR-OIL CYLINDER ACTUATORS. Not used.

2-11. PORTABLE ELECTRIC ACTUATORS. Not used.

2-12. PORTABLE HYDRAULIC ACTUATORS. Not used.

2-13. ACTUATOR ACCESSORIES.

2-13.01. Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the Drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.

At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet [3 m], whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

Extension stems for buried valve actuators shall extend to within 6 inches [150 mm] of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.

2-13.02. Position Indicators. Not Used.

2-13.03. Floor Boxes. Openings through concrete slabs provided for key operation of valves shall be provided with a cast iron floor box complete with cover. The floor box shall be of the depth indicated on the Drawings. Where the operating nut is in the slab, the stem shall have a guide to maintain the nut in the

center of the box; where the nut is below the slab, the opening in the bottom of the box shall accommodate the operating key.

Each floor box and cover shall be shop coated with manufacturer's standard coating.

2-13.04. Torque Tubes. Not used.

2-13.05. Valve Boxes. Each valve buried to a depth of 4 feet [1.2 m] or less shall be provided with a slide type valve box. Valve boxes shall be cast iron, extension sleeve type, suitable for the depth of cover indicated on the Drawings. Only one extension will be allowed with each slide type valve box. Valve boxes shall be at least 5 inches [125 mm] in inside diameter, shall be at least 3/16 inch [4.7 mm] thick, and shall be provided with suitable cast iron bases and covers.

Each valve buried deeper than 4 feet [1.2 m] shall be provided with a valve box consisting of a cast iron cover and a 6 inch [150 mm] Cast Iron Pipe section. The cover shall be Clay & Bailey "No. 2193". The pipe shaft shall extend from the valve to 5 inches [125 mm] inside the valve box cover.

All parts of valve boxes, bases, and covers shall be shop coated with manufacturer's standard coating.

2-14. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy.
Actuators and Accessories	Universal primer.

### PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with the Valve Installation section.

End of Section

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## RESILIENT-SEATED GATE VALVES

### PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing resilient-seated AWWA gate valves for clear water service. Resilient-seated gate valves shall be furnished complete with actuators and accessories as specified herein and as specified in the Valve and Gate Actuator section.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all resilient-seated gate valves shall conform to the applicable requirements of ANSI /AWWA C515.

1-2.03. Temporary Number Plates. Not used.

1-2.04. Identification. Not Used.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals Procedures section.

### PART 2 - PRODUCTS

2-1. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of resilient-seated gate valves shall conform to the requirements of the governing standard.

2-1.01. Bronze Components. All bronze valve components in contact with liquid shall contain less than 16 percent zinc. All aluminum bronze components in contact with liquid shall be inhibited against dealuminization in accordance with Section 4.2.3.3.4 of ANSI/AWWA C515.

2-1.02. Gaskets. Gaskets shall be free of asbestos and corrosive ingredients.

2-1.03. Shop Coatings.

#### Epoxy

For Raw or Treated Water Service in potable water facilities (NSF certified systems)

PPG Amercoat "Amerlock 400 High-Solids Epoxy ", Carboline "Carboguard 891", Sherwin-Williams "Macropoxy 646NSF" or Tnemec "Series N140 Pota-Pox Plus".

For Liquid Service other than in potable water facilities

PPG Amercoat "Amerlock 385 Epoxy", Carboline "Carboguard 890", Sherwin-Williams "Macropoxy 646" or Tnemec "Series N69 Hi-Build Epoxoline II".

Rust-Preventive Compound

As recommended by manufacturer.

Universal Primer

As recommended by manufacturer

## 2-2. VALVE CONSTRUCTION.

2-2.01. Ends. Valve ends shall be compatible with connecting piping and shall be mechanical joint or flanged as indicated in the Drawings . Except as modified or supplemented herein, the ends shall conform to the applicable requirements of the governing standard.

Flanges shall be finished to true plane surfaces within a tolerance limit of 5 mils [125 µm]. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per inch [0.16 mm/mm] of flange diameter.

2-2.02. Stem Seals. Valve stem shall be the non-rising type. O-ring stem seals shall be provided for all buried gate valves, and for all gate valves with non-rising stems.

2-2.03. Rotation. The direction of rotation of the handwheel or the wrench nut to open the valve shall be to the left (counterclockwise).



2-2.04. Shop Coatings. All interior and exterior ferrous metal surfaces of valves and accessories shall be shop coated for corrosion protection. Except as specified below, the valve manufacturer's standard fusion-bonded coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field coating.

Surfaces shall be coated as follows:

Unfinished Surfaces

Interior Surfaces	Epoxy.
Exterior Surfaces of Valves to be Buried or Installed in Manholes or Valve Vaults	Epoxy.
Exterior Surfaces of Valves to be Submerged	Epoxy.
Exterior Surfaces of All Other Valves	Universal primer.

Polished or Machined Surfaces

Flange Faces	Rust-preventive compound.
Other Surfaces	Epoxy.

Alternatively, the manufacturer's standard coating may be used and the interior surfaces of each valve shall be subjected to a nondestructive holiday test in accordance with ASTM G62, Method A, and shall be electrically void-free.

Interior coatings shall comply with ANSI/AWWA C550 and shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Epoxy	10mils [250 µm].
Universal Primer	3 mils [75 µm].

2-3. VALVE ACTUATORS. Requirements for valve actuators shall be as specified in the Valve and Gate Actuator section.

2-4. ACCESSORIES. When the Drawings indicate the need for extension stems, stem guides, position indicators, floor boxes, valve boxes, or operating stands, refer to the Valve and Gate Actuator section.

### PART 3 - EXECUTION

3-1. INSTALLATION. Valves shall be installed in accordance with Valve Installation section.

3-1.01. Installation Check. An installation check by an authorized representative of the manufacturer is not required.

End of Section



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# REPORT

**For Forsyth County  
Department of Water and  
Sewer**

Geotechnical Exploration  
Hurt Bridge Waterline  
Forsyth County  
Cumming, Georgia

Project No.: FORPD-20-GA-04891-01





January 15, 2021

Mr. Mike Grinberg, P.E.  
**Forsyth County Department of Water & Sewer**  
110 East Main Street, Suite 150  
Cumming, Georgia 30040

Via Email: [MIGrinberg@forsythco.com](mailto:MIGrinberg@forsythco.com)

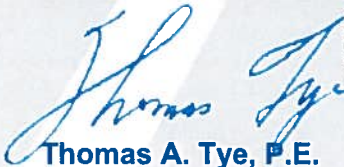
RE: Report of Geotechnical Exploration  
**Hurt Bridge Waterline**  
Cumming, Forsyth County, Georgia  
Project No.: FORPD-20-GA-04891-01

Dear Mr. Grinberg:

United Consulting is pleased to submit this report of our Geotechnical Exploration for the above-referenced project. We appreciate the opportunity to assist you with this project and look forward to our continued participation. Please contact us if you have any questions or if we can be of further assistance.

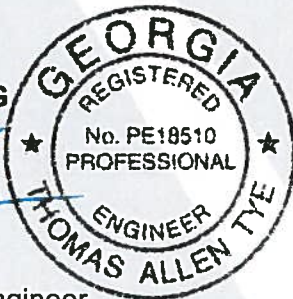
Sincerely,

UNITED CONSULTING



**Thomas A. Tye, P.E.**

Senior Geotechnical Engineer



1/15/2021



**Scott D. Smelter**  
Principal

TAT/SDS/rg

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Soil Corrosion Series (14)





## 1.0 EXECUTIVE SUMMARY

United Consulting has completed a Geotechnical Exploration for the Hurt Bridge Waterline project located along Hurt Bridge Road between Watson Road and Dishroom Road in Cumming, Forsyth County, Georgia. Please refer to the text of the report for a more detailed discussion of the items summarized below.

- The four borings drilled encountered between 2 to 3 feet of fill soils. The fill generally appeared to be free of debris and organic content, but slightly variable in consistency.
- Partially Weathered Rock (PWR) was not encountered in any of the four borings. Auger refusal did not occur in the borings to termination depths.
- Groundwater was not encountered in any of the four borings at the time of drilling. It is likely that stabilized groundwater levels are several feet shallower than time of boring levels, and it is possible that perched water levels could develop at shallower depths at the site. The contractor should be prepared to manage perched water or groundwater as needed.
- The soil resistivity results varied from 16,400 to 34,900 ohm-cm, indicating a mild to low corrosion potential for uncoated steel.
- Chloride test results ranged from 31 to 39 mg/Kg dry and sulfate tests results varied from below reporting limits (<11 mg/Kg) to 23 mg/Kg dry.



## 2.0 PROJECT INFORMATION

The Project Site is located along Hurt Bridge Road in Cumming, Forsyth County, Georgia. The client provided a site plan which showed the location and alignment of the proposed pipeline routing. This site plan was used as a guide to locate the boundaries of the project site. The location of the project site is indicated on the attached Boring Location Plan (Figure 1).

At the time of our fieldwork, the site contained a number of commercial and residential structures, as well as wooded areas along the right-of-ways of the existing streets. The general location of the project site is shown on the attached Boring Location Plan (Figure 1).

We understand that the project consists of construction of approximately 3,942 linear feet of a 36-inch diameter water main starting at Station 0 + 00± located on Hurt Bridge Road, at its intersection with Watson Road. The water main will then be located south-southeast along Hurt Bridge Road until it reaches Dishroom Road slightly southeast of Station 39 + 00±.

If the actual plans and site grading information vary significantly, United Consulting must be contacted to determine if our recommendations should be re-evaluated and/or revised.



### 3.0 PURPOSE

The purpose of this Geotechnical Exploration was to assess the general type and condition of the subsurface materials at the Project Site.





## 4.0 SCOPE

The scope of our geotechnical exploration included the following items:

1. A visual reconnaissance of the site from a geotechnical standpoint;
2. Drilling four (4) Standard Penetration Test (SPT) borings to assess the quality and consistency of the subsurface soils;
3. Visual evaluation of the soil samples obtained during our field testing program for further identification and classification;
4. Performing laboratory testing consisting of three (3) grain size analysis with hydrometer and three (3) Atterberg Limits tests on representative soil samples, five (5) corrosivity tests, five (5) sulfide and chloride tests, and five moisture content tests on samples taken at the approximate depths of the pipeline at each of the boring locations; and
5. Preparing this report to document the results of our field-testing program, laboratory testing, and to provide our findings.



## 5.0 ALIGNMENT REVIEW

A foot and an automobile reconnaissance of the Project area were conducted as part of this exploration. We anticipate that the proposed water line will generally be constructed as open trench excavation. Road/lane closure will be required on the road during the construction activities. We understand that jack and bore trenchless installation will be utilized across portions of the site. Underground utilities such as gas, water, sewer lines, and telephone cables were observed within the right of way. Some of the buried utility lines also crossed the road.



## 6.0 SUBSURFACE CONDITIONS

The geotechnical exploration consisted of four (4) borings located along the proposed water main.

Initially, the borings encountered a thin layer of topsoil. Below the ground surface, each of the borings encountered between 2 and 3 feet of fill soils. The fill soils encountered consisted of loose to medium sand with varying amounts of silt, clay, mica, and rock fragments with the exception of B-1-3, which consisted of stiff clay with some sand, trace silt, and trace mica. Standard Penetration Test resistances (N-values) within the fill sands ranged from 5 bpf to 10 blows per foot (bpf) while the fill clay had an N-value of 12 bpf.

Beneath the fill soils in the aforementioned borings, typical residual soils of the Piedmont Physiographic Province of Georgia were encountered. The residual soils encountered generally consisted of loose to medium sand with varying amounts of silt, clay, mica, and rock fragments as well as one sample of medium silt with some sand, trace clay, and trace mica and two samples of stiff clay with varying amounts of sand, silt, and mica. The N-values within the residual sands ranged from 8 bpf to 25 bpf, the N-value in the residual silt was 8 bpf, and those within the residual clays ranged from 14 bpf to 15 bpf.

Partially Weathered Rock (PWR) was not encountered in any of the four borings.

Auger refusal did not occur in the borings to boring termination depths. Auger refusal is the depth that the boring cannot be advanced with a soil drilling auger. It may represent a seam of rock, a boulder or other hard obstruction, or the upper surface of relatively sound, massive rock.

Groundwater was not encountered in any of the borings at the time of drilling. Groundwater levels should be anticipated to fluctuate with the change of seasons, during periods of very low or high precipitation, or due change in floodplain or watershed upstream of the site.

A summary of the subsurface conditions is provided in the table below:

**Table 1: Summary of Subsurface Conditions**

Boring No.	Station	Elevation (ft.-msl)	Bottom of Water Main Elevation (ft.-msl)	Depth to Bottom of Fill Soils (ft.)	Depth to PWR (ft.)	Groundwater Depth (ft.)	Boring Termination Depth (ft.)
B-1-1	10+00	1204	1093	3	NE	NE	18
B-1-2	20+00	1187	1180	3	NE	NE	15
B-1-3	30+00	1190	1180	3	NE	NE	15
B-1-4	38+50	1191	1176	3	NE	NE	20

NE – Not Encountered, Elevations should be considered approximate.

For a more detailed description of the subsurface conditions encountered, please refer to the boring logs in The Appendix.



## 7.0 LABORATORY TESTING PROGRAM

Laboratory testing for this project included three (3) grain size analysis with hydrometer and three (3) Atterberg Limits tests on representative soil samples, five (5) corrosivity tests, five (5) sulfide and chloride tests, and five moisture content tests on samples taken at the approximate depths of the pipeline at each of the boring locations.

The results of these tests are tabulated below:

**Table 2: Soil Classification Laboratory Data Summary**

Boring No.	Depth (ft.)	Liquid Limit	Plastic Limit	Plasticity Index	Percent Fines	USCS Classification	Water Content %
B-1-2	3.5-5	83	54	29	78	MH	36.8
B-1-2	13.5-15	NV	NP	NP	-	SM	50.5
B-1-4	3.5-5	61	34	27	61	MH	23.2

NP=Non-plastic

**Table 3: Soil Corrosivity Test Results**

Boring	Depth (ft.)	Moisture Content %	Soil pH (S.U.)	Soil Resistivity (ohm-cm)	Chloride Mg/kg dry	Sulfate Mg/Kg dry
B-1-1	8.5-10	13.3	5.29	16,400	34	BRL
B-1-2	6-7.5	21.4	5.85	23,400	39	19
B-1-3	8.5-10	23.0	5.03	34,900	37	BRL
B-1-4	8.5-10	20.2	5.18	19,100	31	23
B-1-4	13.5-15	22.5	5.08	21,200	35	BRL

BRL=Below Reporting limit of 11 mg/Kg dry

A narrative description of the laboratory tests and the laboratory test results are included in The Appendix.





## 8.0 LIMITATIONS

This report is for the exclusive use of **Forsyth County, Black and Veatch**, and the designers of the project described herein, and may only be applied to this specific project. Our conclusions and recommendations have been prepared using generally accepted standards of Geotechnical Engineering practice in the State of Georgia. No other warranty is expressed or implied. Our firm is not responsible for conclusions, opinions or recommendations of others.

The right to rely upon this report and the data within may not be assigned without UNITED CONSULTING'S written permission.

The scope of this evaluation was limited to an evaluation of the load-carrying capabilities and stability of the subsoils. Oil, hazardous waste, radioactivity, irritants, pollutants, molds, or other dangerous substance and conditions were not the subject of this study. Their presence and/or absence are not implied or suggested by this report, and should not be inferred.

Our conclusions and recommendations are based upon design information furnished to us, data obtained from the previously described exploration and testing program and our past experience. They do not reflect variations in subsurface conditions that may exist intermediate of our borings, and in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our conclusions and recommendations based upon "on-site" observations of the conditions.

If the design or location of the project is changed, the preliminary recommendations contained herein must be considered invalid, unless our firm reviews the changes and our recommendations are either verified or modified in writing. When design is complete, we should be given the opportunity to review the foundation plan, grading plan, and applicable portions of the specifications to confirm that they are consistent with the intent of our recommendations.

## UNITED CONSULTING



## **APPENDIX**

**General Notes/Narrative of Drilling Operations**

**Figure 1 – Boring Location Plan**

**Exploration Procedures**

**Laboratory Procedures**

**SPT Boring Logs (4)**

**Liquid and Plastic Test Report (1)**

**Grain Size Distribution Curves (1)**

**Soil Corrosion Series (14)**

## GENERAL NOTES

The soil classifications noted on the Boring Logs are visual classifications unless otherwise noted. Minor constituents of a soil sample are termed as follows:

Trace	0 - 10%
Some	11 - 35%
Suffix "y" or "ey"	36 - 49%

### LEGEND



Split Spoon Sample obtained during Standard Penetration Testing



Relatively Undisturbed Shelby Tube Sample



Groundwater Level at Time of Boring Completion



Groundwater Level at 24 hours (or as noted) after Termination of Boring

w                      Natural Moisture Content

LL                      Liquid Limit

PL                      Plastic Limit                      Atterberg Limits

PI                      Plasticity Index

PF                      Percent Fines (Percent Passing #200 Sieve)

$\gamma_d$                       Dry Unit Weight (Pounds per Cubic Foot or PCF)

$\gamma_m$                       Moist or In-Situ Unit Weight (PCF)

$\gamma_{sat}$                       Saturated Unit Weight (PCF)

## BORING LOG DATA NARRATIVE OF DRILLING OPERATION

The test borings were made by mechanically advancing helical hollow stem augers into the ground. Samples were collected at regular intervals in each of the borings following established procedures for performing the Standard Penetration Test in accordance with ASTM Specification D 1586. Soil samples were obtained with a standard 1.4" I.D. x 2.0" O.D. split barrel sampler. The sampler is first seated 6" to penetrate any loose cuttings and then driven an additional foot with the blows required of a 140-pound hammer freely falling a distance of 30 inches. The number of blows required to drive the sampler the final foot is designated the "standard penetration resistance." The driving resistance, known as the "N" value, can be correlated with the relative density of granular soils and the consistency of cohesive deposits.

The following table describes soil consistency and relative densities based on standard penetration resistance values (N) determined by the Standard Penetration Test (SPT).

	<u>"N"</u>	<u>Consistency</u>
Clay and Silt	0-2	Very Soft
	3-4	Soft
	5-8	Firm
	9-15	Stiff
	16-30	Very Stiff
	Over 31	Hard
	<u>"N"</u>	<u>Relative Density</u>
Sand	0-4	Very Loose
	5-10	Loose
	11-19	Firm
	20-29	Medium Dense
	30-49	Dense
	50+	Very Dense





**Prepared:** ML

**Checked:** TAT

**Date:** 01/06/2021

**Scale:** NTS

**Title:** Hurst Bridge Waterline

**Project:** Hurst Bridge Rd, Cumming, GA

**Project No.:** FORPD-20-GA-04191-01

**Client:** Forsyth County, GA

**FIG 1**



**UNITED  
CONSULTING**



## EXPLORATION PROCEDURES

Four (4) SPT borings (designated B-1-1 through B-1-4) were drilled at approximate locations indicated on the attached Boring Location Plan (Figure 1). The SPT borings were performed in general accordance with ASTM D 1586. Soil samples obtained during testing were visually evaluated by the Project Engineer and classified according to the visual-manual procedure described in ASTM D 2488. A narrative of field operations is included in The Appendix.

The test locations in the field were determined by the Project Engineer using a handheld GPS unit. The test locations shown on the Boring Location Plan should, therefore, be considered approximate.





## LABORATORY PROCEDURES

### Grain Size (Sieve) Analysis with or without Hydrometer

Grain Size Analysis tests were performed to determine the particle size distribution of selected samples tested. The grain size distribution of soils coarser than a number 200 sieve was determined by passing the samples through a standard set of nested sieves. Materials finer than the number 200 sieves were suspended in water and the grain size distribution computed from the time rate of settlement of the different size particles. Air-dried soil passed through a #200 sieve. 50 grams of that must soak in s/c agent for a minimum of 8 hours. Soil is then put in graduated cylinder with a hydrometer. Readings are taken at specified times. A graph is drawn from data. These tests were similar to those described by ASTM D 421 and D 422. The results are included in The Appendix.

### Liquid and Plastic Limits (Atterberg Limits)

Liquid Limit and Plastic Limit tests aid in the classification of the soils and provide an indication of the soil behavior with moisture change. The Plasticity Index is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid and is the upper limit of the plastic range, as determined in accordance with ASTM D 4318. The Plastic Limit is the moisture content at which the soil begins to lose its plasticity, as determined in accordance with ASTM D 4318. The Plasticity Index is the difference between the Liquid Limit and Plastic Limit. The Liquidity Index is the ratio of the difference between the in-place moisture and the plastic limit to the Plasticity Limit. The data obtained are in The Appendix.

### Moisture Content

The moisture content was determined for selected soil samples obtained in the split spoon sampler. A representative portion of each sample was weighed and then placed in an oven and dried at 110 degrees Centigrade for at least 15 to 16 hours. After removal from the oven, the soil was again weighed. The weight of the moisture lost during drying thus was determined. From this data, the moisture content of the sample was then calculated as the weight of moisture divided by dry weight of the soil, expressed as a percentage. This test was conducted according to ASTM D 2216. The moisture content results are indicated on the attached boring logs.

Moisture content is a useful index of a soil's compressibility. If the soil is to be used as fill, the moisture content may be compared to the range of water content for which proper compaction may be achieved.



United Consulting, Ltd.  
625 Holcomb Bridge Road  
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Telephone: 770-209-0029  
Fax: 770-582-2800

# BORING NUMBER B-1-1

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Hurt Bridge Road Pipeline  
PROJECT NUMBER FORDP-20-GA-4891-01 PROJECT LOCATION Cumming, GA  
DATE STARTED 1/5/2021 DATE COMPLETED 1/5/2021 GROUND ELEVATION 1204 ft HOLE SIZE 8 inches  
DRILLING CONTRACTOR Drilling Solutions GROUND WATER LEVELS:  
DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING --- No groundwater encountered.  
STATION                      LOGGED BY JJ AT END OF DRILLING ---  
NOTES Station 10+00 AFTER DRILLING ---

GEOTECH GDOT TEMPLATE - GINT STD US LAB.GDT - 14/1/21 14:30 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04891-01 HURT BRIDGE WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS ON ROCK (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS				NOTES
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX		
0			Topsoil											
			Sand-some clay, trace silt and mica; firm; red brown (fill)	SPT 1	67	3-4-6 (10)								
	1200		Sand-some silt, trace clay, some mica; firm; red-brown to orange-brown (residual)	SPT 2	83	4-5-7 (12)								
5			-tan-brown/gray	SPT 3	100	4-5-6 (11)								
	1195		-trace rock fragments	SPT 4	72	5-8-9 (17)								
10														
	1190			SPT 5	100	4-9-15 (24)								
15														
				SPT 6	100	6-8-10 (18)								

Boring terminated at 18.0 feet.



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# BORING NUMBER B-1-2

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Hurt Bridge Road Pipeline  
PROJECT NUMBER FORDP-20-GA-4891-01 PROJECT LOCATION Cumming, GA  
DATE STARTED 1/5/2021 DATE COMPLETED 1/5/2021 GROUND ELEVATION 1187 ft HOLE SIZE 8 inches  
DRILLING CONTRACTOR Drilling Solutions GROUND WATER LEVELS:  
DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING --- No groundwater encountered.  
STATION                      LOGGED BY JJ AT END OF DRILLING ---  
NOTES Station 20+00 AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS ON ROCK (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			NOTES
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0			Topsoil										
	1185		Sand-some clay, trace silt, mica, and rock fragments; loose; red brown (fill)	SPT 1	100	3-3-5 (8)							
5			Silt-clayey, some sand and mica; stiff; orange brown (residual) (MH)	SPT 2	100	3-6-8 (14)			37	83	54	29	
	1180		Sand-silty, trace clay, some mica; firm; tan (SM)	SPT 3	100	3-4-8 (12)							
10				SPT 4	100	3-4-6 (10)							
	1175												
15			-trace mica; loose; tan-brown and orange-brown	SPT 5	100	3-3-5 (8)			51				

Boring terminated at 15.0 feet.



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# BORING NUMBER B-1-3

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Hurt Bridge Road Pipeline  
PROJECT NUMBER FORDP-20-GA-4891-01 PROJECT LOCATION Cumming, GA  
DATE STARTED 1/5/2021 DATE COMPLETED 1/5/2021 GROUND ELEVATION 1190 ft HOLE SIZE 8 inches  
DRILLING CONTRACTOR Drilling Solutions GROUND WATER LEVELS:  
DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING --- No groundwater encountered.  
STATION                      LOGGED BY JJ AT END OF DRILLING ---  
NOTES Station 30+00 AFTER DRILLING ---

GEOTECH GDOT TEMPLATE - GINT STD US LAB.GDT - 14/1/21 14:31 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04891-01 HURT BRIDGE WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS ON ROCK (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			NOTES
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0	1190		Topsoil										
			Clay-some sand, trace silt and mica; stiff; red-brown (fill)	SPT 1	67	4-5-7 (12)							
			Sand-some silt, trace clay and mica; firm; red-brown and orange brown (residual)	SPT 2	100	4-4-7 (11)							
5	1185												
			-loose	SPT 3	100	3-4-4 (8)							
10	1180		- tan-brown to orange brown	SPT 4	100	3-4-5 (9)							
15	1175		- some rock fragments; medium dense; brown to red-brown	SPT 5	67	3-15-10 (25)							

Boring terminated at 15.0 feet.



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# BORING NUMBER B-1-4

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Hurt Bridge Road Pipeline  
PROJECT NUMBER FORDP-20-GA-4891-01 PROJECT LOCATION Cumming, GA  
DATE STARTED 1/5/2021 DATE COMPLETED 1/5/2021 GROUND ELEVATION 1191 ft HOLE SIZE 8 inches  
DRILLING CONTRACTOR Drilling Solutions GROUND WATER LEVELS:  
DRILLING METHOD Hollow Stem Auger AT TIME OF DRILLING --- No groundwater encountered.  
STATION                      LOGGED BY JJ AT END OF DRILLING ---  
NOTES Station 38-50 AFTER DRILLING ---

GEOTECH GDOT TEMPLATE - GINT STD US LAB.GDT - 14/1/21 14:31 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04891-01 HURT BRIDGE WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS ON ROCK (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			NOTES
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0													
	1190		Topsoil										
			Sand-some clay, trace silt and mica; firm; red brown (fill)	SPT 1	100	3-3-2 (5)							
			Silt-clayey-sandy; stiff; orange-brown (residual) (MH)	SPT 2	100	5-6-9 (15)			23	61	34	27	
5													
	1185		Sand-some clay, trace silt and mica; firm; red-brown and orange brown	SPT 3	100	4-6-8 (14)							
				SPT 4	100	5-6-7 (13)							
10													
	1180												
			-some clay and silt, trace rock; loose	SPT 5	100	3-4-4 (8)							
15													
	1175												
			-some rock fragments	SPT 6	100	3-4-5 (9)							
20													

Boring terminated at 20.0 feet.



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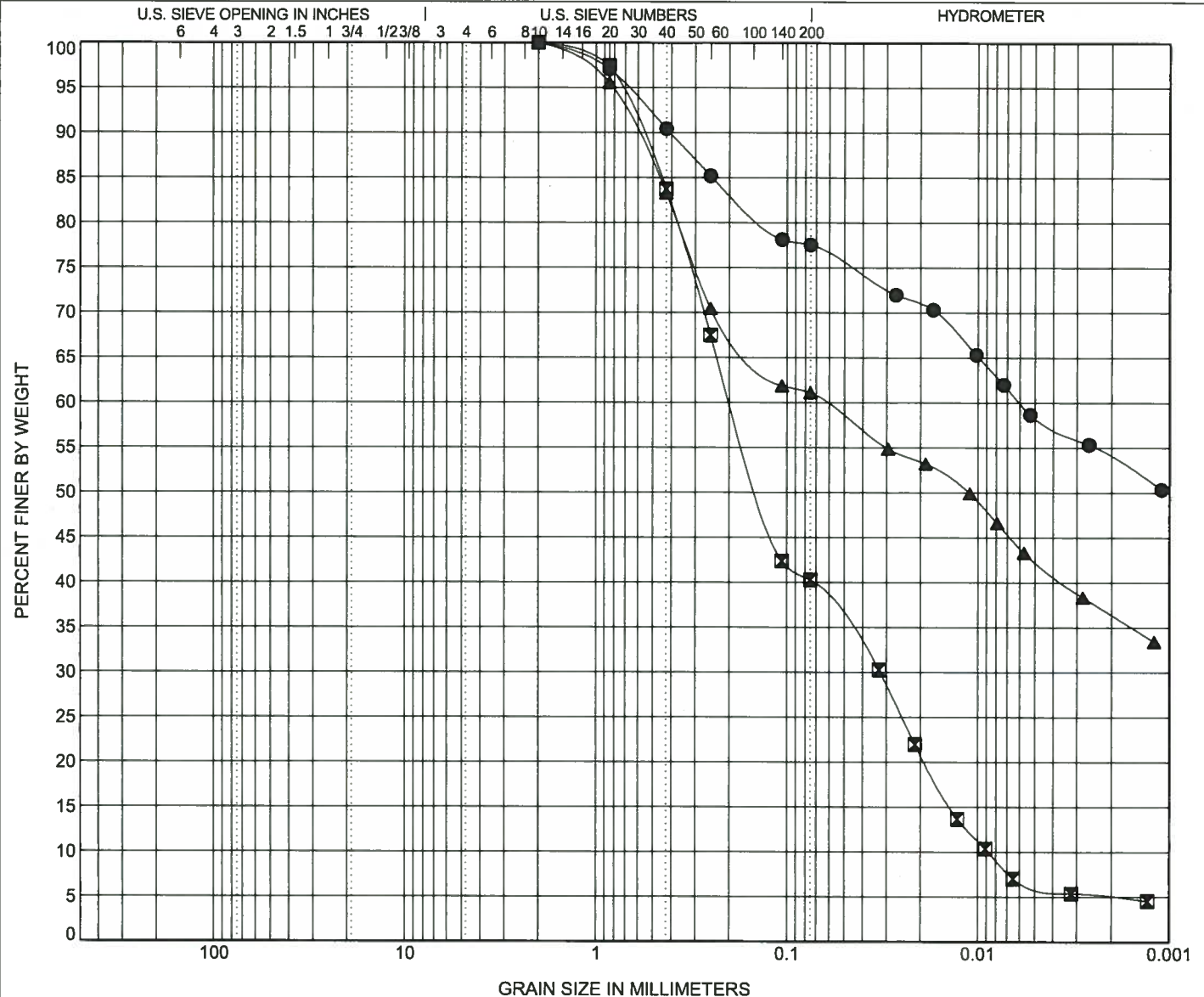
# GRAIN SIZE DISTRIBUTION

CLIENT Forsyth County

PROJECT NAME Hurt Bridge Road Pipeline

PROJECT NUMBER FORDP-20-GA-4891-01

PROJECT LOCATION Cumming, GA

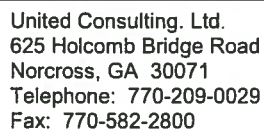


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	Classification					LL	PL	PI	Cc	Cu
●	B-1-2	4.0	Silt-clayey, some sand, orange brown (MH)					83	54	29		
☒	B-1-2	14.0	Sand-silty, trace clay, tan (SM)								0.62	22.05
▲	B-1-4	4.0	Silt-clayey-sandy, orange brown (MH)					61	34	27		
BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
●	B-1-2	4.0	2	0.006			0.0	22.5	19.1	58.4		
☒	B-1-2	14.0	2	0.194	0.032	0.009	0.0	59.7	33.8	6.4		
▲	B-1-4	4.0	2	0.064			0.0	38.9	18.7	42.4		

GRAIN SIZE - GINT STD US LAB.GDT - 13/1/21 10:02 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04891-01A HURTS BRIDGE WATERLINE.GPJ



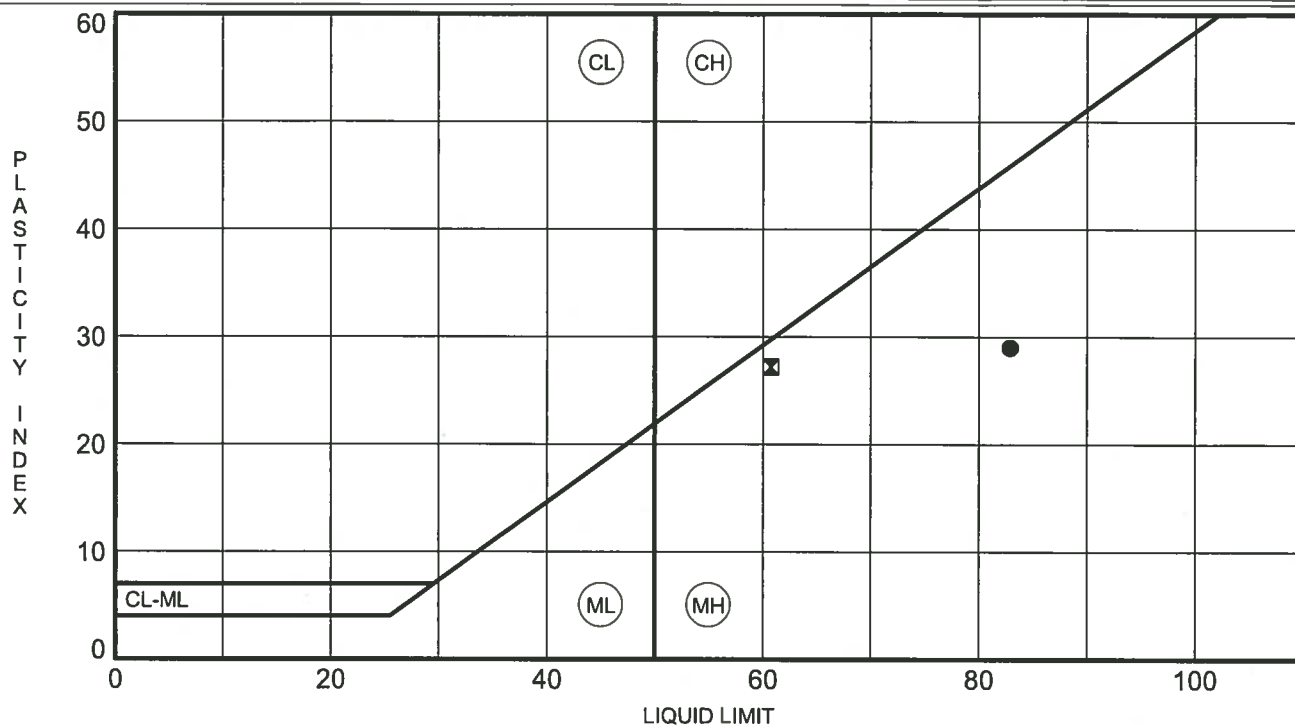


**CLIENT** Forsyth County

**PROJECT NAME** Hurt Bridge Road Pipeline

**PROJECT NUMBER** FORDP-20-GA-4891-01

**PROJECT LOCATION** Cumming, GA



WATTERBERG LIMITS - GINT STD US LAB GDT - 13/1/21 10:04 - H:\GINT DATABASE\PROJECTS\2020\FORPD-20-GA-04891-01A HURTS BRIDGE WATERLINE.GPJ



## ANALYTICAL ENVIRONMENTAL SERVICES, INC.

January 13, 2021

Mahvand Saleki  
United Consulting Group Inc.

625 Holcomb Bridge Rd  
Norcross GA 30071

RE: Hurt Bridge Waterline

Dear Mahvand Saleki:

Order No: 2101747

Analytical Environmental Services, Inc. received 5 samples on 1/8/2021 1:52:00 PM  
for the analyses presented in following report.

"No problems were encountered during the analyses except as noted in the Case Narrative or by qualifiers in the report or QC Summary. Additionally, all results for the associated Quality Control samples were within EPA and/or AES established limits.

AES's accreditations are as follows:

-NELAP/State of Florida Laboratory ID E87582 for analysis of Non-Potable Water, Solid & Chemical Materials, Air & Emissions Volatile Organics, and Drinking Water Microbiology & Metals, effective 07/01/20-06/30/21.

State of Georgia, Department of Natural Resources ID #800 for analysis of Drinking Water Metals, effective through 06/30/21 and Total Coliforms/ E. coli, effective 04/20/20-04/24/23.

-AIHA-LAP, LLC Laboratory ID: 100671 for Industrial Hygiene samples (Metals and PCM Asbestos), Environmental Lead (Paint, Soil, Dust Wipes, Air), and Environmental Microbiology (Fungal) Direct Examination, effective until 11/01/21.

These results relate only to the items tested as received. This report may only be reproduced in full.

If you have any questions regarding these test results, please feel free to call.

Sincerely,

Ioana Pacurar  
Project Manager

2101747

[www.uniteaconsilting.com](http://www.uniteaconsilting.com)

[illegible]

**Client:** United Consulting Group Inc.  
**Project:** Hurt Bridge Waterline  
**Lab ID:** 2101747

**Case Narrative**

pH Analysis by Method SW9045D:

Samples for pH analysis by Method SW9045D were received and analyzed outside holding time requirement of "immediate or 15 minutes."

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-1-1@8.5-10'
<b>Project Name:</b>	Hurt Bridge Waterline	<b>Collection Date:</b>	1/8/2021
<b>Lab ID:</b>	2101747-001	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Soil Resistivity SW9050A</b>					<b>(SW9050)</b>			
Resistivity (@100% Moisture Saturation)	16400	0		ohms*cm	308710	1	01/13/2021 08:41	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>					<b>(SW9045D)</b>			
pH	5.29	0.01	H	pH Units	308603	1	01/11/2021 11:32	CB
<b>ION SCAN SW9056A</b>					<b>(SW9056A)</b>			
Chloride	34	11		mg/Kg-dry	308687	1	01/12/2021 19:25	IP
Sulfate	BRL	11		mg/Kg-dry	308687	1	01/12/2021 19:25	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	13.3	0		wt%	R443907	1	01/10/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-1-2@6-7.5'
<b>Project Name:</b>	Hurt Bridge Waterline	<b>Collection Date:</b>	1/8/2021
<b>Lab ID:</b>	2101747-002	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Soil Resistivity SW9050A</b>								
					(SW9050)			
Resistivity (@100% Moisture Saturation)	23400	0		ohms*cm	308710	1	01/13/2021 08:41	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>								
					(SW9045D)			
pH	5.85	0.01	H	pH Units	308603	1	01/11/2021 11:34	CB
<b>ION SCAN SW9056A</b>								
					(SW9056A)			
Chloride	39	13		mg/Kg-dry	308687	1	01/12/2021 20:13	IP
Sulfate	19	13		mg/Kg-dry	308687	1	01/12/2021 20:13	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	21.4	0		wt%	R443907	1	01/10/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-1-3@8.5-10'
<b>Project Name:</b>	Hurt Bridge Waterline	<b>Collection Date:</b>	1/8/2021
<b>Lab ID:</b>	2101747-003	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Soil Resistivity SW9050A</b>					<b>(SW9050)</b>			
Resistivity (@100% Moisture Saturation)	34900	0		ohms*cm	308710	1	01/13/2021 08:41	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>					<b>(SW9045D)</b>			
pH	5.03	0.01	H	pH Units	308603	1	01/11/2021 11:36	CB
<b>ION SCAN SW9056A</b>					<b>(SW9056A)</b>			
Chloride	37	13		mg/Kg-dry	308687	1	01/12/2021 20:29	IP
Sulfate	BRL	13		mg/Kg-dry	308687	1	01/12/2021 20:29	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	23.0	0		wt%	R443907	1	01/10/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

Client: United Consulting Group Inc.  
 Project Name: Hurt Bridge Waterline  
 Lab ID: 2101747-004

Client Sample ID: B-1-4@13.5-15'  
 Collection Date: 1/8/2021  
 Matrix: Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Soil Resistivity SW9050A</b>					<b>(SW9050)</b>			
Resistivity (@100% Moisture Saturation)	21200	0		ohms*cm	308710	1	01/13/2021 08:41	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>					<b>(SW9045D)</b>			
pH	5.08	0.01	H	pH Units	308603	1	01/11/2021 11:37	CB
<b>ION SCAN SW9056A</b>					<b>(SW9056A)</b>			
Chloride	35	13		mg/Kg-dry	308687	1	01/12/2021 20:45	IP
Sulfate	BRL	13		mg/Kg-dry	308687	1	01/12/2021 20:45	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	22.5	0		wt%	R443907	1	01/10/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit



<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-1-4@8.5-10'
<b>Project Name:</b>	Hurt Bridge Waterline	<b>Collection Date:</b>	1/8/2021
<b>Lab ID:</b>	2101747-005	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Soil Resistivity SW9050A</b>					<b>(SW9050)</b>			
Resistivity (@100% Moisture Saturation)	19100	0		ohms*cm	308710	1	01/13/2021 08:41	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>					<b>(SW9045D)</b>			
pH	5.18	0.01	H	pH Units	308603	1	01/11/2021 11:39	CB
<b>ION SCAN SW9056A</b>					<b>(SW9056A)</b>			
Chloride	31	13		mg/Kg-dry	308687	1	01/12/2021 21:01	IP
Sulfate	23	13		mg/Kg-dry	308687	1	01/12/2021 21:01	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	20.2	0		wt%	R443907	1	01/10/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

**SAMPLE/COOLER RECEIPT CHECKLIST**

Clear

Save as

1. Client Name: **United Consulting Group Inc.**

AES Work Order Number: **2101747**

2. Carrier: FedEx ☐ UPS ☐ USPS ☐ Client ☒ Courier ☐ Other \_\_\_\_\_

	Yes	No	N/A	Details			Comments
3. Shipping container/cooler received in good condition?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	damaged <input type="checkbox"/>	leaking <input type="checkbox"/>	other <input type="checkbox"/>	
4. Custody seals present on shipping container?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
5. Custody seals intact on shipping container?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
6. Temperature blanks present?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
7. Cooler temperature(s) within limits of 0-6°C? [See Item 13 and 14 for temperature recordings.]	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	Cooling initiated for recently collected samples / ice present <input type="checkbox"/>			
8. Chain of Custody (COC) present?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
9. Chain of Custody signed, dated, and timed when relinquished and received?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
10. Sampler name and/or signature on COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
11. Were all samples received within holding time?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
12. TAT marked on the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	If no TAT indicated, proceeded with standard TAT per Terms & Conditions. <input type="checkbox"/>			

13. Cooler 1 Temperature 0.9 °C Cooler 2 Temperature \_\_\_\_\_ °C Cooler 3 Temperature \_\_\_\_\_ °C Cooler 4 Temperature \_\_\_\_\_ °C  
 14. Cooler 5 Temperature \_\_\_\_\_ °C Cooler 6 Temperature \_\_\_\_\_ °C Cooler 7 Temperature \_\_\_\_\_ °C Cooler 8 Temperature \_\_\_\_\_ °C

15. Comments: \_\_\_\_\_ I certify that I have completed sections 1-15 (dated initials). ARS 1/8/21

	Yes	No	N/A	Details			Comments
16. Were sample containers intact upon receipt?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
17. Custody seals present on sample containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
18. Custody seals intact on sample containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
19. Do sample container labels match the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	incomplete info <input type="checkbox"/>	illegible <input type="checkbox"/>	no label <input type="checkbox"/>	
20. Are analyses requested indicated on the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
21. Were all of the samples listed on the COC received?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	samples received but not listed on COC <input type="checkbox"/>			
22. Was the sample collection date/time noted?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
23. Did we receive sufficient sample volume for indicated analyses?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
24. Were samples received in appropriate containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
25. Were VOA samples received without headspace (< 1/4" bubble)?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
26. Were trip blanks submitted?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	listed on COC <input type="checkbox"/>	not listed on COC <input type="checkbox"/>		

27. Comments: \_\_\_\_\_

	Yes	No	N/A	Details		Comments
28. Have containers needing chemical preservation been checked? *	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>			
29. Containers meet preservation guidelines?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>			
30. Was pH adjusted at Sample Receipt?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>			

\* Note: Certain analyses require chemical preservation but must be checked in the laboratory and not upon Sample Receipt such as Coliforms, VOCs and Oil & Grease/TPH.  
 This also excludes metals by EPA 200.7, 200.8 and 245.1 which will be verified between 16 and 24 hours after preservation.

Locked

Client: United Consulting Group Inc.  
Project Name: Hurt Bridge Waterline  
Lab Order: 2101747

## Dates Report

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
2101747-001A	B-1-1@8.5-10'	1/8/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		1/11/2021 8:37:00AM	01/11/2021
2101747-001A	B-1-1@8.5-10'	1/8/2021 12:00:00AM	Soil	Soil Resistivity		1/11/2021 8:36:00AM	01/13/2021
2101747-001A	B-1-1@8.5-10'	1/8/2021 12:00:00AM	Soil	ION SCAN		1/12/2021 3:28:57PM	01/12/2021
2101747-001A	B-1-1@8.5-10'	1/8/2021 12:00:00AM	Soil	PERCENT MOISTURE			01/10/2021
2101747-002A	B-1-2@6-7.5'	1/8/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		1/11/2021 8:37:00AM	01/11/2021
2101747-002A	B-1-2@6-7.5'	1/8/2021 12:00:00AM	Soil	Soil Resistivity		1/11/2021 8:36:00AM	01/13/2021
2101747-002A	B-1-2@6-7.5'	1/8/2021 12:00:00AM	Soil	ION SCAN		1/12/2021 3:28:57PM	01/12/2021
2101747-002A	B-1-2@6-7.5'	1/8/2021 12:00:00AM	Soil	PERCENT MOISTURE			01/10/2021
2101747-003A	B-1-3@8.5-10'	1/8/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		1/11/2021 8:37:00AM	01/11/2021
2101747-003A	B-1-3@8.5-10'	1/8/2021 12:00:00AM	Soil	Soil Resistivity		1/11/2021 8:36:00AM	01/13/2021
2101747-003A	B-1-3@8.5-10'	1/8/2021 12:00:00AM	Soil	ION SCAN		1/12/2021 3:28:57PM	01/12/2021
2101747-003A	B-1-3@8.5-10'	1/8/2021 12:00:00AM	Soil	PERCENT MOISTURE			01/10/2021
2101747-004A	B-1-4@13.5-15'	1/8/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		1/11/2021 8:37:00AM	01/11/2021
2101747-004A	B-1-4@13.5-15'	1/8/2021 12:00:00AM	Soil	Soil Resistivity		1/11/2021 8:36:00AM	01/13/2021
2101747-004A	B-1-4@13.5-15'	1/8/2021 12:00:00AM	Soil	ION SCAN		1/12/2021 3:28:57PM	01/12/2021
2101747-004A	B-1-4@13.5-15'	1/8/2021 12:00:00AM	Soil	PERCENT MOISTURE			01/10/2021
2101747-005A	B-1-4@8.5-10'	1/8/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		1/11/2021 8:37:00AM	01/11/2021
2101747-005A	B-1-4@8.5-10'	1/8/2021 12:00:00AM	Soil	Soil Resistivity		1/11/2021 8:36:00AM	01/13/2021
2101747-005A	B-1-4@8.5-10'	1/8/2021 12:00:00AM	Soil	ION SCAN		1/12/2021 3:28:57PM	01/12/2021
2101747-005A	B-1-4@8.5-10'	1/8/2021 12:00:00AM	Soil	PERCENT MOISTURE			01/10/2021

Client: United Consulting Group Inc.  
Project Name: Hurt Bridge Waterline  
Workorder: 2101747

ANALYTICAL QC SUMMARY REPORT

BatchID: 308603

Sample ID: LCS-308603	Client ID:	Units:	pH Units	Prep Date:	01/11/2021	Run No:	443935				
SampleType: LCS	TestCode: Laboratory Hydrogen Ion (pH)	BatchID:	308603	Analysis Date:	01/11/2021	Seq No:	10121307				
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

pH 6.950 0.01 7.000 99.3 90 110

Sample ID: 2101329-001ADUP	Client ID:	Units:	pH Units	Prep Date:	01/11/2021	Run No:	443935				
Sample Type: DUP	Test Code: Laboratory Hydrogen Ion (pH)	BatchID:	308603	Analysis Date:	01/11/2021	Seq No:	10121322				
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual

pH 7.210 0.01 7.220 0.139 10 H

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL		Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J		Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
		Rpt Lim Reporting Limit	S	Spike Recovery outside limits due to matrix		

## ANALYTICAL QC SUMMARY REPORT

Client: United Consulting Group Inc.  
 Project Name: Hurt Bridge Waterline  
 Workorder: 2101747

BatchID: 308687

Sample ID: MB-308687	Client ID:	Units: mg/Kg	Prep Date: 01/12/2021	Run No: 444212
SampleType: MBLK	TestCode: ION SCAN SW9056A	BatchID: 308687	Analysis Date: 01/12/2021	Seq No: 10127650
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
			%REC	Low Limit High Limit
			RPD Ref Val	%RPD RPD Limit Qual

Chloride BRL 10  
 Sulfate BRL 10

Sample ID: LCS-308687	Client ID:	Units: mg/Kg	Prep Date: 01/12/2021	Run No: 444212
SampleType: LCS	TestCode: ION SCAN SW9056A	BatchID: 308687	Analysis Date: 01/12/2021	Seq No: 10127651
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
			%REC	Low Limit High Limit
			RPD Ref Val	%RPD RPD Limit Qual

Chloride 104.3 10 100.0 104 90 110  
 Sulfate 263.6 10 250.0 105 90 110

Sample ID: 2101747-001AMS	Client ID: B-1-1@8.5-10'	Units: mg/Kg-dry	Prep Date: 01/12/2021	Run No: 444212
SampleType: MS	TestCode: ION SCAN SW9056A	BatchID: 308687	Analysis Date: 01/12/2021	Seq No: 10127653
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
			%REC	Low Limit High Limit
			RPD Ref Val	%RPD RPD Limit Qual

Chloride 145.9 11 114.9 34.24 97.2 80 120  
 Sulfate 237.3 11 287.2 10.50 78.9 80 120 S

Sample ID: 2101747-001AMSD	Client ID: B-1-1@8.5-10'	Units: mg/Kg-dry	Prep Date: 01/12/2021	Run No: 444212
SampleType: MSD	TestCode: ION SCAN SW9056A	BatchID: 308687	Analysis Date: 01/12/2021	Seq No: 10127654
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
			%REC	Low Limit High Limit
			RPD Ref Val	%RPD RPD Limit Qual

Chloride 142.6 12 115.3 34.24 93.9 80 120  
 Sulfate 228.3 12 288.4 10.50 75.5 80 120 237.3 3.83 20 S

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
		BRL		E	H	Holding times for preparation or analysis exceeded
		J		N	R	RPD outside limits due to matrix
		Rpt Lim		S		Spike Recovery outside limits due to matrix

Client: United Consulting Group Inc.  
Project Name: Hurt Bridge Waterline  
Workorder: 2101747

ANALYTICAL QC SUMMARY REPORT

BatchID: 308710

Sample ID: 2101747-004ADUP Client ID: B-1-4@13.5-15' Units: ohms\*cm Prep Date: 01/11/2021 Run No: 444139  
SampleType: DUP TestCode: Soil Resistivity SW9050A BatchID: 308710 Analysis Date: 01/13/2021 Seq No: 10125650

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Resistivity (@100% Moisture Saturati	21180	0						21210	0.148	30	

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
	HRL	Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
	J	Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
	Rpt Lim	Reporting Limit	S	Spike Recovery outside limits due to matrix		

**End of Report**



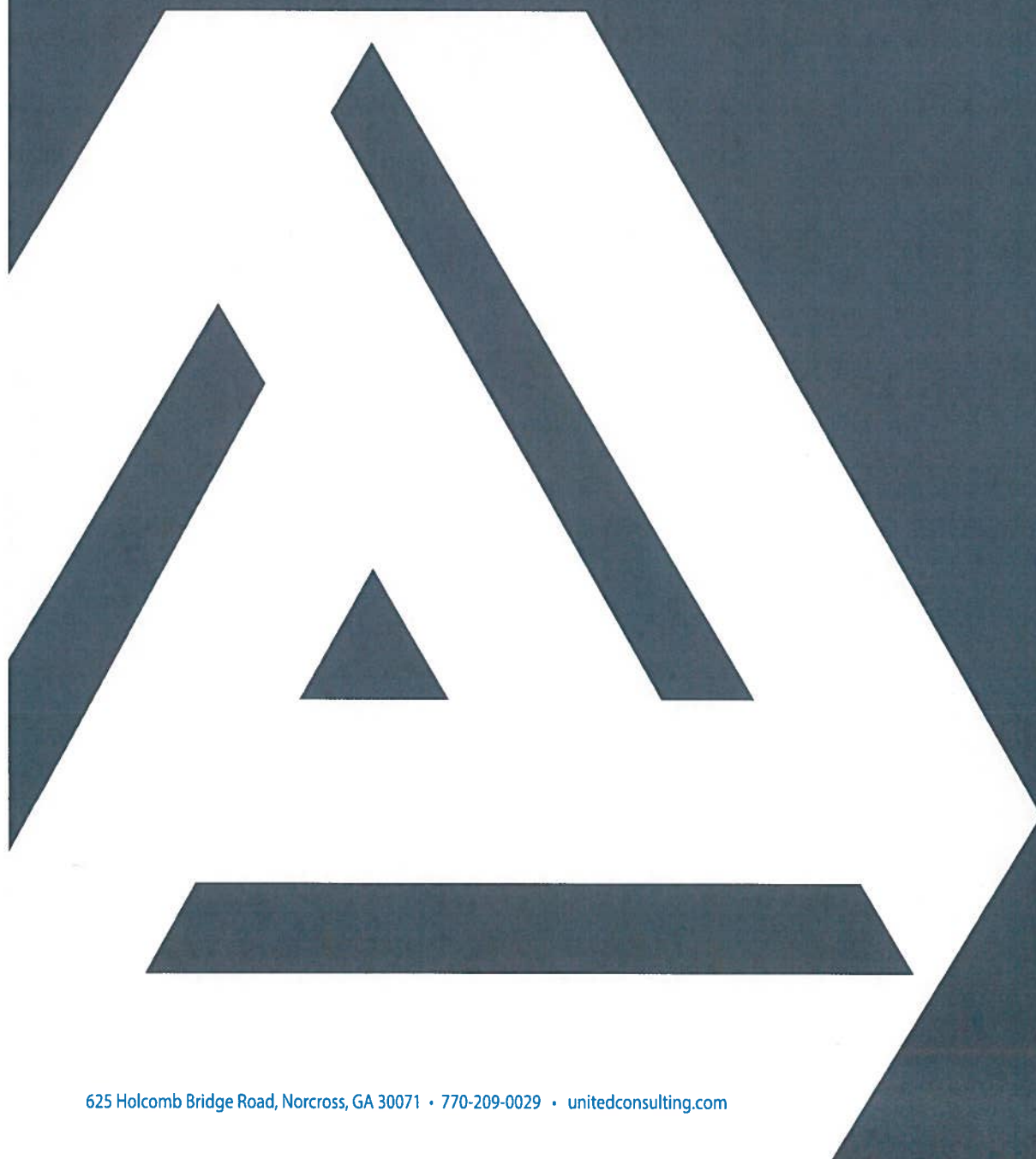
UNITED  
CONSULTING

# REPORT

**For Forsyth County  
Department of Water and  
Sewer**

Geotechnical Exploration  
Hurt Bridge Waterline  
Forsyth County  
Cumming, Georgia

Project No.: FORPD-20-GA-04892-01







February 22, 2021

Mr. Mike Grinberg, P.E.  
**Forsyth County Department of Water and Sewer**  
110 East Main Street, Suite 150  
Cumming, Georgia 30040

Via Email: [MIGrinberg@forsythco.com](mailto:MIGrinberg@forsythco.com)


RE: Report of Geotechnical Exploration  
**CIP Water Main**  
Keith Bridge Road  
Cumming, Forsyth County, Georgia  
Project No.: FORPD-20-GA-04892-01

Dear Mr. Grinberg:

United Consulting is pleased to submit this report of our Geotechnical Exploration for the above-referenced project. We appreciate the opportunity to assist you with this project and look forward to our continued participation. Please contact us if you have any questions or if we can be of further assistance.


Sincerely,

UNITED CONSULTING

  
**Thomas A. Tye, P.E.**  
Senior Geotechnical Engineer



2/22/2021

  
**Scott D. Smelter**  
Principal

SRT/TAT/SDS/rg

unc-sps: Geotechnical Documents/FORPD-20-GA-04892-01 - Geo.docx



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7.0 LABORATORY TESTING PROGRAM .....	12
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## APPENDIX

General Notes/Narrative of Drilling Operations  
Figure 1– Boring Location Plan (8 Pages)  
Fence Diagrams (6 Pages)  
Exploration Procedures  
Laboratory Procedures  
SPT Boring Logs (23)  
Summary Grain Size Distribution (1)  
Soil Corrosion Series (18)



## 1.0 EXECUTIVE SUMMARY

United Consulting has completed a Geotechnical Exploration for the CIP Water Main project located along Keith Bridge Road in Cumming, Forsyth County, Georgia. Please refer to the text of the report for a more detailed discussion of the items summarized below.

- Fill soils were encountered in 21 out of 23 borings to depths ranging from 3 to 17 feet. The fill generally appeared to be free of debris and organic content, but variable in consistency.
- Partially Weathered Rock (PWR) was encountered in borings B-2-10, B-2-12, B-2-13, B-2-22, and B-2-23 starting at depths ranging from 6 feet to 22 feet.
- Auger refusal occurred in the boring B-2-2 at a depth of 18.5 feet. The rock was cored to a depth of 15 feet below refusal and incompetent schist encountered with rock quality (RQD) ranging from 8 to 23 percent.
- Groundwater was encountered in 8 borings at depths ranging from 1 foot to 24 feet at the time of drilling or 24 hours after drilling. It is likely that stabilized groundwater levels are several feet shallower than time of boring levels, and it is possible that perched water levels could develop at shallower depths at the site. The contractor should be prepared to manage perched water or groundwater as needed.
- The soil resistivity results varied from 17,800 to 29,500 ohm-cm, indicating a mild corrosion potential for uncoated steel.
- Chloride test results ranged from below reporting limits (<11 mg/Kg) to 52 mg/Kg dry and sulfate tests results varied from below reporting limits (<11 mg/Kg) to 55 mg/Kg dry.



## 2.0 PROJECT INFORMATION

The Project Site is located along Keith Bridge Road in Cumming, Forsyth County, Georgia. The client provided a site plan which showed the location and alignment of the proposed pipeline routing. This site plan was used as a guide to locate the boundaries of the project site.

At the time of our fieldwork, the site contained a number of commercial and residential structures, as well as wooded areas along the right-of-ways of the existing streets. The general location of the project site is shown on the attached Boring Location Plan (Figure 1).

We understand that the project consists of construction of approximately 19,355 linear feet of a 36-inch diameter water main starting at Station 0 + 00± located on Keith Bridge Road, at its intersection with Shadburn Road. The water main will then be located northeast along Keith Bridge Road until it reaches Station 154 + 01± located west of its intersection with Grindle Road.



### 3.0 PURPOSE

The purpose of this Geotechnical Exploration was to assess the general type and condition of the subsurface materials at the Project Site.





## 4.0 SCOPE

The scope of our geotechnical exploration included the following items:

1. A visual reconnaissance of the site from a geotechnical standpoint;
2. Drilling twenty-three (23) Standard Penetration Test (SPT) borings to assess the quality and consistency of the subsurface soils;
3. Performing three rock cores at SPT boring location B-2-2 to assess the quality and continuity of the rock below the auger refusal level;
4. Visual evaluation of the soil samples obtained during our field testing program for further identification and classification;
5. Performing laboratory testing consisting of three (3) grain size analysis with hydrometer and three (3) Atterberg Limits tests on representative soil samples, five (5) oxidation/reduction potential, five (5) corrosivity tests, five (5) sulfide, sulfate, and chloride tests, and five (5) moisture content tests on samples taken at the approximate depths of the pipeline at each of the boring locations; and
6. Preparing this report to document the results of our field-testing program, laboratory testing, and to provide our findings.



## 5.0 ALIGNMENT REVIEW

A foot and an automobile reconnaissance of the Project area were conducted as part of this exploration. We anticipate that the proposed water line will generally be constructed as open trench excavation. Road/lane closure will be required on the road during the construction activities. We understand that jack and bore trenchless installation will be utilized across portions of the site. Underground utilities such as gas, water, sewer lines, and telephone cables were observed within the right of way. Some of the buried utility lines also crossed the road.



## 6.0 SUBSURFACE CONDITIONS

The geotechnical exploration consisted of twenty-three (23) borings located along the proposed water main route.

Initially, the borings encountered a thin layer of topsoil. Below the ground surface, fill soils were encountered in 21 out of 23 borings drilled to depths ranging from three to 17 feet. The fill consists of loose to firm sand with varying amounts of silt, clay, mica, and rock fragments; soft to stiff silt with varying amounts of sand, clay, mica, and rock fragments; or soft to stiff clay with varying amounts sand, trace silt, and trace mica. Standard Penetration Test resistances (N-values) within the fill sands ranged from 6 to 11 blows per foot (bpf); those within the fill silt ranged from 4 to 10 bpf; and those within the fill clay ranged from 4 to 12 bpf.

Beneath the fill soils in the aforementioned borings and ground surface in remaining borings, typical residual soils of the Piedmont Physiographic Province of Georgia were encountered. The residual soils encountered generally consisted of very loose to very dense sand with varying amounts of silt, clay, mica, and rock fragments; very soft to very stiff silt with varying amounts of sand, clay, mica, and rock fragments; or soft to stiff clay with varying amounts sand, trace silt, and trace mica. The N-values within the residual sands ranged from 4 to 60 bpf, those within the residual silt ranged from 2 to 21 bpf, and those within the residual clays ranged from 3 to 11 bpf.

Partially Weathered Rock (PWR) was encountered in borings B-2-10, B-2-12, B-2-13, B-2-22, and B-2-23 starting at depths ranging from 6 feet to 22 feet. PWR is a term for the residuum that can be penetrated by a soil drilling auger and has N-values in excess of 100 bpf. The PWR encountered was classified as very dense sand with varying amounts of rock fragments, silt, and clay.

Auger refusal occurred in the boring B-2-2 at a depth of 18.5 feet. Auger refusal is the depth that the boring cannot be advanced with a soil drilling auger. It may represent a seam of rock, a boulder or other hard obstruction, or the upper surface of relatively sound, massive rock. The refusal material was cored and is described as

Groundwater was encountered in 8 borings at depths ranging from 1 foot to 24 feet at the time of drilling or 24 hours after drilling. Groundwater levels should be anticipated to fluctuate with the change of seasons, during periods of very low or high precipitation, or due change in floodplain or watershed upstream of the site.

The borings were backfilled with cement-bentonite grout. For a more detailed description of the subsurface conditions encountered, please refer to the boring logs in Appendix A. A boring summary table is presented below:





**Table 1: Summary of Subsurface Conditions**

Boring No.	Station	Elevation (ft.-msl)	Bottom of Water Main Elevation (ft.-msl)	Depth to Bottom of Fill Soils (ft.)	Depth to PWR (ft.)	Shallowest Groundwater Depth (ft.)	Boring Termination Depth (ft.)
B-2-1	6+00	1189	1171	6	NE	19	35
B-2-2	8+85	1185	1162	13	NE	NE	18.5
B-2-3	11+00	1195	1185	7	NE	NE	15
B-2-4	20+00	1247	1238	NE	NE	NE	15
B-2-5	30+00	1264	1255	3	NE	NE	15
B-2-6	39+00	1248	1240	8	NE	NE	15
B-2-7	40+70	1242	1228	3	NE	NE	20
B-2-8	44+50	1235	1222	13	NE	14	25
B-2-9	49+50	1263	1254	2	NE	NE	15
B-2-10	60+00	1259	1243	6	22	19	25
B-2-11	70+00	1277	1269	3	NE	NE	15
B-2-12	76+00	1248	1237	3	18	6	20
B-2-13	77+70	1246	1238	NE	14	1	20
B-2-14	86+75	1285	1276	3	NE	NE	15
B-2-15	97+00	1291	1284	3	NE	NE	15
B-2-16	108+50	1259	1250	6	NE	NE	20
B-2-17	115+75	1259	1251	3	NE	NE	20
B-2-18	122+20	1218	1194	17	NE	19	30
B-2-19	123+70	1217	1191	11	NE	14	30
B-2-20	130+00	1228	1221	3	NE	NE	15
B-2-21	138+37	1242	1226	3	NE	NE	20
B-2-22	143+16	1241	1231	3	6,19	20	25
B-2-23	143+70	1241	1228	6	9	NE	25

NE – Not Encountered, Elevations should be considered approximate.

Rock coring was performed in boring B-2-2 below auger refusal depth which occurred at 18.5 feet below existing grade. The rock consisted of very soft to medium hard, grey, moderately weathered Schist typically encountered in the region with RQD values ranging from 8 to 23%. The following tables provide a summary of the core recoveries and the rock quality designations (RQD) in each of the core holes.



**Table 2: Rock Coring Data**

Boring	Depth (feet)	Recovery (%)	RQD (%)
B-2-2	18.5 to 23.5	57	23
B-2-2	23.5 to 28.5	40	8
B-2-2	28.5 to 33.5	57	8

The results of the rock coring indicate generally incompetent (RQD<40%) schist rock. The definitions of the terms used related to rock quality are included in Appendix A.



## 7.0 LABORATORY TESTING PROGRAM

Laboratory testing for this project included three (3) grain size analysis with hydrometer and three (3) Atterberg Limits tests on representative soil samples, five (5) oxidation/reduction potential, five (5) corrosivity tests, five (5) sulfide, sulfate, and chloride tests, and five (5) moisture content tests on samples taken at the approximate depths of the pipeline at each of the boring locations.

The results of these tests are tabulated below:

**Table 3: Soil Classification Laboratory Data Summary**

Boring No.	Depth (ft.)	Liquid Limit	Plastic Limit	Plasticity Index	Percent Fines	USCS Classification	Water Content %
B-2-4	8.5 – 10	NV	NP	NP	19	SM	20
B-2-11	8.5 – 10	NV	NP	NP	35	SM	17
B-2-17	6.0 – 7.5	NV	NP	NP	27	SM	28

NP=Non-plastic

**Table 4: Soil Corrosivity Test Results**

Boring	Depth (ft.)	Moisture Content %	Soil pH (S.U.)	Soil Resistivity (ohm-cm)	Oxidation/Reduction Potential (mV)	Sulfide (mg/Kg-dry)	Chloride (mg/Kg-dry)	Sulfate (mg/Kg-dry)
B-2-4	6.0-7.5	18.3	5.57	24,900	< 1	47.6	52	< 12
B-2-9	6.0-7.5	10.8	5.37	22,300	270	43.1	11	13
B-2-14	6.0-7.5	23.4	5.15	17,800	210	< 51.2	< 13	53
B-2-17	8.5-10	17.5	5.34	21,600	160	< 46.2	12	55
B-2-22	6.0-7.5	14.8	5.37	29500	< 1	< 45.2	< 12	< 12

A narrative description of the laboratory tests and the laboratory test results are included in The Appendix.



## 8.0 LIMITATIONS

This report is for the exclusive use of **Forsyth County Procurement**, and the designers of the project described herein, and may only be applied to this specific project. Our conclusions have been prepared using generally accepted standards of Geotechnical Engineering practice in the State of Georgia. No other warranty is expressed or implied. Our firm is not responsible for conclusions, opinions or recommendations of others.

The right to rely upon this report and the data within may not be assigned without UNITED CONSULTING'S written permission.

Our findings are based upon design information furnished to us, data obtained from the previously described exploration and testing program and our past experience. They do not reflect variations in subsurface conditions that may exist intermediate of our borings, and in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our conclusions and recommendations based upon "on-site" observations of the conditions.

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## **APPENDIX**

General Notes/Narrative of Drilling Operations

Figure 1– Boring Location Plan (8 Pages)

Fence Diagrams (6 Pages)

Exploration Procedures

Laboratory Procedures

SPT Boring Logs (23)

Summary Grain Size Distribution (1)

Soil Corrosion Series (18)

## GENERAL NOTES

The soil classifications noted on the Boring Logs are visual classifications unless otherwise noted. Minor constituents of a soil sample are termed as follows:

Trace	0 - 10%
Some	11 - 35%
Suffix "y" or "ey"	36 - 49%

### LEGEND



Split Spoon Sample obtained during Standard Penetration Testing



Relatively Undisturbed Shelby Tube Sample



Groundwater Level at Time of Boring Completion



Groundwater Level at 24 hours (or as noted) after Termination of Boring

w                      Natural Moisture Content

LL                      Liquid Limit

PL                      Plastic Limit                      Atterberg Limits

PI                      Plasticity Index

PF                      Percent Fines (Percent Passing #200 Sieve)

$\gamma_d$                       Dry Unit Weight (Pounds per Cubic Foot or PCF)

$\gamma_m$                       Moist or In-Situ Unit Weight (PCF)

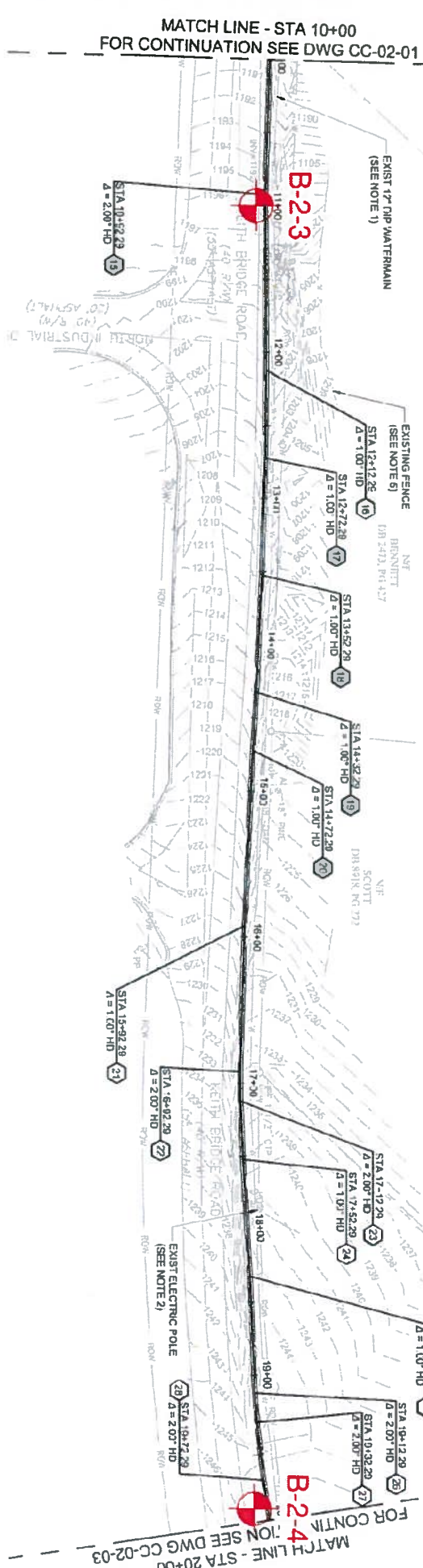
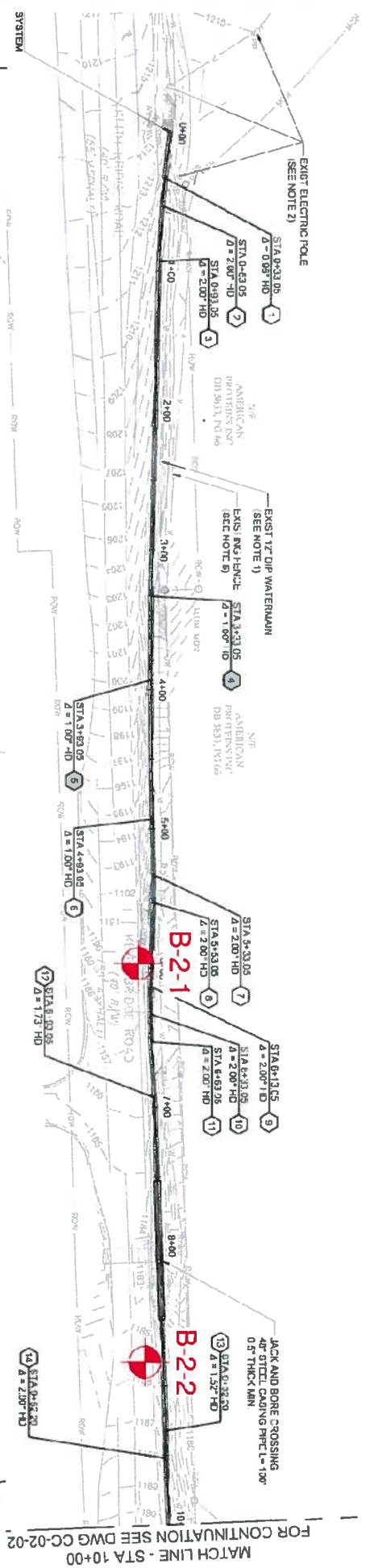
$\gamma_{sat}$                       Saturated Unit Weight (PCF)


## BORING LOG DATA NARRATIVE OF DRILLING OPERATION

The test borings were made by mechanically advancing helical hollow stem augers into the ground. Samples were collected at regular intervals in each of the borings following established procedures for performing the Standard Penetration Test in accordance with ASTM Specification D 1586. Soil samples were obtained with a standard 1.4" I.D. x 2.0" O.D. split barrel sampler. The sampler is first seated 6" to penetrate any loose cuttings and then driven an additional foot with the blows required of a 140-pound hammer freely falling a distance of 30 inches. The number of blows required to drive the sampler the final foot is designated the "standard penetration resistance." The driving resistance, known as the "N" value, can be correlated with the relative density of granular soils and the consistency of cohesive deposits.

The following table describes soil consistency and relative densities based on standard penetration resistance values (N) determined by the Standard Penetration Test (SPT).


	<u>"N"</u>	<u>Consistency</u>
Clay and Silt	0-2	Very Soft
	3-4	Soft
	5-8	Firm
	9-15	Stiff
	16-30	Very Stiff
	Over 31	Hard
	<u>"N"</u>	<u>Relative Density</u>
Sand	0-4	Very Loose
	5-10	Loose
	11-19	Firm
	20-29	Medium Dense
	30-49	Dense
	50+	Very Dense





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Scale:	NTS	Notes	Client:
Prepared:	SRT		Forsyth County Procurement
Checked:	TAT		CIP Water Mains
Project No.:	FORPD-20-GA-04892-01		Hurt Bridge & Keith Bridge Roads
			Forsyth County, Georgia
			Boring Location Plan

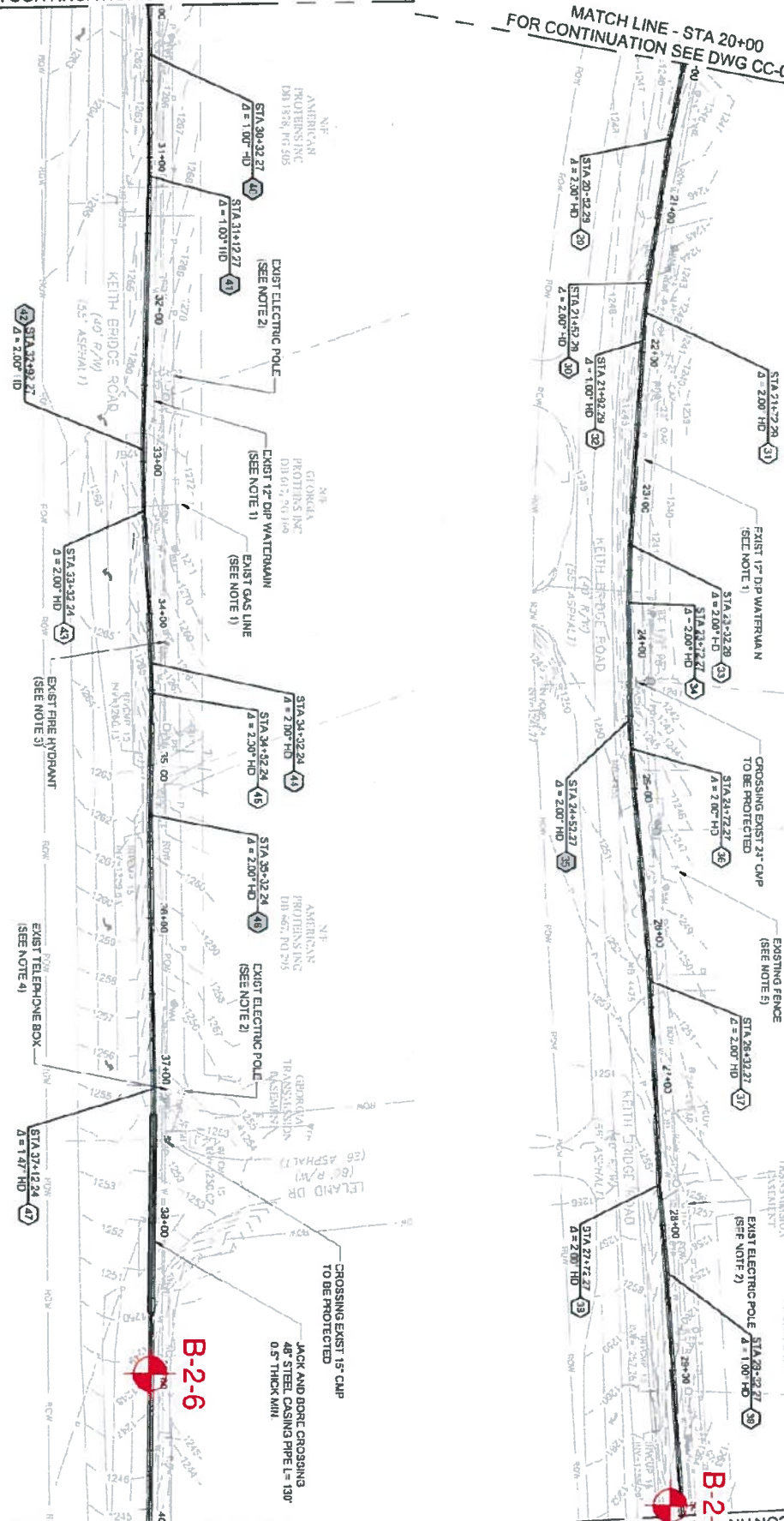
**FIG. 1**

**Page 1**



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MATCH LINE - STA 30+00  
FOR CONTINUATION SEE DWG CC-02-03



MATCH LINE - STA 30+00  
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MATCH LINE - STA 40+00  
FOR CONTINUATION SEE DWG CC-02-05



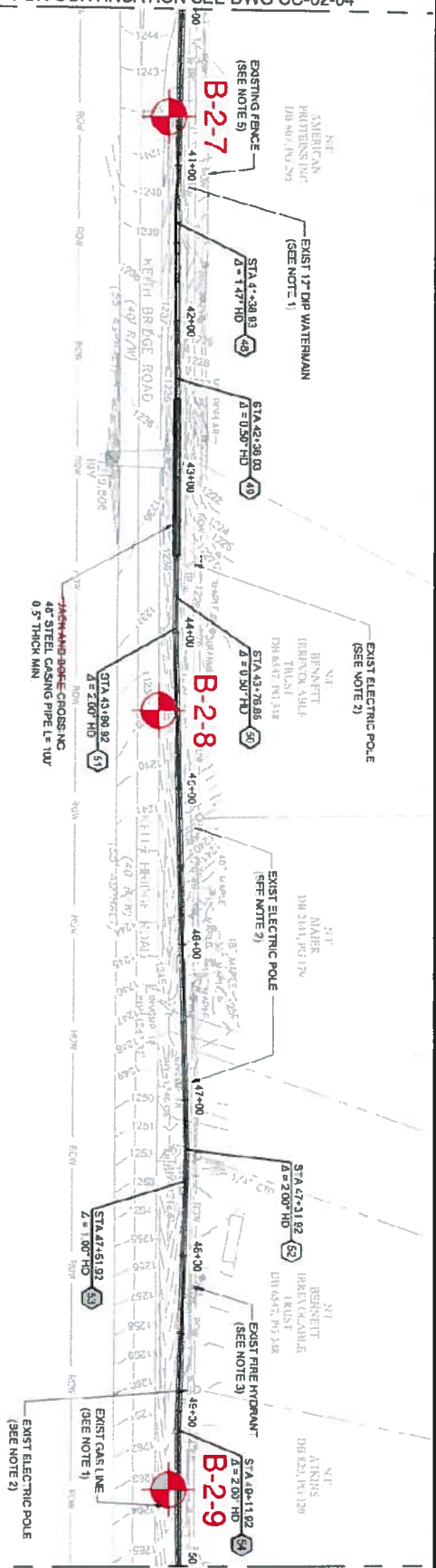
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Checked:	RIO
Project No.:	FORPD-20-GA-04892-01

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	Site:

**Forsyth County Procurement**  
CIP Water Mains  
Hurt Bridge & Keith Bridge Roads  
Forsyth County, Georgia

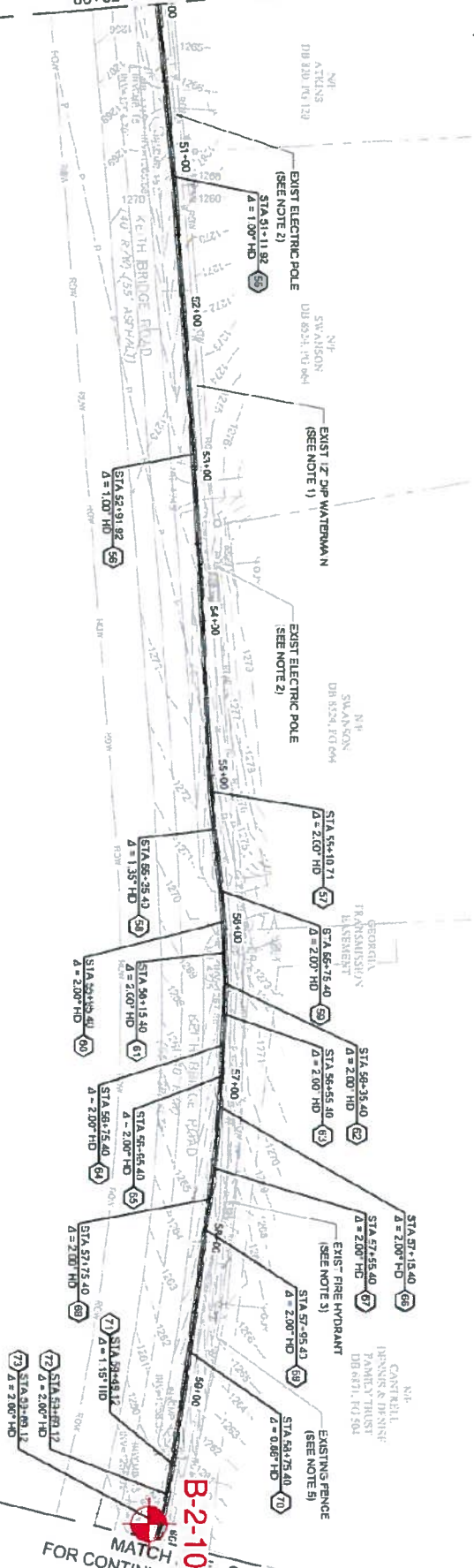
**Boring Location Plan**

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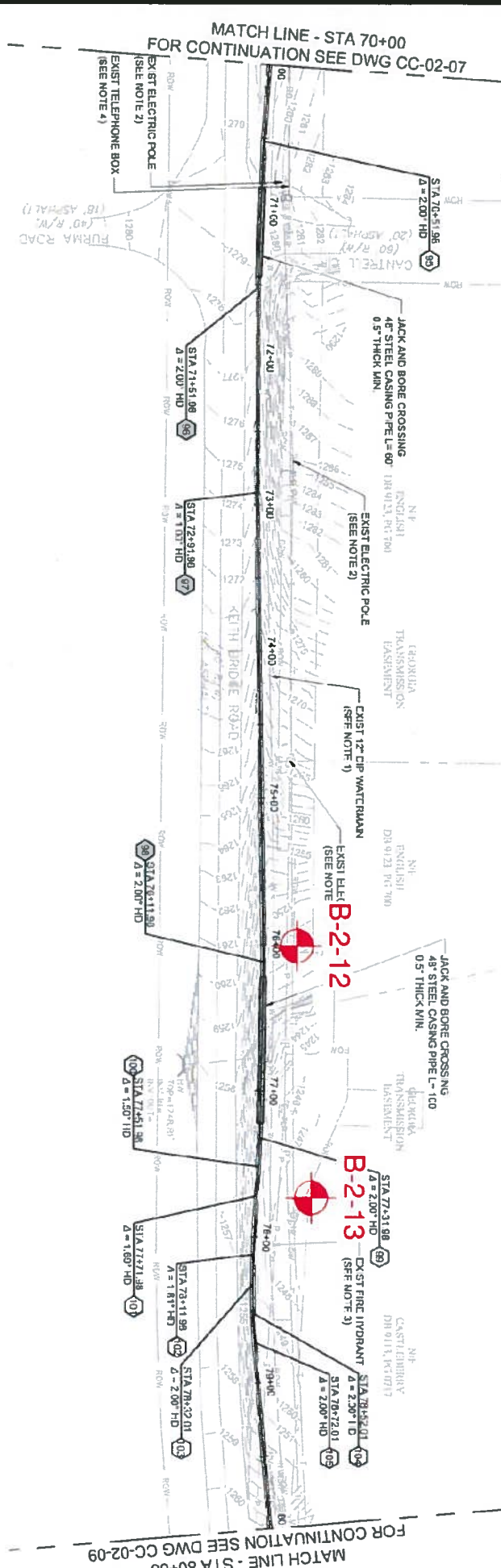
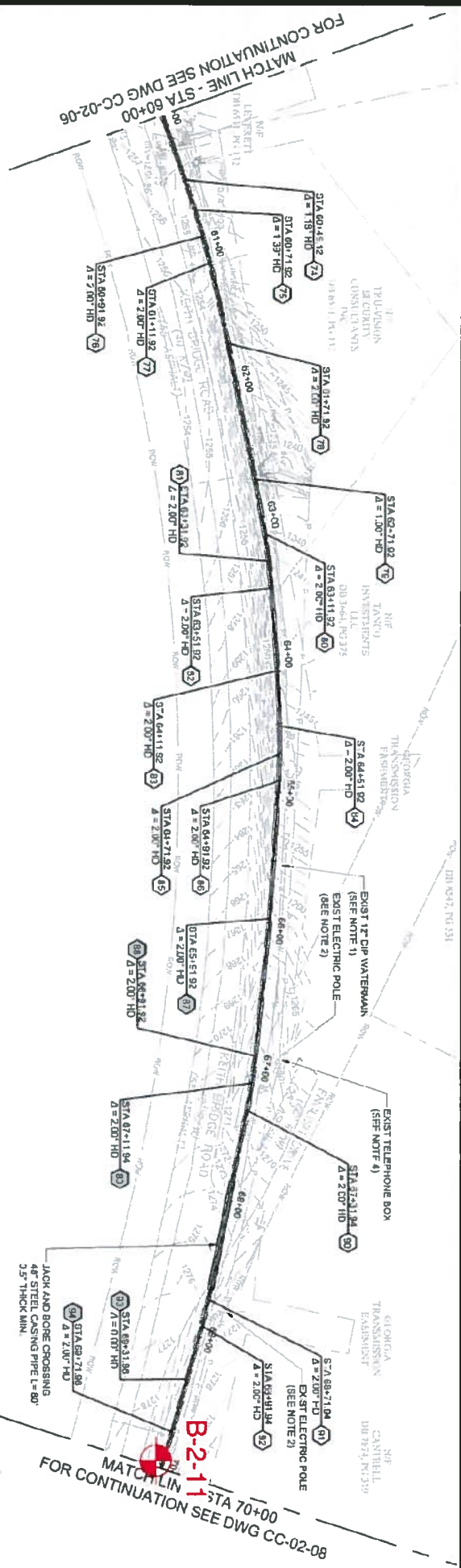


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Notes	Client:	Forsyth County Procurement
	Site:	CIP Water Mains Hurt Bridge & Keith Bridge Roads Forsyth County, Georgia
	Title:	Boring Location Plan





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Checked:	RIO
Project No.:	GCTRS-20-GA-04006-01

Notes	Client:
	Site:

Forsyth County Procurement

CIP Water Mains

Hurt Bridge & Keith Bridge Roads

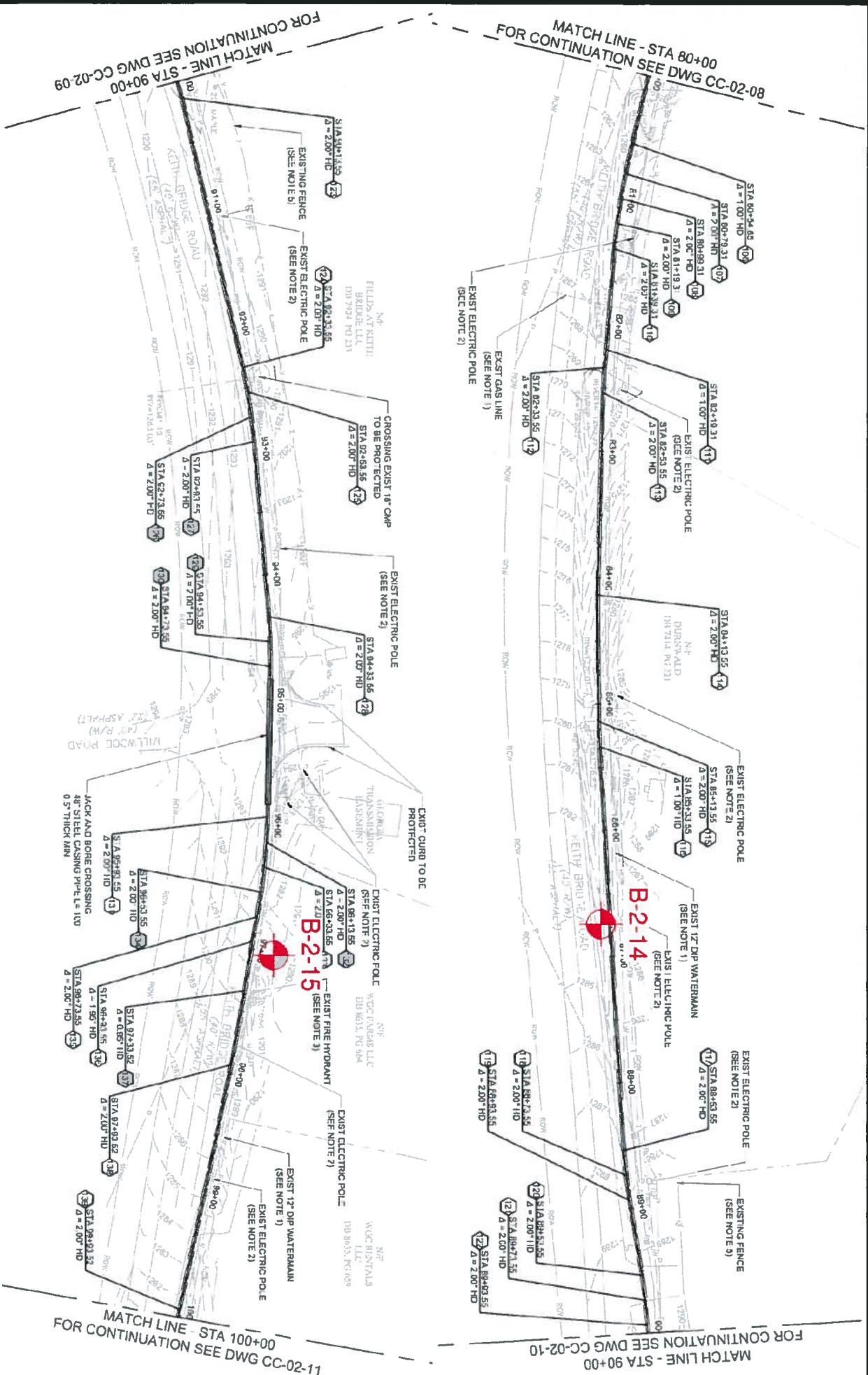
Forsyth County, Georgia

Boring Location Plan

**FIG. 1**

**Page 4**







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Checked:	RIO			Hurt Bridge & Keith Bridge Roads	
Project No.:	GCTRS-20-GA-04006-01		Title:	Forsyth County, Georgia	

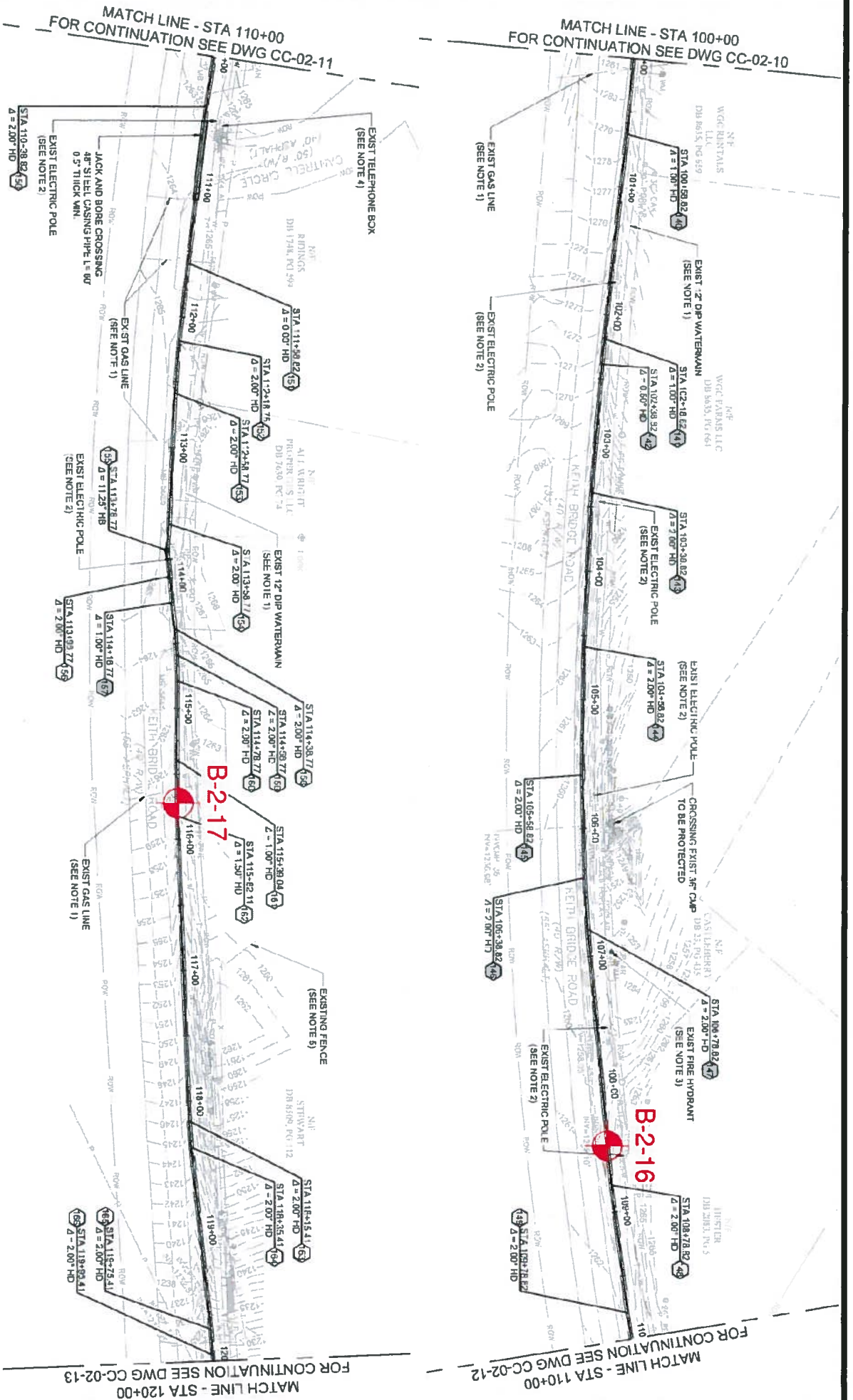
Boring Location Plan



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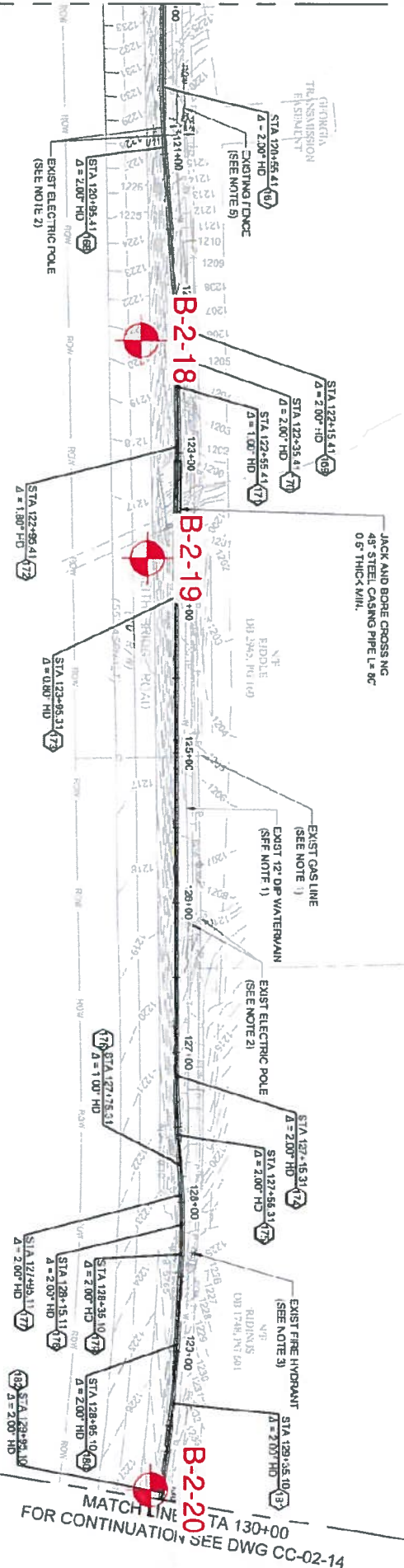
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	Site:

Forsyth County Procurement
CIP Water Mains
Hurt Bridge & Keith Bridge Roads
Forsyth County, Georgia
Boring Location Plan



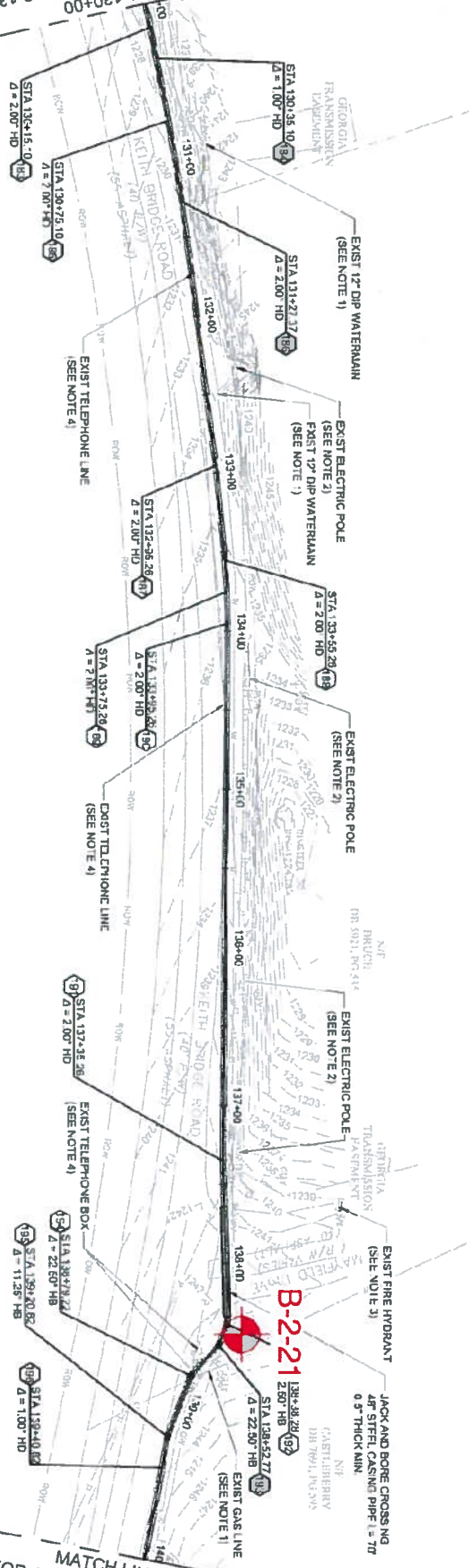


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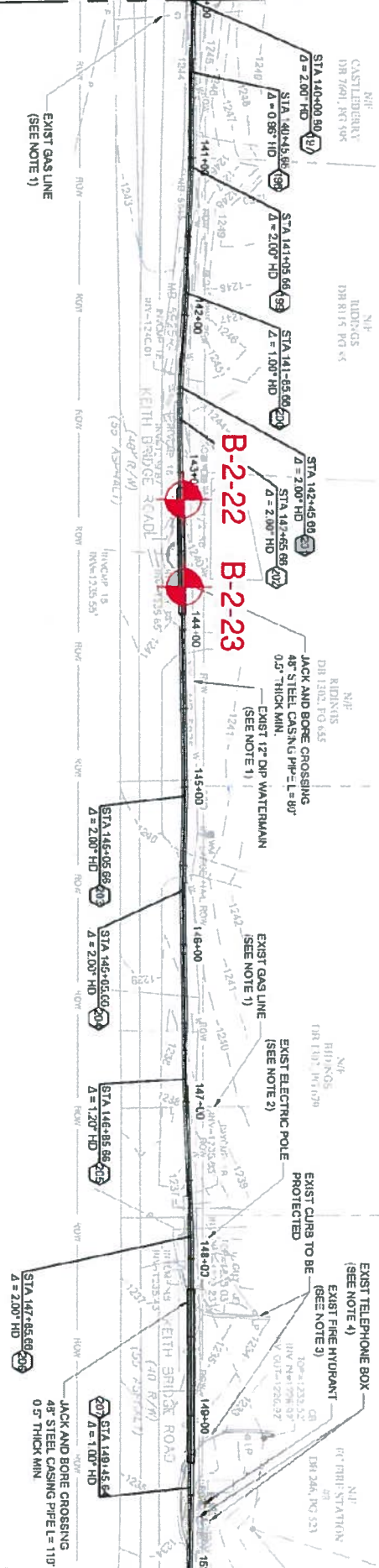
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	Title:	Boring Location Plan

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MATCH LINE - STA 150+00  
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Project No.:	GCTRS-20-GA-04006-01

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	Site:	CIP Water Mains Hurt Bridge & Keith Bridge Roads Forsyth County, Georgia
	Title:	Boring Location Plan

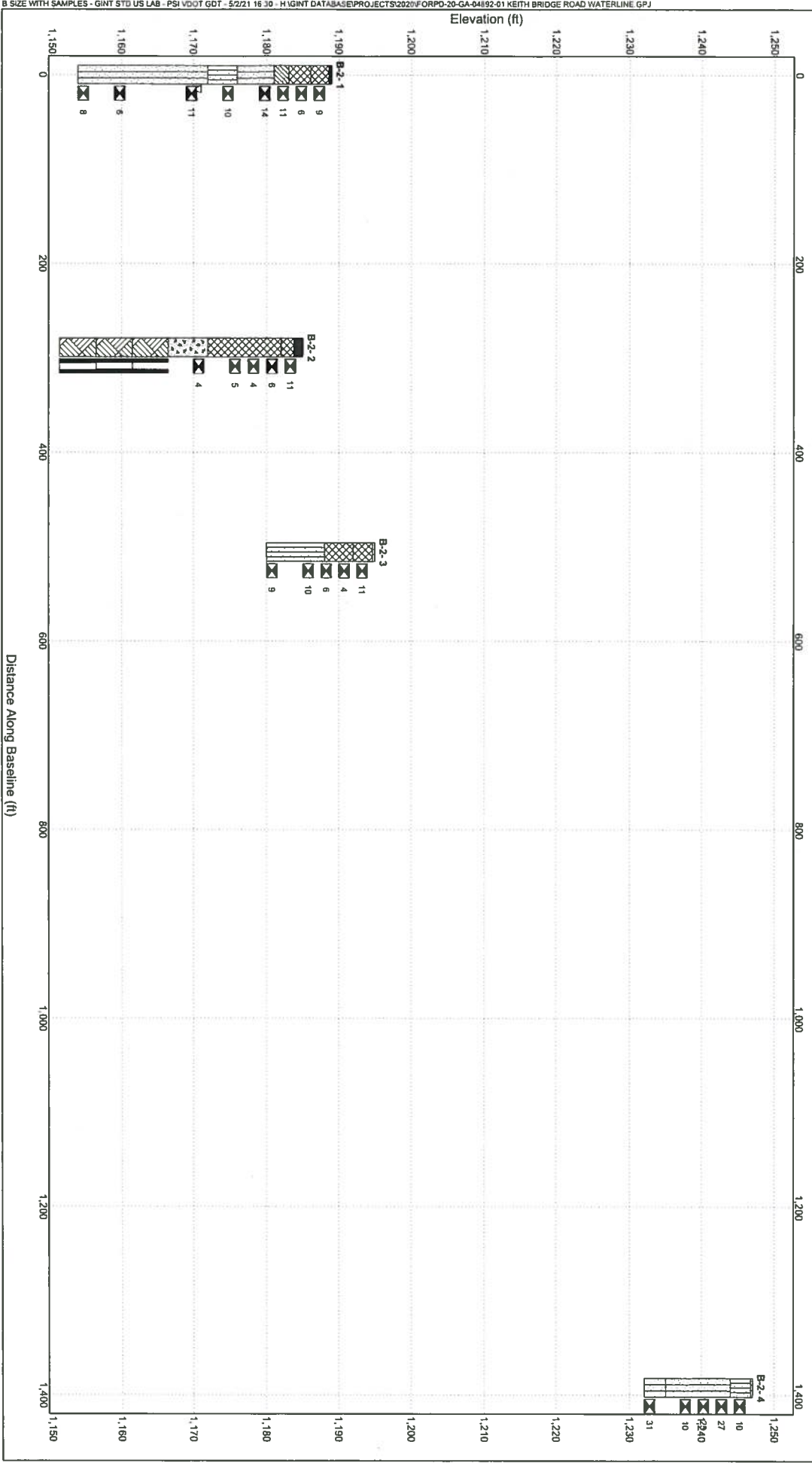

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 Norcross, GA 30071  
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 Fax: 770-582-2800

CLIENT Forsyth County  
 PROJECT NUMBER FORDP-20-GA-04892-01

PROJECT NAME Keith Bridge Road Pipeline  
 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

# SUBSURFACE DIAGRAM 1

-  Asphalt
-  USCS Silty Sand
-  Bedrock
-  Fill (made ground)
-  USCS Sandy Silt
-  Topsoil
-  USCS Low Plasticity Silty Clay
-  Concrete







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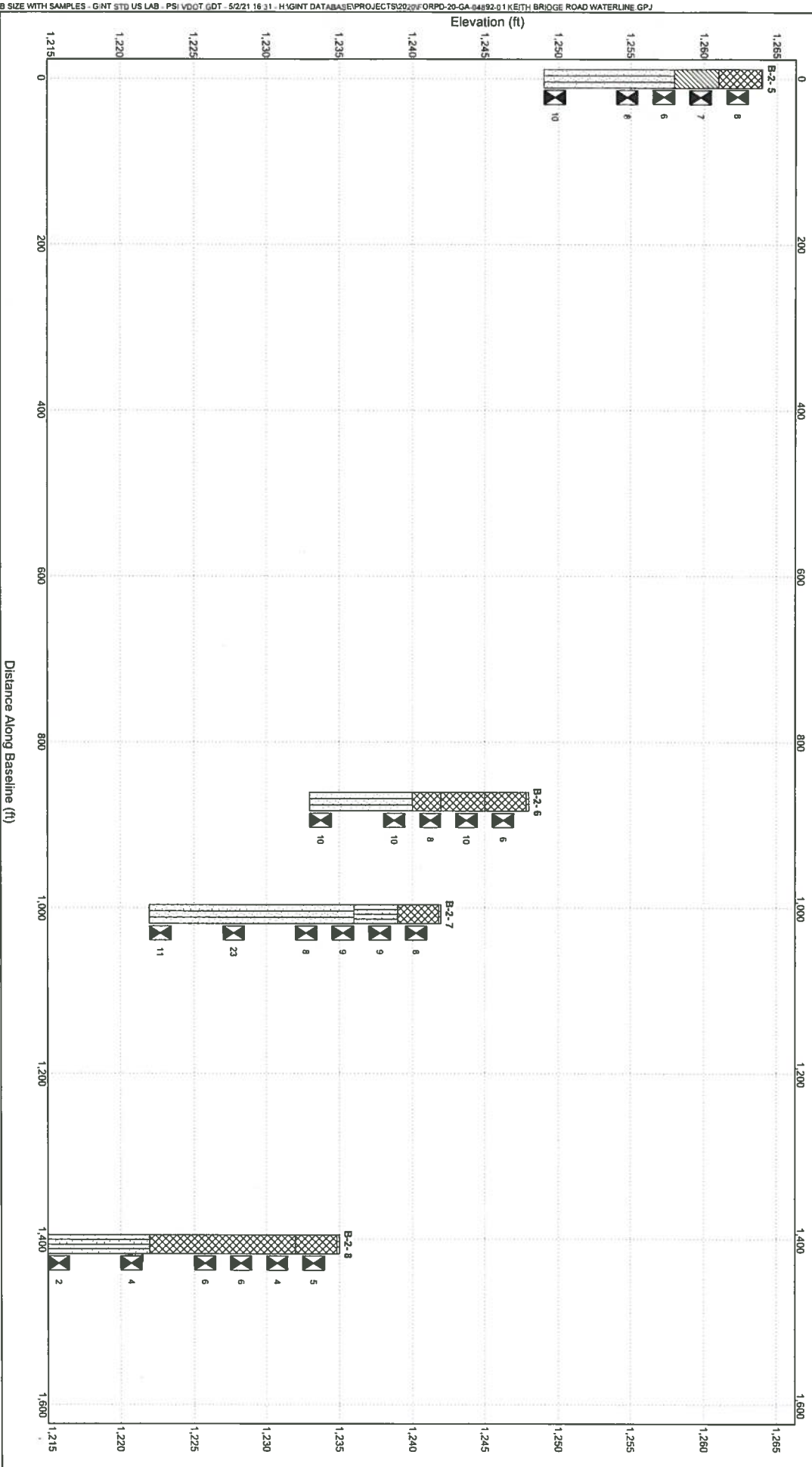
CLIENT Forsyth County

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## SUBSURFACE DIAGRAM 2

PROJECT NAME Keith Bridge Road Pipeline

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia





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### SUBSURFACE DIAGRAM 3



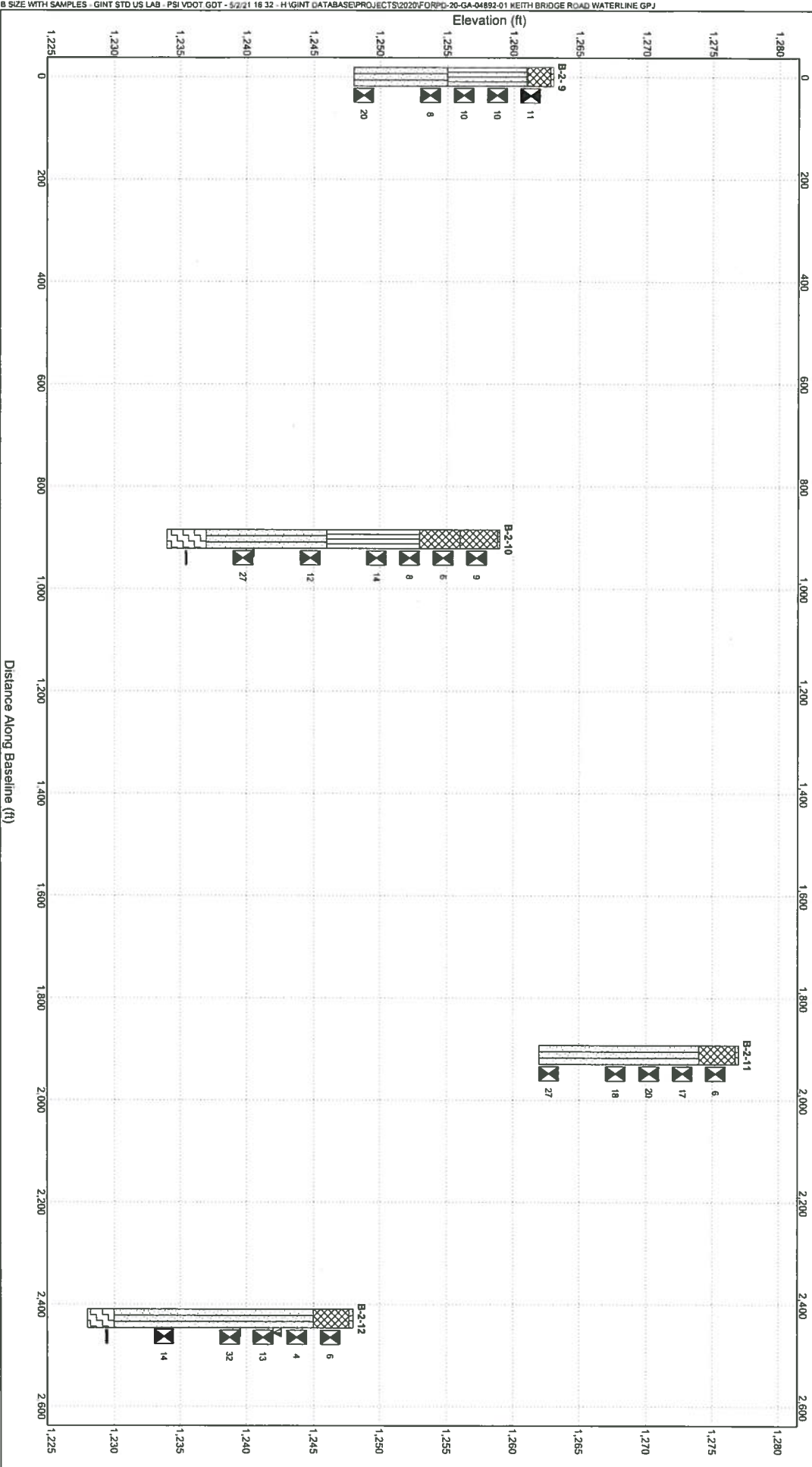
Topsoil  
USCS Silty Sand



Fill (made ground)  
USCS Silt



USCS Sandy Silt  
Partially Weathered Rock





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PROJECT NUMBER FORDP-20-GA-04892-01

PROJECT NAME Keith Bridge Road Pipeline  
PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

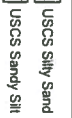
## SUBSURFACE DIAGRAM 4



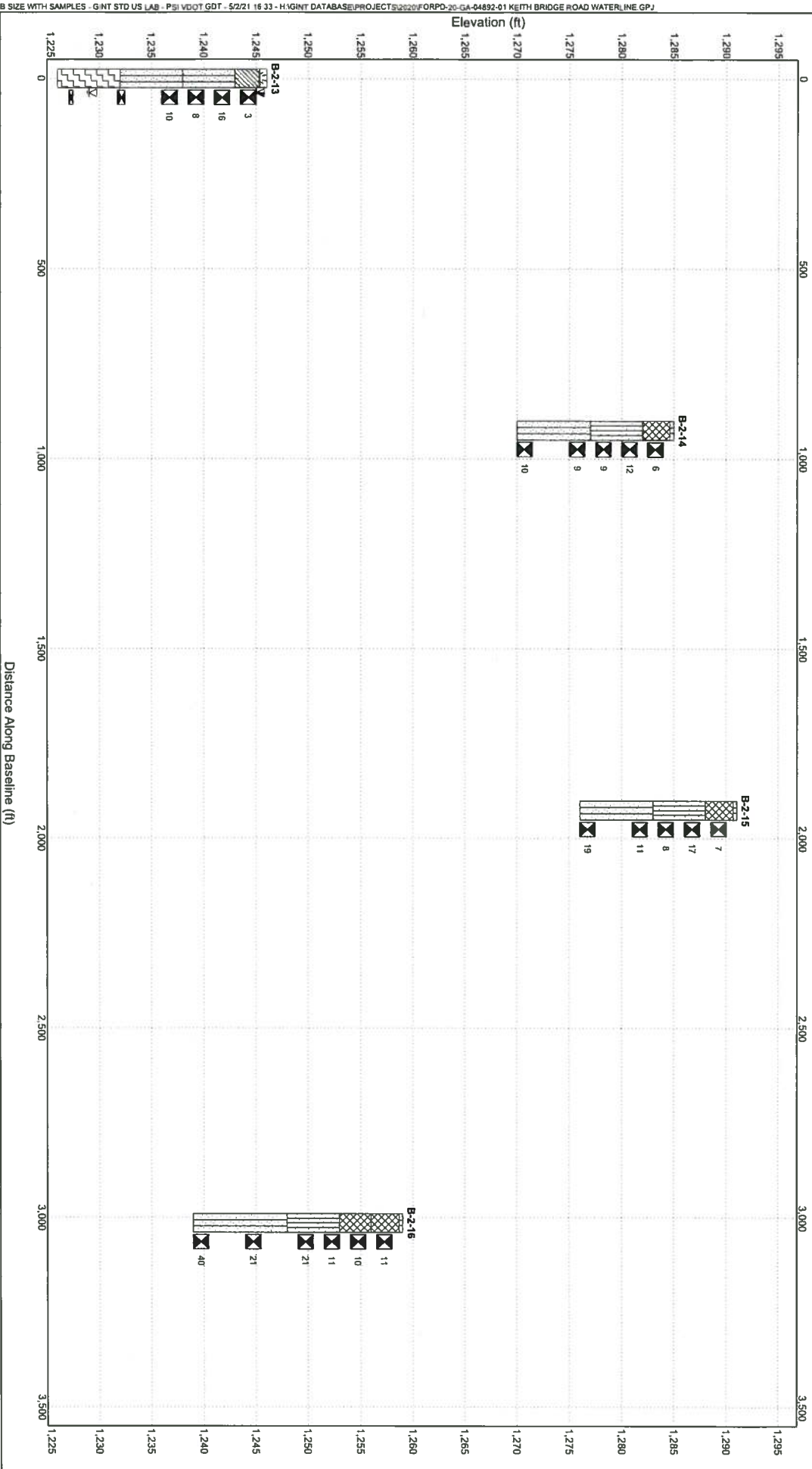
Topsoil  
Partially Weathered Rock



USCS Low Plasticity  
Sandy Clay  
Fill (made ground)



USCS Silty Sand  
USCS Sandy Silt





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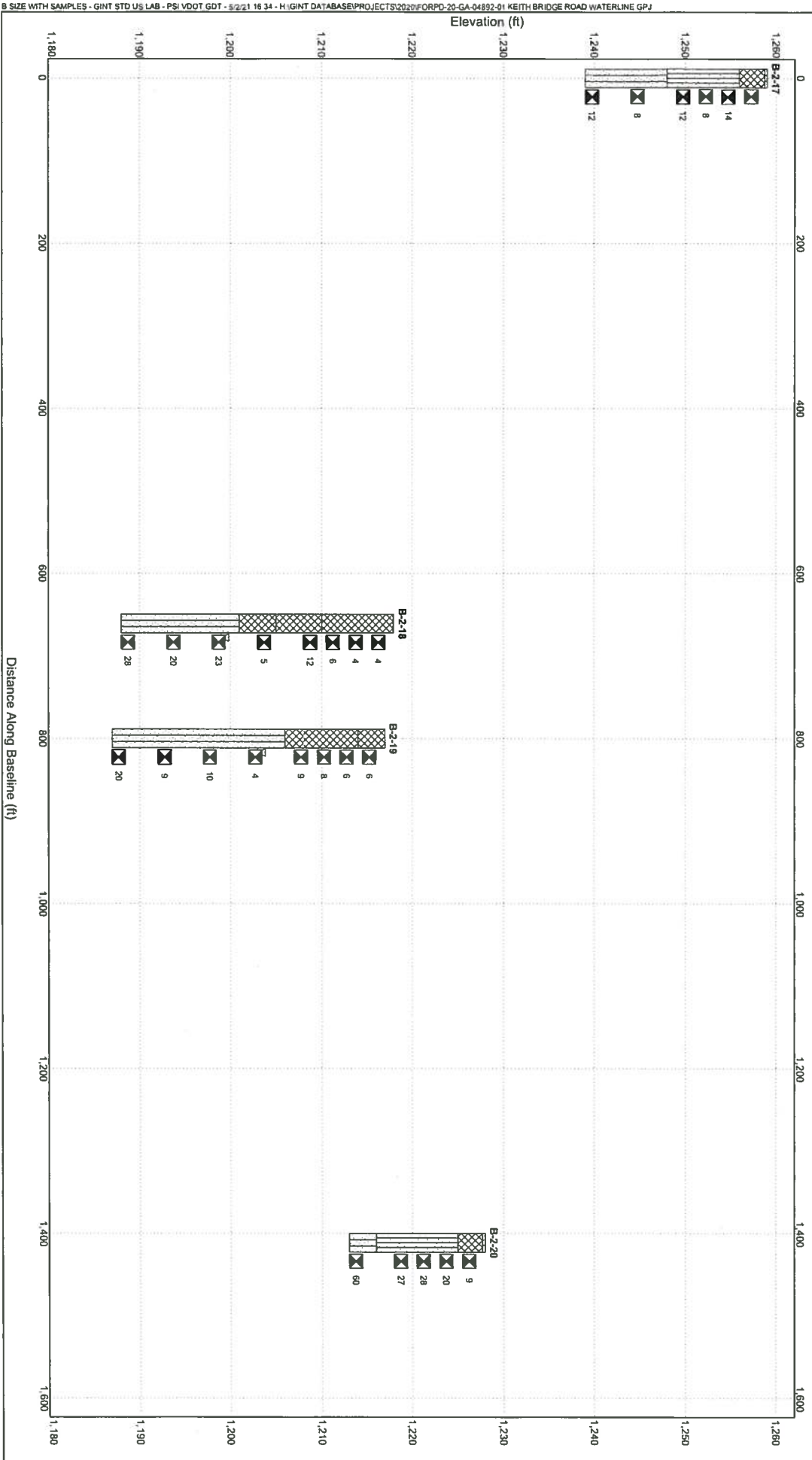
CLIENT Forsyth County

PROJECT NUMBER FORDP-20-GA-04892-01

## SUBSURFACE DIAGRAM 5

PROJECT NAME Keith Bridge Road Pipeline  
PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

Topsoil  
USCS Silty Sand  
Fill (made ground)  
USCS Sandy Silt





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CLIENT Forsyth County

PROJECT NUMBER FORDP-20-GA-04892-01

## SUBSURFACE DIAGRAM 6

PROJECT NAME Keith Bridge Road Pipeline

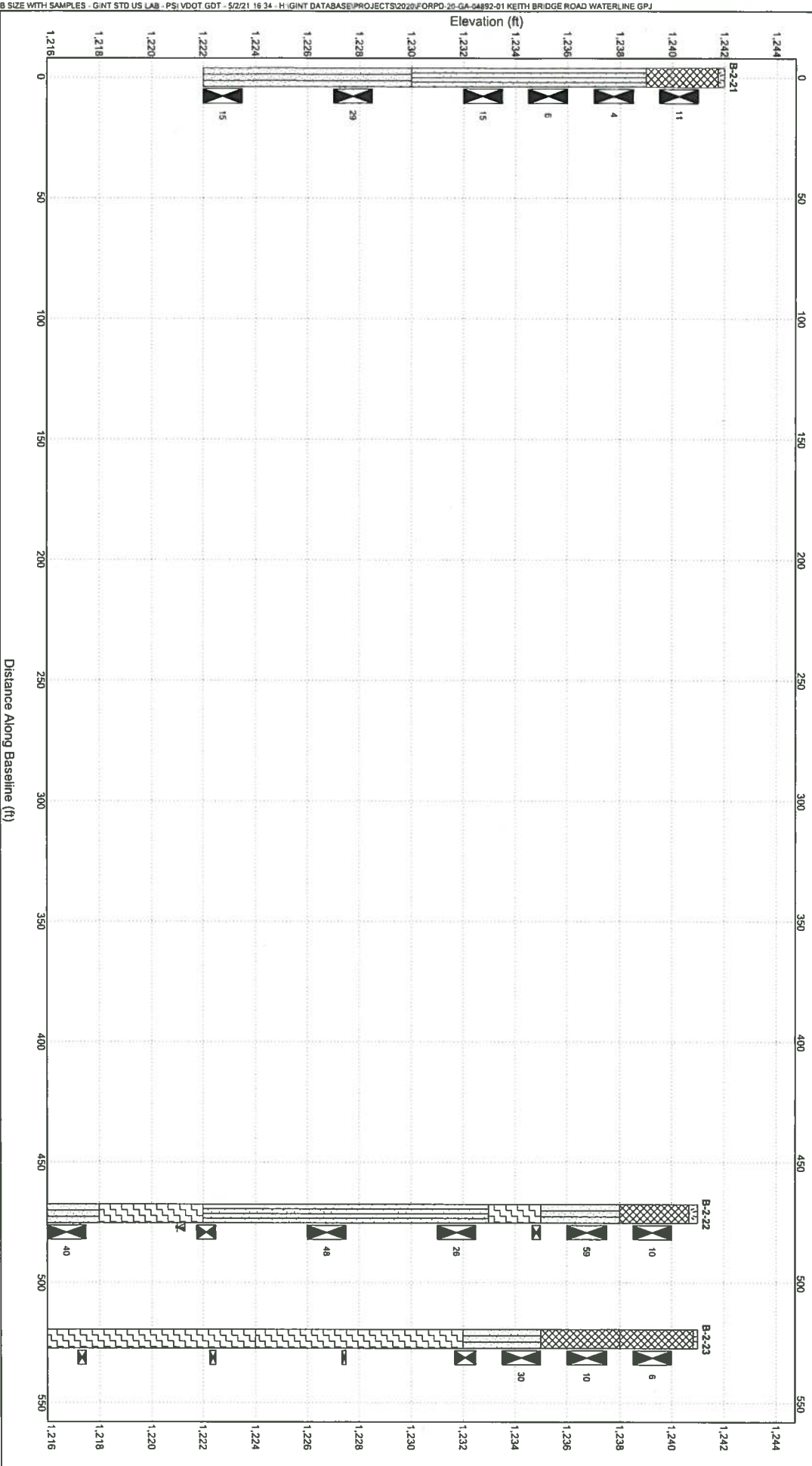
PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

Topsoil

USCS Silty Sand

Fill (made ground)  
Partially Weathered Rock

USCS Sandy Silt





## EXPLORATION PROCEDURES

Twenty-three (23) SPT borings (designated B-2-1 through B-2-23) were drilled at approximate locations indicated on the attached Boring Location Plan (Figure 1). The SPT borings were performed in general accordance with ASTM D 1586. Soil samples obtained during testing were visually evaluated by the Project Engineer and classified according to the visual-manual procedure described in ASTM D 2488. A narrative of field operations is included in The Appendix.

The test locations in the field were determined by the Project Engineer using a handheld GPS unit. The test locations shown on the Boring Location Plan should, therefore, be considered approximate.





## LABORATORY PROCEDURES

### Grain Size (Sieve) Analysis with or without Hydrometer

Grain Size Analysis tests were performed to determine the particle size distribution of selected samples tested. The grain size distribution of soils coarser than a number 200 sieve was determined by passing the samples through a standard set of nested sieves. Materials finer than the number 200 sieves were suspended in water and the grain size distribution computed from the time rate of settlement of the different size particles. Air-dried soil passed through a #200 sieve. 50 grams of that must soak in s/c agent for a minimum of 8 hours. Soil is then put in graduated cylinder with a hydrometer. Readings are taken at specified times. A graph is drawn from data. These tests were similar to those described by ASTM D 421 and D 422. The results are included in The Appendix.

### Liquid and Plastic Limits (Atterberg Limits)

Liquid Limit and Plastic Limit tests aid in the classification of the soils and provide an indication of the soil behavior with moisture change. The Plasticity Index is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid and is the upper limit of the plastic range, as determined in accordance with ASTM D 4318. The Plastic Limit is the moisture content at which the soil begins to lose its plasticity, as determined in accordance with ASTM D 4318. The Plasticity Index is the difference between the Liquid Limit and Plastic Limit. The Liquidity Index is the ratio of the difference between the in-place moisture and the plastic limit to the Plasticity Limit. The data obtained are in The Appendix.

### Moisture Content

The moisture content was determined for selected soil samples obtained in the split spoon sampler. A representative portion of each sample was weighed and then placed in an oven and dried at 110 degrees Centigrade for at least 15 to 16 hours. After removal from the oven, the soil was again weighed. The weight of the moisture lost during drying thus was determined. From this data, the moisture content of the sample was then calculated as the weight of moisture divided by dry weight of the soil, expressed as a percentage. This test was conducted according to ASTM D 2216. The moisture content results are indicated on the attached boring logs.

Moisture content is a useful index of a soil's compressibility. If the soil is to be used as fill, the moisture content may be compared to the range of water content for which proper compaction may be achieved.



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# BORING NUMBER B-2- 1

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/27/2021 COMPLETED 01/28/2021

GROUND ELEVATION 1189 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

▽ AT TIME OF DRILLING 19.00 ft / Elev 1170.00 ft

LOGGED BY Jovon James

CHECKED BY \_\_\_\_\_

AT END OF DRILLING ---

NOTES \_\_\_\_\_

AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
0			Asphalt						PL	MC	LL	
			Sand; some silt, trace clay, some rock and asphalt fragments, loose; red brown (fill)	SPT 1	10	5-5-4 (9)			20	40	60	80
5	1185		Silt; some sand, trace clay, trace mica, firm; red brown	SPT 2	18	2-3-3 (6)						
			Clay; some sandy silt, trace mica, stiff; red brown and orange brown (residuum)	SPT 3	18	5-5-6 (11)						
10	1180		Sand-silty; trace clay, trace mica, firm; orange brown	SPT 4	18	5-6-8 (14)						
15	1175		Silt-clayey; trace sand, trace mica, stiff; red brown to orange brown	SPT 5	18	3-5-5 (10)						
20	1170	▽	Sand-silty; trace clay, trace mica, loose to firm; gray brown	SPT 6	18	4-5-6 (11)						
25	1165											
30	1160			SPT 7	18	3-3-3 (6)						
35	1155			SPT 8	18	3-4-4 (8)						

Boring terminated at 35.0 feet.





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# BORING NUMBER B-2-2

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/28/2021 GROUND ELEVATION 1185 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING ---

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
0	1185		Asphalt									
			Sand; trace clayey silt, trace mica, very loose; red brown (fill)	SPT 1	18	4-5-6 (11)						
5	1180		Silt-sandy; trace clay, trace mica, trace rock fragments, very soft	SPT 2	18	3-3-3 (6)						
				SPT 3	18	2-2-2 (4)						
10	1175			SPT 4	18	2-2-3 (5)						
15	1170		Sand-silty; trace mica, very loose; moist; tan brown and red brown (residuum)	SPT 5	18	1-2-2 (4)						
20	1165		Medium hard to soft, gray, SCHIST, moderately weathered, 57%, Layer RQD = 23, incompetent	RC 1		34 (14)						
25	1160		Soft to medium hard, gray, SCHIST, 40%, Layer RQD = 8, incompetent	RC 2		24 (5)						
30	1155		Medium hard to very soft, gray, SCHIST, 57%, Layer RQD = 8, incompetent	RC 3		34 (5)						
Refusal at 18.5 feet. Boring terminated at 33.5 feet.												

GEOTECH BH PLOTS INCHES REC - DF STD US LAB GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



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# BORING NUMBER B-2-3

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline  
PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia  
DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1195 ft HOLE SIZE \_\_\_\_\_  
DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:  
DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING ---  
LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---  
NOTES \_\_\_\_\_ AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/>
0	1195		Topsoil						
			Sand; some silt, trace clay, some rock fragments, firm; dark brown (fill)	SPT 1	8	3-5-6 (11)			
5	1190		Clay; trace sand, trace silt, trace mica, soft	SPT 2	12	2-2-2 (4)			
				SPT 3	18	3-3-3 (6)			
10	1185		Silt; some sand, trace clay, trace mica, firm to stiff; red brown and gray brown (residuum)	SPT 4	18	4-5-5 (10)			
15	1180			SPT 5	18	3-4-5 (9)			

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2-4

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021

GROUND ELEVATION 1247 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING ---

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_

AT END OF DRILLING ---

NOTES \_\_\_\_\_

AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/> 20 40 60 80
0			Topsoil						
	1245		Silt-sandy; trace clay, trace mica, stiff to very stiff; red brown and orange brown (residuum)	SPT 1	15	3-4-6 (10)			
5			Sand; some silt, trace clay, medium dense; tan brown and dark brown	SPT 2	18	10-12-15 (27)			
	1240		Some rock fragments	SPT 3	15	8-11-12 (23)			
10			Sand (SM); some silt, trace clay, firm	SPT 4	15	4-5-5 (10)			
	1235		Sand-silty; trace clay, trace mica, some rock fragments, dense; orange brown and tan brown	SPT 5	18	10-12-19 (31)			
15									

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2- 5

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1264 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING —

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING —

NOTES \_\_\_\_\_ AFTER DRILLING —

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
0			Topsoil									
	1260		Sand; some silt, trace clay, trace mica, loose; red brown and dark gray (fill)	SPT 1	18	6-5-3 (8)						
5			Clay; some silt, trace sand, firm; red brown and orange brown (residuum)	SPT 2	18	2-3-4 (7)						
	1255		Sand-silty; trace clay, trace mica, trace rock fragments, loose; red brown and orange brown	SPT 3	18	3-3-3 (6)						
10				SPT 4	18	3-4-4 (8)						
	1250											
15				SPT 5	18	4-5-5 (10)						

Boring terminated at 15.0 feet.

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



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# BORING NUMBER B-2- 6

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1248 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING ---

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/> 20 40 60 80
0			Topsoil						
	1245		Sand; some silt, trace mica, some Asphalt and rock fragments, loose; (fill)	SPT 1	18	3-3-3 (6)			
5			Clay; trace silty sand, trace mica, stiff; red brown	SPT 2	18	4-5-5 (10)			
	1240		Silt; trace sand, some clay, trace mica, firm	SPT 3	18	3-4-4 (8)			
10			Sand-silty; trace clay, loose; red brown and orange brown (residuum)	SPT 4	18	4-4-6 (10)			
	1235								
15				SPT 5	18	4-5-5 (10)			

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2-7

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CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021

GROUND ELEVATION 1242 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_

AT END OF DRILLING ---

NOTES \_\_\_\_\_

AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
									PL	MC	LL	
0									20	40	60	80
									□ FINES CONTENT (%) □			
									20	40	60	80
0			Topsoil									
	1240		Sand; some clay, trace silt, trace, loose; (fill)	SPT 1	18	3-5-3 (8)						
5			Silt; trace sand, trace mica, stiff; red brown and tan brown (residium)	SPT 2	18	3-4-5 (9)						
	1235		Sand-silty; some rock fragments, trace mica, loose to medium dense; brown gray	SPT 3	18	4-4-5 (9)						
10				SPT 4	18	4-4-4 (8)						
	1230											
15				SPT 5	18	11-10-13 (23)						
	1225											
20				SPT 6	18	4-5-6 (11)						

Boring terminated at 20.0 feet.

G:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



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# BORING NUMBER B-2-8

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline  
PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia  
DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1235 ft HOLE SIZE \_\_\_\_\_  
DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:  
DRILLING METHOD 4-1/4" Hollow stem auger ☒ AT TIME OF DRILLING 14.00 ft / Elev 1221.00 ft  
LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING \_\_\_\_\_  
NOTES \_\_\_\_\_ AFTER DRILLING \_\_\_\_\_

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	<div>▲ SPT N VALUE ▲</div> <div>20 40 60 80</div> <div>PL MC LL</div> <div>20 40 60 80</div> <div><input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/></div> <div>20 40 60 80</div>
0	1235		Topsoil						
			Silt-sandy; some clay, trace mica, trace asphalt fragments, firm; red brown and dark brown (fill)	SPT 1	18	2-2-3 (5)			
5	1230		Clay-silty; trace sand, trace mica, very soft; red brown	SPT 2	18	2-2-2 (4)			
				SPT 3	18	3-3-3 (6)			
10	1225			SPT 4	18	2-3-3 (6)			
15	1220		Silt; trace clay, trace sand, very soft to soft; (residuum)	SPT 5	6	2-2-2 (4)			
20	1215			SPT 6	3	2-1-1 (2)			
25	1210		Sand-silty; trace clay, trace mica, firm; tan brown	SPT 7	18	3-5-8 (13)			

Boring terminated at 25.0 feet.





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# BORING NUMBER B-2- 9

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1263 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/>
0			Topsoil						
	1260		Clay; trace sand, trace mica, trace rock fragments, stiff; red brown to dark brown (fill)	SPT 1	18	3-5-6 (11)			
5			Silt-sandy; trace clay, trace mica, stiff; tan brown to dark brown (residuum)	SPT 2	18	5-5-5 (10)			
	1255		Orange brown	SPT 3	18	4-4-6 (10)			
10			Sand-silty; trace clay, trace rock fragments, trace mica, loose to firm; red brown and tan brown	SPT 4	18	3-4-4 (8)			
	1250								
15				SPT 5	18	7-9-11 (20)			

Boring terminated at 15.0 feet.





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# BORING NUMBER B-2-10

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2022 GROUND ELEVATION 1259 ft HOLE SIZE \_\_\_\_\_

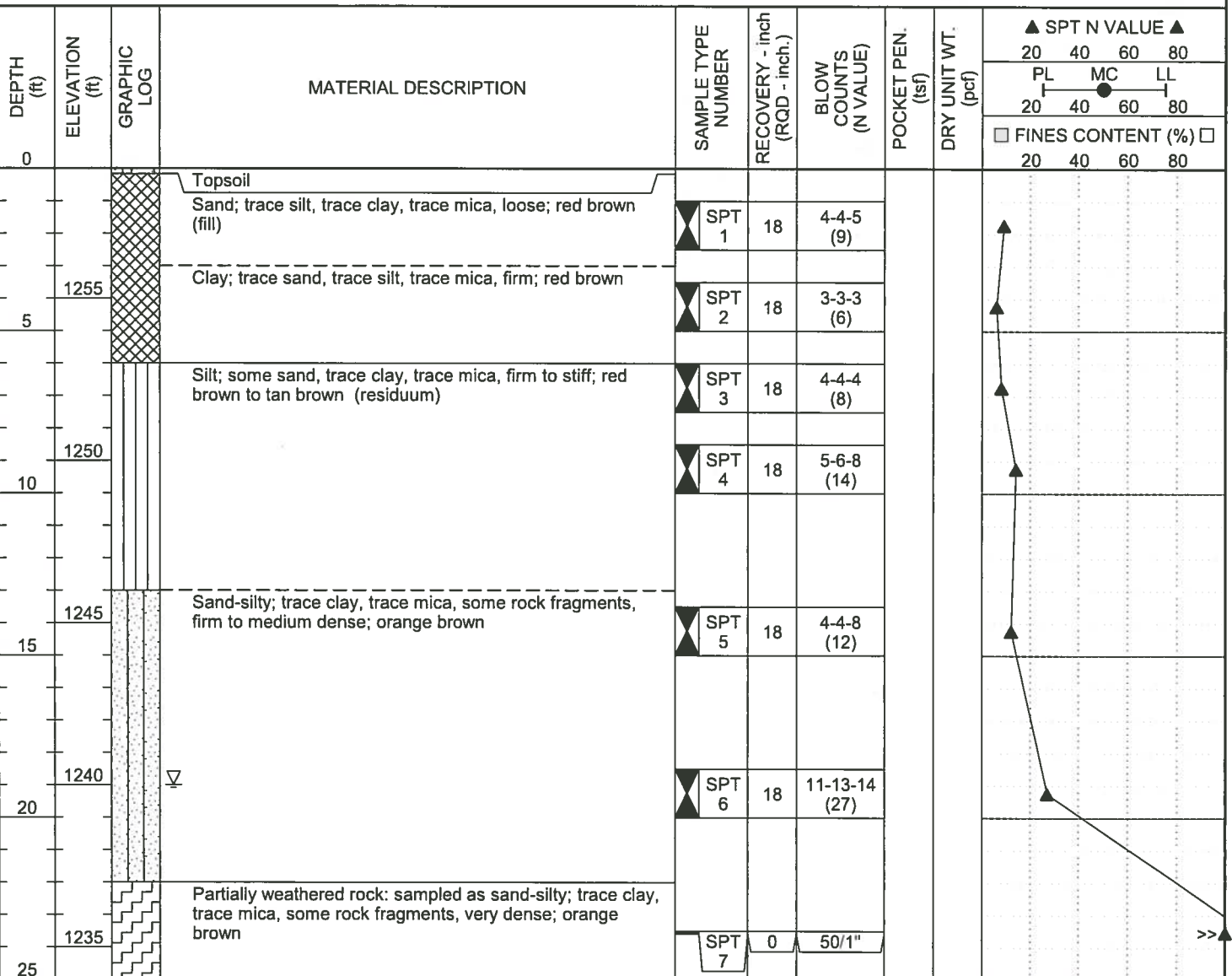
DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger  $\nabla$  AT TIME OF DRILLING 19.00 ft / Elev 1240.00 ft

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING \_\_\_\_\_

NOTES \_\_\_\_\_ AFTER DRILLING \_\_\_\_\_

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ





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# BORING NUMBER B-2-11

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/26/2021 COMPLETED 01/26/2021 GROUND ELEVATION 1277 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/> 20 40 60 80
0			Topsoil						
	1275		Silt; some sand, trace clay, trace rock fragments, soft; red brown; trace mica (fill)	SPT 1	18	3-3-3 (6)			
5			Sand; some silt, trace clay, firm to medium dense; grayish brown and orange brown (residuum)	SPT 2	18	5-7-10 (17)			
	1270			SPT 3	18	4-10-10 (20)			
10			Sand (SM); no silt, some clay, firm to medium dense; grayish brown	SPT 4	18	7-8-10 (18)			
	1265								
15				SPT 5	18	5-12-15 (27)			

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2-12

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CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/25/2021 COMPLETED 01/25/2021

GROUND ELEVATION 1248 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

▽ AT TIME OF DRILLING 9.00 ft / Elev 1239.00 ft

LOGGED BY Jovon James

CHECKED BY \_\_\_\_\_

AT END OF DRILLING —

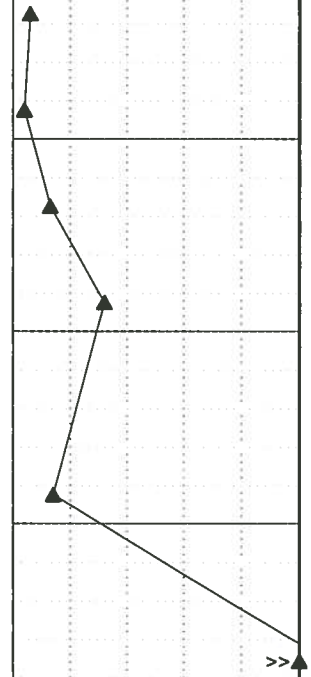
NOTES \_\_\_\_\_

▽ AFTER DRILLING 6.00 ft / Elev 1242.00 ft

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
									PL MC LL			
									20	40	60	80
									□ FINES CONTENT (%) □			
									20	40	60	80
0			Topsoil									
	1245		Sand; some clay, trace silt, trace mica, loose; red brown (fill)	SPT 1	15	3-3-3 (6)						
5			Sand-silty; trace clay, trace mica, very loose to dense; red brown and gray brown (residuum)	SPT 2	15	3-2-2 (4)						
	1240			SPT 3	18	4-6-7 (13)						
10				SPT 4	18	9-12-20 (32)						
	1235											
15			Rock fragments	SPT 5	12	4-7-7 (14)						
	1230											
20			Partially weathered rock: sampled as sand; some silt, trace clay, some rock fragments, very dense; gray	SPT 6	2	50/2"						

Boring terminated at 20.0 feet.





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# BORING NUMBER B-2-13

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CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/25/2021 COMPLETED 01/25/2021 GROUND ELEVATION 1246 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger ∇ AT TIME OF DRILLING 17.00 ft / Elev 1229.00 ft

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ ∇ AFTER DRILLING 1.00 ft / Elev 1245.00 ft Area was flooded

G:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲				FINES CONTENT (%)
									20	40	60	80	
0	1245		Topsoil										
			Clay-sandy; trace silt, trace mica, trace rock fragments, soft; gray and orange brown (residuum)	SPT 1	18	1-1-2 (3)							
5	1240		Sand; some clay, trace silt, some rock fragments, loose to firm; gray and orange brown	SPT 2	15	7-8-8 (16)							
			Some silt, trace clay, trace rock fragments	SPT 3	10	3-4-4 (8)							
10	1235		Sand-silty; trace clay, trace mica, loose; gray brown	SPT 4	18	5-5-5 (10)							
15	1230		Partially weathered rock: sampled as sand-silty; trace clay, some mica, very dense; gray brown	SPT 5	9	22-50/3"							
20				SPT 6	5	50/5"							

Boring terminated at 20.0 feet.



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# BORING NUMBER B-2-14

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/25/2021 COMPLETED 01/25/2021

GROUND ELEVATION 1285 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING ---

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_

AT END OF DRILLING ---

NOTES \_\_\_\_\_

AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/>
0	1285		Topsoil						
			Sand; some sand, trace silt, trace mica, loose; red brown (fill)	SPT 1	18	2-3-3 (6)			
5	1280		Silt-sandy; trace clay, trace mica, stiff; red brown and gray brown (residuum)	SPT 2	18	4-6-6 (12)			
				SPT 3	10	4-4-5 (9)			
10	1275		Sand-silty; loose; orange brown and gray brown	SPT 4	18	3-4-5 (9)			
15	1270		Tan brown	SPT 5	18	4-5-5 (10)			

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2-15

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/25/2021 COMPLETED 01/25/2021

GROUND ELEVATION 1291 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James

CHECKED BY \_\_\_\_\_

AT END OF DRILLING ---

NOTES \_\_\_\_\_

AFTER DRILLING ---

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/>
0	1290		Topsoil						
			Clay; trace silty sand, trace rock fragments, trace wood, firm; red brown (fill)	SPT 1	15	1-2-5 (7)			
5	1285		Silt-sandy; trace clay, trace mica, firm to very stiff; red brown and gray brown (residuum)	SPT 2	18	4-8-9 (17)			
				SPT 3	18	3-4-4 (8)			
10	1280		Sand-silty; trace clay, trace mica, firm; red brown and tan brown	SPT 4	18	4-5-6 (11)			
15			Some rock fragments; tan brown and dark brown	SPT 5	18	5-8-11 (19)			

Boring terminated at 15.0 feet.



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# BORING NUMBER B-2-16

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/25/2021 COMPLETED 01/25/2021

GROUND ELEVATION 1259 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING -- not encountered

LOGGED BY Jovon James

CHECKED BY \_\_\_\_\_

AT END OF DRILLING --

NOTES \_\_\_\_\_

AFTER DRILLING --

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 □ FINES CONTENT (%) □ 20 40 60 80
0			Topsoil						
			Clay-sandy; trace silt, trace mica, trace rock fragments, stiff; red brown (fill)	SPT 1	12	3-5-6 (11)			
5	1255		Silt; some sand, trace clay, trace mica, stiff; red brown	SPT 2	18	4-5-5 (10)			
			Silt; trace sand, trace clay, trace mica, stiff to very stiff; (residuum)	SPT 3	10	3-4-7 (11)			
10	1250			SPT 4	18	9-10-11 (21)			
			Sand-silty; trace mica, medium dense to dense; red brown and orange brown						
15	1245			SPT 5	18	4-8-13 (21)			
20	1240			SPT 6	18	9-17-23 (40)			

Boring terminated at 20.0 feet.





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# BORING NUMBER B-2-17

PAGE 1 OF 1

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/22/2021

GROUND ELEVATION 1259 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers

GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger

AT TIME OF DRILLING — not encountered

LOGGED BY Jovon James

CHECKED BY \_\_\_\_\_

AT END OF DRILLING —

NOTES \_\_\_\_\_

AFTER DRILLING —

G:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	<div>▲ SPT N VALUE ▲</div> <div>20 40 60 80</div> <div>PL MC LL</div> <div>20 40 60 80</div> <div>□ FINES CONTENT (%) □</div> <div>20 40 60 80</div>
0			Topsoil						
			Silt; some sand, trace mica, trace rock fragments, soft; red brown (fill)	SPT 1	18	3-4-3 (7)			
5	1255		Sand (SM); some silt, trace clay, trace mica, firm to loose; red brown and tan brown (residuum)	SPT 2	18	4-7-7 (14)			
				SPT 3	18	3-4-4 (8)			
10	1250			SPT 4	18	4-6-6 (12)			
			Sand-silty; trace mica, trace, loose to firm; tan brown						
15	1245			SPT 5	18	4-4-4 (8)			
20	1240			SPT 6	18	5-6-6 (12)			

Boring terminated at 20.0 feet.





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# BORING NUMBER B-2-18

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline  
PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia  
DATE STARTED 01/22/2021 COMPLETED 01/22/2021 GROUND ELEVATION 1218 ft HOLE SIZE \_\_\_\_\_  
DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:  
DRILLING METHOD 4-1/4" Hollow stem auger ∇ AT TIME OF DRILLING 19.00 ft / Elev 1199.00 ft  
LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING \_\_\_\_\_  
NOTES \_\_\_\_\_ AFTER DRILLING \_\_\_\_\_

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:28 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	<div>▲ SPT N VALUE ▲</div> <div>20 40 60 80</div> <div>PL MC LL</div> <div>20 40 60 80</div> <div>▣ FINES CONTENT (%) ▣</div> <div>20 40 60 80</div>
0			Topsoil						
	1215		Silt; some sand, some clay, trace mica, soft; red brown and black (fill)	SPT 1	18	2-2-2 (4)			
5			Trace rock fragments	SPT 2	18	2-2-2 (4)			
	1210		Clay; some sand, trace mica, trace rock fragments, stiff to stiff	SPT 3	18	2-3-3 (6)			
10				SPT 4	18	4-6-6 (12)			
	1205		Silt; some sand, trace clay, trace mica, firm; red brown	SPT 5	15	2-2-3 (5)			
15									
	1200		Sand; trace silt, some rock fragments, firm to medium dense; tan brown (residuum)	SPT 6	12	7-11-12 (23)			
20									
	1195		Silty; trace clay, some rock fragments, trace mica; red brown and gray	SPT 7	8	7-12-8 (20)			
25									
	1190								
30				SPT 8	12	10-12-16 (28)			

Boring terminated at 30.0 feet.



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# BORING NUMBER B-2-19

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/22/2021 GROUND ELEVATION 1217 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger  $\nabla$  AT TIME OF DRILLING 14.00 ft / Elev 1203.00 ft

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING \_\_\_\_\_

NOTES \_\_\_\_\_ AFTER DRILLING \_\_\_\_\_

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	<div>▲ SPT N VALUE ▲</div> <div>20 40 60 80</div> <div>PL MC LL</div> <div>20 40 60 80</div> <div>FINES CONTENT (%)</div> <div>20 40 60 80</div>
0			Clay; some sand, some silt, some rock fragments, firm; (fill)						
	1215			SPT 1	18	3-3-3 (6)			
5			Silt; some sand, some clay, trace mica, firm to stiff; red brown and black	SPT 2	18	2-3-3 (6)			
	1210		Tan brown and orange brown	SPT 3	18	4-4-4 (8)			
10			Trace clay; red brown	SPT 4	18	3-4-5 (9)			
	1205		Sand-silty; very loose to firm; red brown and tan brown (residuum)						
15				SPT 5	16	3-2-2 (4)			
	1200								
20			Brown gray and white	SPT 6	18	4-5-5 (10)			
	1195								
25			Some rock fragments; red brown and white	SPT 7	18	3-4-5 (9)			
	1190								
30				SPT 8	18	4-9-11 (20)			

Boring terminated at 30.0 feet.



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# BORING NUMBER B-2-20

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/22/2021 GROUND ELEVATION 1228 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/>
0			Topsoil						
	1225		Sand; some silt, trace clay, trace mica, loose; red brown and black (fill)	SPT 1	18	3-4-5 (9)			
5			Sand; some silt, trace clay, trace mica, medium dense; orange brown (residuum)	SPT 2	18	8-9-11 (20)			
	1220			SPT 3	18	8-12-16 (28)			
10				SPT 4	18	9-12-15 (27)			
	1215		Sand-silty; trace clay, trace mica, some rock fragments, very dense; orange brown						
15				SPT 5	18	11-28-32 (60)			

Boring terminated at 15.0 feet.

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



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# BORING NUMBER B-2-21

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/22/2021 GROUND ELEVATION 1242 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲			
									20	40	60	80
									PL	MC	LL	
									20	40	60	80
									□ FINES CONTENT (%) □			
									20	40	60	80
0			Topsoil									
	1240		Sand; some clay, trace silt, trace mica, firm; red brown (fill)	SPT 1	18	3-5-6 (11)						
5			Silt; some sand, trace clay, trace mica, soft to stiff; orange brown (residuum)	SPT 2	18	2-2-2 (4)						
	1235			SPT 3	15	2-3-3 (6)						
10				SPT 4	16	4-7-8 (15)						
	1230		Sand-silty; trace clay, trace mica, some rock fragments, firm to medium dense; orange brown and red brown	SPT 5	18	10-12-17 (29)						
15												
	1225			SPT 6	15	6-7-8 (15)						
20												

Boring terminated at 20.0 feet.

GEOTECH.BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



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# BORING NUMBER B-2-22

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/22/2021 GROUND ELEVATION 1241 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger  $\nabla$  AT TIME OF DRILLING 24.00 ft / Elev 1217.00 ft

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_  $\nabla$  AFTER DRILLING 20.00 ft / Elev 1221.00 ft

GEOTECH BH PLOTS INCHES REC. - DF STD US LAB.GDT. - 10/2/21 14:26 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/> 20 40 60 80
0	1240		Topsoil						
			Clay; some sand, trace silt, trace mica, stiff; red brown (fill)	SPT 1	12	3-4-6 (10)			
5			Sand; some clay, trace silt, trace mica, very dense; (residuum)	SPT 2	16	14-45-14 (59)			
	1235		Partially weathered rock: sampled as sand; trace silt, trace mica, trace rock fragments, very dense	SPT 3	4	50/4"			
10			Silt-sandy; trace clay, trace mica, some rock fragments, very stiff to hard; red brown and white	SPT 4	15	5-10-16 (26)			
	1230								
15			Partially weathered rock: sampled as sand; some silt, trace clay, trace rock fragments, very dense; red brown and gray brown	SPT 5	15	19-22-26 (48)			
	1225								
20			Partially weathered rock: sampled as sand; some silt, trace clay, trace rock fragments, very dense; red brown and gray brown	SPT 6	8	25-50/3"			
	1220								
25			Sand-silty; trace mica, some rock fragments, trace clay, dense; tan brown and orange brown	SPT 7	18	14-18-22 (40)			

Boring terminated at 25.0 feet.



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# BORING NUMBER B-2-23

PAGE 1 OF 1

CLIENT Forsyth County PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01 PROJECT LOCATION Forsyth County, GA, Cumming, Georgia

DATE STARTED 01/22/2021 COMPLETED 01/28/2021 GROUND ELEVATION 1241 ft HOLE SIZE \_\_\_\_\_

DRILLING CONTRACTOR Kilman Brothers GROUND WATER LEVELS:

DRILLING METHOD 4-1/4" Hollow stem auger AT TIME OF DRILLING --- not encountered

LOGGED BY Jovon James CHECKED BY \_\_\_\_\_ AT END OF DRILLING ---

NOTES \_\_\_\_\_ AFTER DRILLING ---

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY - inch (RQD - inch.)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 PL MC LL 20 40 60 80 <input type="checkbox"/> FINES CONTENT (%) <input type="checkbox"/> 20 40 60 80
0	1240		Topsoil						
			Sand; some clay, trace silt, loose; red brown (fill)	SPT 1	18	3-3-3 (6)			
5			Clay; trace silty sand, trace mica, stiff; red brown	SPT 2	18	4-4-6 (10)			
	1235		Sand; some silty clay, trace rock fragments, trace mica, medium dense to very dense; orange brown (residuum)	SPT 3	18	11-13-17 (30)			
10			Partially weathered rock: sampled as sand; some silt, trace clay, some rock fragments, very dense; orange brown	SPT 4	10	21-50/4"			
	1230								
15				SPT 5	2	50/2"			
	1225								
20			Partially weathered rock: sampled as sand; trace silt, some rock fragments, very dense; gray	SPT 6	3	50/3"			
	1220								
25				SPT 7	4	50/4"			

Boring terminated at 25.0 feet.

GEOTECH BH PLOTS INCHES REC - DF STD US LAB.GDT - 10/2/21 14:26 - H:\GINT\DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ





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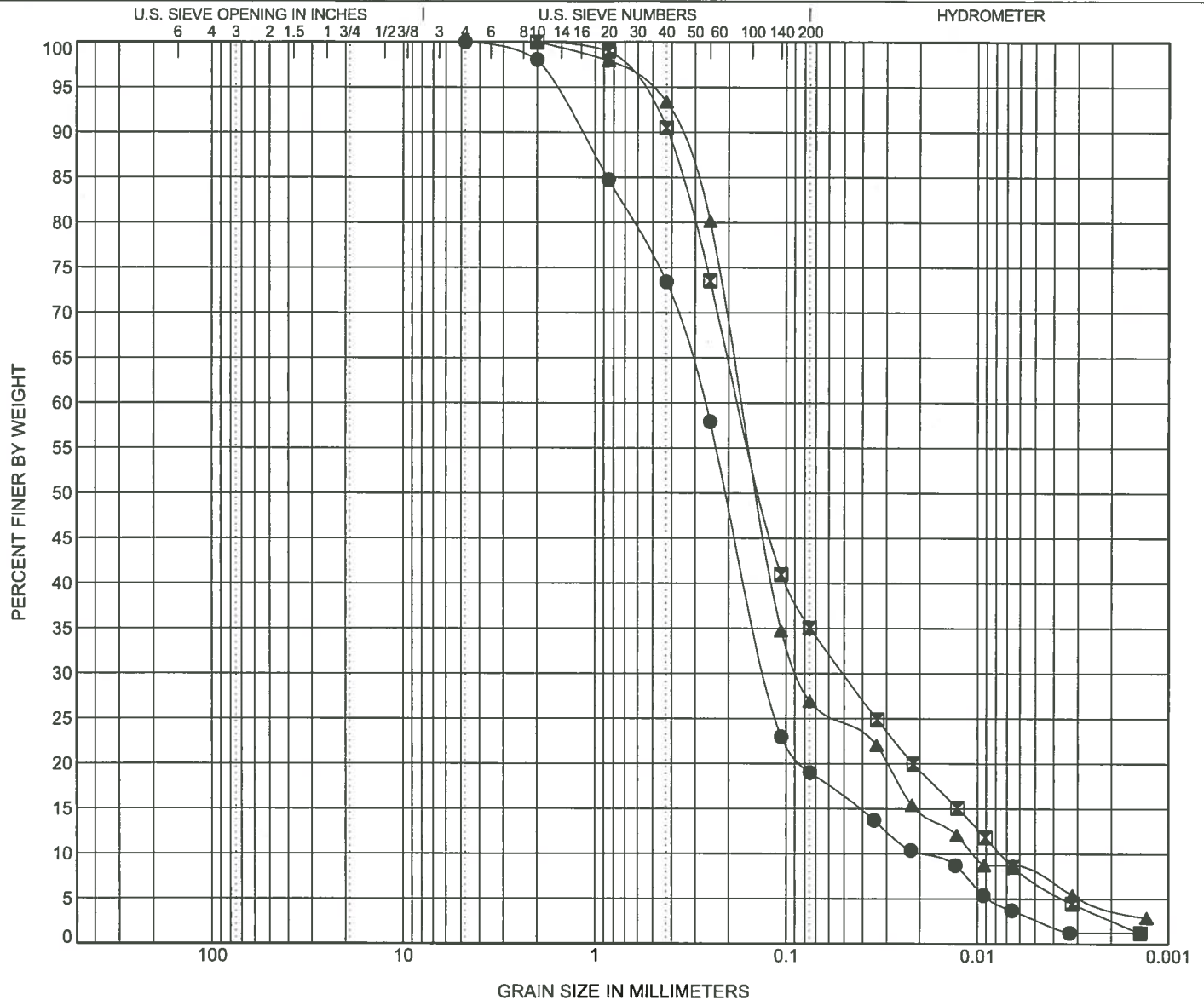
# GRAIN SIZE DISTRIBUTION

CLIENT Forsyth County

PROJECT NAME Keith Bridge Road Pipeline

PROJECT NUMBER FORDP-20- GA-04892-01

PROJECT LOCATION Forsyth County, GA, Cumming, Georgia



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE		DEPTH	Classification					LL	PL	PI	Cc	Cu
●	B-2- 4	8.5	Sand, some silt, trace clay, dark brown (SM)								3.00	13.64
☒	B-2-11	8.5	Sand, some silt, trace clay, gray (SM)								1.91	23.21
▲	B-2-17	6.0	Sand, some silt, trace clay, brown (SM)								4.15	16.38
BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay			
●	B-2- 4	8.5	4.75	0.268	0.126	0.02	0.0	81.0	16.3	2.7		
☒	B-2-11	8.5	2	0.175	0.05	0.008	0.0	64.9	28.0	7.0		
▲	B-2-17	6.0	2	0.171	0.086	0.01	0.0	73.1	19.4	7.5		

GRAIN SIZE - GINT STD. US LAB. GDT - 5/2/21 17:27 - H:\GINT DATABASE\PROJECTS\2020\FORDP-20-GA-04892-01 KEITH BRIDGE ROAD WATERLINE.GPJ



## ANALYTICAL ENVIRONMENTAL SERVICES, INC.

February 08, 2021

Mahvand Saleki  
United Consulting Group Inc.

625 Holcomb Bridge Rd  
Norcross GA 30071

RE: Keith Bridge Road Water Main Project

Dear Mahvand Saleki:

Order No: 2102071

Analytical Environmental Services, Inc. received 5 samples on 2/1/2021 2:07:00 PM  
for the analyses presented in following report.

"No problems were encountered during the analyses except as noted in the Case Narrative or by qualifiers in the report or QC Summary. Additionally, all results for the associated Quality Control samples were within EPA and/or AES established limits.

AES's accreditations are as follows:

-NELAP/State of Florida Laboratory ID E87582 for analysis of Non-Potable Water, Solid & Chemical Materials, Air & Emissions Volatile Organics, and Drinking Water Microbiology & Metals, effective 07/01/20-06/30/21.

State of Georgia, Department of Natural Resources ID #800 for analysis of Drinking Water Metals, effective through 06/30/21 and Total Coliforms/ E. coli, effective 04/20/20-04/24/23.

-AIHA-LAP, LLC Laboratory ID: 100671 for Industrial Hygiene samples (Metals and PCM Asbestos), Environmental Lead (Paint, Soil, Dust Wipes, Air), and Environmental Microbiology (Fungal) Direct Examination, effective until 11/01/21.

These results relate only to the items tested as received. This report may only be reproduced in full.

If you have any questions regarding these test results, please feel free to call.

Sincerely,

Ioana Pacurar  
Project Manager



# SAMPLE CHAIN-OF-CUSTODY RECORD

2102071

UNITED CONSULTING  
625 Holcomb Bridge  
NORCROSS, GEORGIA 30071  
(770) 209-0029 FAX (770) 582-2895  
www.unitedconsulting.com

PROJECT NAME: Keith Bridge Road Water Main Project										Project#:		ANALYSIS (Indicate origin test)									
CONTACT: Mahvand Saleki										PROJECT MANAGER		FORPPD20GA0489201									
TAT of DUE DATE: 2/8/2021										RECEIVING LAB											
PHONE#										Tom Tye											
(770)582-2843										A/E/S											
SAMPLE NUMBER	SAMPLE DESCRIPTION	Date Shipped	Sample Name	Preservative	# / Size of Cont.	pH	Resistivity	Chloride	Sulfate												
B-2-4@6-7.5'	Soil	2/1/2021	S	ICE	8 Oz.	X	X	X	X												
B-2-9@6-7.5'	Soil	2/1/2021	S	ICE	8 Oz.	X	X	X	X												
B-2-14@6-7.5'	Soil	2/1/2021	S	ICE	8 Oz.	X	X	X	X												
B-2-17@8.5-10'	Soil	2/1/2021	S	ICE	8 Oz.	X	X	X	X												
B-2-22@6-7.5'	Soil	2/1/2021	S	ICE	8 Oz.	X	X	X	X												
SAMPLES RELINQUISHED BY		DATE/TIME	SAMPLES ACCEPTED BY		DATE/TIME	COMMENTS															
FHUC VO		02/01/21	[Signature]		2/1/21	14:07															
		14:06																			

**Client:** United Consulting Group Inc.  
**Project:** Keith Bridge Road Water Main Project  
**Lab ID:** 2102071

**Case Narrative**

pH Analysis by SW9045D:

Samples for pH analysis by Method SW9045D were received and analyzed outside holding time requirement of "immediate or 15 minutes."

Additional Testing:

At the request of Mahvand Saleki with United Consulting via e-mail on 2/3/2021, all samples were additionally analyzed for Sulfide and Redox.

Oxidation/Reduction Potential in Soil ASTM G200-9:

Samples for Oxidation/Reduction Potential in Soil ASTM G200-9 were received and analyzed outside holding time requirement of "immediate or 15 minutes."

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-2-4@6-7.5'
<b>Project Name:</b>	Keith Bridge Road Water Main Project	<b>Collection Date:</b>	2/1/2021
<b>Lab ID:</b>	2102071-001	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Sulfide by SW9030B/9034</b>				<b>(SW9030B)</b>				
Sulfide	47.6	47.6		mg/Kg-dry	309854	1	02/03/2021 14:50	BW
<b>Soil Resistivity SW9050A</b>				<b>(SW9050)</b>				
Resistivity (@100% Moisture Saturation)	24900	0		ohms*cm	309902	1	02/05/2021 08:34	CB
<b>Oxidation/Reduction Potential by ASTM G200-9</b>								
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>				<b>(SW9045D)</b>				
pH	5.57	0.01	H	pH Units	309816	1	02/03/2021 15:06	CB
<b>ION SCAN SW9056A</b>				<b>(SW9056A)</b>				
Chloride	52	12		mg/Kg-dry	309740	1	02/03/2021 16:02	IP
Sulfate	BRL	12		mg/Kg-dry	309740	1	02/03/2021 16:02	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	18.3	0		wt%	R445638	1	02/02/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-2-9@6-7.5'
<b>Project Name:</b>	Keith Bridge Road Water Main Project	<b>Collection Date:</b>	2/1/2021
<b>Lab ID:</b>	2102071-002	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Sulfide by SW9030B/9034 (SW9030B)</b>								
Sulfide	43.1	43.1		mg/Kg-dry	309854	1	02/03/2021 14:50	BW
<b>Soil Resistivity SW9050A (SW9050)</b>								
Resistivity (@100% Moisture Saturation)	22300	0		ohms*cm	309902	1	02/05/2021 08:34	CB
<b>Oxidation/Reduction Potential by ASTM G200-9</b>								
Oxidation-Reduction Potential	270	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	230	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	200	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D (SW9045D)</b>								
pH	5.37	0.01	H	pH Units	309816	1	02/03/2021 15:09	CB
<b>ION SCAN SW9056A (SW9056A)</b>								
Chloride	11	11		mg/Kg-dry	309740	1	02/03/2021 17:44	IP
Sulfate	13	11		mg/Kg-dry	309740	1	02/03/2021 17:44	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	10.8	0		wt%	R445638	1	02/02/2021 00:00	JW

**Qualifiers:**

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- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-2-14@6-7.5'
<b>Project Name:</b>	Keith Bridge Road Water Main Project	<b>Collection Date:</b>	2/1/2021
<b>Lab ID:</b>	2102071-003	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Sulfide by SW9030B/9034</b>		<b>(SW9030B)</b>						
Sulfide	BRL	51.2		mg/Kg-dry	309854	1	02/03/2021 14:50	BW
<b>Soil Resistivity SW9050A</b>		<b>(SW9050)</b>						
Resistivity (@100% Moisture Saturation)	17800	0		ohms*cm	309902	1	02/05/2021 08:34	CB
<b>Oxidation/Reduction Potential by ASTM G200-9</b>								
Oxidation-Reduction Potential	190	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	210	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	180	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D</b>		<b>(SW9045D)</b>						
pH	5.15	0.01	H	pH Units	309816	1	02/03/2021 15:10	CB
<b>ION SCAN SW9056A</b>		<b>(SW9056A)</b>						
Chloride	BRL	13		mg/Kg-dry	309740	1	02/03/2021 18:48	IP
Sulfate	53	13		mg/Kg-dry	309740	1	02/03/2021 18:48	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	23.4	0		wt%	R445638	1	02/02/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-2-17@8.5-10'
<b>Project Name:</b>	Keith Bridge Road Water Main Project	<b>Collection Date:</b>	2/1/2021
<b>Lab ID:</b>	2102071-004	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Sulfide by SW9030B/9034 (SW9030B)</b>								
Sulfide	BRL	46.2		mg/Kg-dry	309854	1	02/03/2021 14:50	BW
<b>Soil Resistivity SW9050A (SW9050)</b>								
Resistivity (@100% Moisture Saturation)	21600	0		ohms*cm	309902	1	02/05/2021 08:34	CB
<b>Oxidation/Reduction Potential by ASTM G200-9</b>								
Oxidation-Reduction Potential	150	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	160	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	140	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D (SW9045D)</b>								
pH	5.34	0.01	H	pH Units	309816	1	02/03/2021 15:13	CB
<b>ION SCAN SW9056A (SW9056A)</b>								
Chloride	12	12		mg/Kg-dry	309740	1	02/03/2021 19:04	IP
Sulfate	55	12		mg/Kg-dry	309740	1	02/03/2021 19:04	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	17.5	0		wt%	R445638	1	02/02/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

<b>Client:</b>	United Consulting Group Inc.	<b>Client Sample ID:</b>	B-2-22@6-7.5'
<b>Project Name:</b>	Keith Bridge Road Water Main Project	<b>Collection Date:</b>	2/1/2021
<b>Lab ID:</b>	2102071-005	<b>Matrix:</b>	Soil

Analyses	Result	Reporting Limit	Qual	Units	BatchID	Dilution Factor	Date Analyzed	Analyst
<b>Sulfide by SW9030B/9034 (SW9030B)</b>								
Sulfide	BRL	45.2		mg/Kg-dry	309854	1	02/03/2021 14:50	BW
<b>Soil Resistivity SW9050A (SW9050)</b>								
Resistivity (@100% Moisture Saturation)	29500	0		ohms*cm	309902	1	02/05/2021 08:34	CB
<b>Oxidation/Reduction Potential by ASTM G200-9</b>								
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
Oxidation-Reduction Potential	BRL	1.0	H	mV	R445978	1	02/04/2021 12:29	CB
<b>Laboratory Hydrogen Ion (pH) SW9045D (SW9045D)</b>								
pH	5.37	0.01	H	pH Units	309816	1	02/03/2021 15:14	CB
<b>ION SCAN SW9056A (SW9056A)</b>								
Chloride	BRL	12		mg/Kg-dry	309740	1	02/03/2021 19:20	IP
Sulfate	BRL	12		mg/Kg-dry	309740	1	02/03/2021 19:20	IP
<b>PERCENT MOISTURE D2216</b>								
Percent Moisture	14.8	0		wt%	R445638	1	02/02/2021 00:00	JW

**Qualifiers:**

- \* Value exceeds maximum contaminant level
- BRL Below reporting limit
- H Holding times for preparation or analysis exceeded
- N Analyte not NELAC certified
- B Analyte detected in the associated method blank
- > Greater than Result value

- E Estimated (value above quantitation range)
- S Spike Recovery outside limits due to matrix
- Narr See case narrative
- F Analyzed in the lab which is a deviation from the method
- < Less than Result value
- J Estimated value detected below Reporting Limit

1. Client Name: **United Consulting Group Inc.**

AES Work Order Number: **2102071**

2. Carrier: FedEx ☐ UPS ☐ USPS ☐ Client ☒ Courier ☐ Other ☐

	Yes	No	N/A	Details			Comments
3. Shipping container/cooler received in good condition?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		damaged <input type="checkbox"/>	leaking <input type="checkbox"/>	other <input type="checkbox"/>
4. Custody seals present on shipping container?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
5. Custody seals intact on shipping container?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
6. Temperature blanks present?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
7. Cooler temperature(s) within limits of 0-8°C? [See Item 13 and 14 for temperature recordings.]	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		Cooling initiated for recently collected samples / ice present <input type="checkbox"/>		
8. Chain of Custody (COC) present?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
9. Chain of Custody signed, dated, and timed when relinquished and received?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
10. Sampler name and/or signature on COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
11. Were all samples received within holding time?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
12. TAT marked on the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		If no TAT indicated, proceeded with standard TAT per Terms & Conditions. <input type="checkbox"/>		

13. Cooler 1 Temperature 3.1 °C Cooler 2 Temperature °C Cooler 3 Temperature °C Cooler 4 Temperature °C  
 14. Cooler 5 Temperature °C Cooler 6 Temperature °C Cooler 7 Temperature °C Cooler 8 Temperature °C

15. Comments: \_\_\_\_\_

	Yes	No	N/A	Details			Comments
16. Were sample containers intact upon receipt?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
17. Custody seals present on sample containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
18. Custody seals intact on sample containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
19. Do sample container labels match the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		incomplete info <input type="checkbox"/>	illegible <input type="checkbox"/>	
					no label <input type="checkbox"/>	other <input type="checkbox"/>	
20. Are analyses requested indicated on the COC?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
21. Were all of the samples listed on the COC received?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		samples received but not listed on COC <input type="checkbox"/>		
					samples listed on COC not received <input type="checkbox"/>		
22. Was the sample collection date/time noted?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
23. Did we receive sufficient sample volume for indicated analyses?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
24. Were samples received in appropriate containers?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
25. Were VOA samples received without headspace (< 1/4" bubble)?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
26. Were trip blanks submitted?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>		listed on COC <input type="checkbox"/>	not listed on COC <input type="checkbox"/>	

27. Comments: \_\_\_\_\_

	Yes	No	N/A	Details			Comments
28. Have containers needing chemical preservation been checked? *	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
29. Containers meet preservation guidelines?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				
30. Was pH adjusted at Sample Receipt?	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>				

This section only applies to samples where pH can be checked at Sample Receipt. I certify that I have completed sections 16-27 (dated initials). BH 2/1/21

\* Note: Certain analyses require chemical preservation but must be checked in the laboratory and not upon Sample Receipt such as Coliforms, VOCs and Oil & Grease/TPH. I certify that I have completed sections 28-30 (dated initials). BH 2/1/21

This also excludes metals by EPA 200.7, 200.8 and 245.1 which will be verified between 16 and 24 hours after preservation.



**Client:** United Consulting Group Inc.  
**Project Name:** Keith Bridge Road Water Main Project  
**Lab Order:** 2102071

**Dates Report**

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Sulfide		2/3/2021 2:50:00PM	02/03/2021
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		2/2/2021 11:00:00AM	02/03/2021
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Soil Resistivity		2/2/2021 4:00:00PM	02/05/2021
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	ION SCAN		2/2/2021 5:12:13PM	02/03/2021
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	PERCENT MOISTURE			02/02/2021
2102071-001A	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-001B	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-001C	B-2-4@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Sulfide		2/3/2021 2:50:00PM	02/03/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		2/2/2021 11:00:00AM	02/03/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Soil Resistivity		2/2/2021 4:00:00PM	02/05/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	ION SCAN		2/2/2021 5:12:13PM	02/03/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	PERCENT MOISTURE			02/02/2021
2102071-002A	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-002B	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-002C	B-2-9@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Sulfide		2/3/2021 2:50:00PM	02/03/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		2/2/2021 11:00:00AM	02/03/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Soil Resistivity		2/2/2021 4:00:00PM	02/05/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	ION SCAN		2/2/2021 5:12:13PM	02/03/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	PERCENT MOISTURE			02/02/2021
2102071-003A	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-003B	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-003C	B-2-14@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Sulfide		2/3/2021 2:50:00PM	02/03/2021
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		2/2/2021 11:00:00AM	02/03/2021
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Soil Resistivity		2/2/2021 4:00:00PM	02/05/2021
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	ION SCAN		2/2/2021 5:12:13PM	02/03/2021
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	PERCENT MOISTURE			02/02/2021

**Client:** United Consulting Group Inc.  
**Project Name:** Keith Bridge Road Water Main Project  
**Lab Order:** 2102071

**Dates Report**

Lab Sample ID	Client Sample ID	Collection Date	Matrix	Test Name	TCLP Date	Prep Date	Analysis Date
2102071-004A	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-004B	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-004C	B-2-17@8.5-10'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Sulfide		2/3/2021 2:50:00PM	02/03/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Laboratory Hydrogen Ion (pH)		2/2/2021 11:00:00AM	02/03/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Soil Resistivity		2/2/2021 4:00:00PM	02/05/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	ION SCAN		2/2/2021 5:12:13PM	02/03/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	PERCENT MOISTURE			02/02/2021
2102071-005A	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-005B	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021
2102071-005C	B-2-22@6-7.5'	2/1/2021 12:00:00AM	Soil	Oxidation/Reduction Potential in Soil			02/04/2021

Client: United Consulting Group Inc.  
Project Name: Keith Bridge Road Water Main Project  
Workorder: 2102071

## ANALYTICAL QC SUMMARY REPORT

BatchID: 309740

Sample ID: MB-309740		Client ID:	Units: mg/Kg		Prep Date: 02/02/2021	Run No: 445904
SampleType: MBLK		TestCode: ION SCAN	BatchID: 309740		Analysis Date: 02/03/2021	Seq No: 10171805
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Chloride	BRL	10				
Sulfate	BRL	10				
Sample ID: LCS-309740		Client ID:	Units: mg/Kg		Prep Date: 02/02/2021	Run No: 445904
SampleType: LCS		TestCode: ION SCAN	BatchID: 309740		Analysis Date: 02/03/2021	Seq No: 10171806
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Chloride	104.9	10	100.0		105	90 110
Sulfate	267.8	10	250.0		107	90 110
Sample ID: 2101TT9-025BMS		Client ID:	Units: mg/Kg-dry		Prep Date: 02/02/2021	Run No: 445904
SampleType: MS		TestCode: ION SCAN	BatchID: 309740		Analysis Date: 02/03/2021	Seq No: 10171817
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Chloride	156.3	12	118.6	37.32	100	80 120
Sulfate	1124	12	296.5	822.7	102	80 120
Sample ID: 2102071-001AMS		Client ID: B-2-4@6-7.5'	Units: mg/Kg-dry		Prep Date: 02/02/2021	Run No: 445904
SampleType: MS		TestCode: ION SCAN	BatchID: 309740		Analysis Date: 02/03/2021	Seq No: 10171812
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Chloride	167.5	12	120.1	51.71	96.5	80 120
Sulfate	117.2	12	300.1	7.468	36.6	80 120
Sample ID: 2102071-001AMSD		Client ID: B-2-4@6-7.5'	Units: mg/Kg-dry		Prep Date: 02/02/2021	Run No: 445904
SampleType: MSD		TestCode: ION SCAN	BatchID: 309740		Analysis Date: 02/03/2021	Seq No: 10171813
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Chloride	181.5	12	121.2	51.71	107	80 120 167.5 8.01 20

Qualifiers: &gt; Greater than Result value

BRL Below reporting limit

&lt; Less than Result value

E Estimated (value above quantitation range)

J Estimated value detected below Reporting Limit

N Analyte not NELAC certified

B Analyte detected in the associated method blank

H Holding times for preparation or analysis exceeded

Rpt Lim Reporting Limit

S Spike Recovery outside limits due to matrix

R RPD outside limits due to matrix

Client: United Consulting Group Inc.  
Project Name: Keith Bridge Road Water Main Project  
Workorder: 2102071

ANALYTICAL QC SUMMARY REPORT

BatchID: 309740

Sample ID: 2102071-001AMSD Client ID: B-2-4@6-7.5'  
SampleType: MSD TestCode: ION SCAN SW9056A

Units: mg/Kg-dry Prep Date: 02/02/2021 Run No: 445904  
BatchID: 309740 Analysis Date: 02/03/2021 Seq No: 10171813

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
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Sulfate	122.6	12	303.1	7.468	38.0	80	120	117.2	4.54	20	S
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Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL		Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J		Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim		Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: United Consulting Group Inc.

Project Name: Keith Bridge Road Water Main Project

Workorder: 2102071

## ANALYTICAL QC SUMMARY REPORT

BatchID: 309816

Sample ID: LCS-309816	Client ID:	Units: pH Units	Prep Date: 02/02/2021	Run No: 445841
SampleType: LCS	TestCode: Laboratory Hydrogen Ion (pH)	BatchID: 309816	Analysis Date: 02/03/2021	Seq No: 10170295
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
		%REC	Low Limit	High Limit
			RPD Ref Val	%RPD
			RPD Limit	Qual

pH 7.040 0.01 7.000 101 90 110

Sample ID: 2101T04-020ADUP	Client ID:	Units: pH Units	Prep Date: 02/02/2021	Run No: 445841
SampleType: DUP	TestCode: Laboratory Hydrogen Ion (pH)	BatchID: 309816	Analysis Date: 02/03/2021	Seq No: 10170374
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
		%REC	Low Limit	High Limit
			RPD Ref Val	%RPD
			RPD Limit	Qual

pH 5.620 0.01 5.620 0 10 H

Sample ID: 2101T04-031ADUP	Client ID:	Units: pH Units	Prep Date: 02/02/2021	Run No: 445841
SampleType: DUP	TestCode: Laboratory Hydrogen Ion (pH)	BatchID: 309816	Analysis Date: 02/03/2021	Seq No: 10170378
Analyte	Result	RPT Limit	SPK value	SPK Ref Val
		%REC	Low Limit	High Limit
			RPD Ref Val	%RPD
			RPD Limit	Qual

pH 6.810 0.01 6.760 0.737 10 H

Qualifiers: &gt; Greater than Result value &lt; Less than Result value B Analyte detected in the associated method blank

BRL Below reporting limit E Estimated (value above quantitation range) H Holding times for preparation or analysis exceeded

J Estimated value detected below Reporting Limit N Analyte not NELAC certified R RPD outside limits due to matrix

Rpt Lim Reporting Limit S Spike Recovery outside limits due to matrix

Client: United Consulting Group Inc.

Project Name: Keith Bridge Road Water Main Project

Workorder: 2102071

## ANALYTICAL QC SUMMARY REPORT

BatchID: 309854

Sample ID: MB-309854		Client ID:	Units: mg/Kg		Prep Date: 02/03/2021	Run No: 445969
SampleType: MBLK		TestCode: Sulfide by SW9030B/9034	BatchID: 309854		Analysis Date: 02/03/2021	Seq No: 10173331
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Sulfide	0	40.0				
Sample ID: LCS-309854		Client ID:	Units: mg/Kg		Prep Date: 02/03/2021	Run No: 445969
SampleType: LCS		TestCode: Sulfide by SW9030B/9034	BatchID: 309854		Analysis Date: 02/03/2021	Seq No: 10173332
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Sulfide	1960	40.0	1960		100	70 130
Sample ID: 2102071-001AMS		Client ID: B-2-4@6-7.5'	Units: mg/Kg-dry		Prep Date: 02/03/2021	Run No: 445969
SampleType: MS		TestCode: Sulfide by SW9030B/9034	BatchID: 309854		Analysis Date: 02/03/2021	Seq No: 10173335
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Sulfide	2113	48.0	2353	47.56	87.8	68.9 122
Sample ID: 2102071-001AMSD		Client ID: B-2-4@6-7.5'	Units: mg/Kg-dry		Prep Date: 02/03/2021	Run No: 445969
SampleType: MSD		TestCode: Sulfide by SW9030B/9034	BatchID: 309854		Analysis Date: 02/03/2021	Seq No: 10173336
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit High Limit RPD Ref Val %RPD RPD Limit Qual
Sulfide	2140	47.6	2330	47.56	89.8	68.9 122 2113 1.27 20

Qualifiers: &gt; Greater than Result value

BRL Below reporting limit

J Estimated value detected below Reporting Limit

Rpt Lim Reporting Limit

&lt; Less than Result value

E Estimated (value above quantitation range)

N Analyte not NELAC certified

S Spike Recovery outside limits due to matrix

B Analyte detected in the associated method blank

H Holding times for preparation or analysis exceeded

R RPD outside limits due to matrix

Client: United Consulting Group Inc.  
Project Name: Keith Bridge Road Water Main Project  
Workorder: 2102071

ANALYTICAL QC SUMMARY REPORT

BatchID: 309902

Sample ID: LCS-309902	Client ID:	Units: ohms*cm	Prep Date: 02/02/2021	Run No: 445971
SampleType: LCS	TestCode: Soil Resistivity	BatchID: 309902	Analysis Date: 02/05/2021	Seq No: 10173348

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
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Resistivity (@100% Moisture Saturati 9709 0 10000 97.1 90 110

Sample ID: 2102071-002ADUP	Client ID: B-2-9@6-7.5'	Units: ohms*cm	Prep Date: 02/02/2021	Run No: 445971
SampleType: DUP	TestCode: Soil Resistivity	BatchID: 309902	Analysis Date: 02/05/2021	Seq No: 10173350

Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
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Resistivity (@100% Moisture Saturati 23160 0 22300 3.79 30

Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL		Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J		Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
		Rpt Lim Reporting Limit	S	Spike Recovery outside limits due to matrix		

Client: United Consulting Group Inc.  
Project Name: Keith Bridge Road Water Main Project  
Workorder: 2102071

ANALYTICAL QC SUMMARY REPORT  
BatchID: R445978

Sample ID: LCS-R445978	Client ID:	Units: mV	Prep Date:	Run No: 445978							
SampleType: LCS	TestCode: Oxidation/Reduction Potential by ASTM G200-9	BatchID: R445978	Analysis Date: 02/04/2021	Seq No: 10173377							
Analyte	Result	RPT Limit	SPK value	SPK Ref Val	%REC	Low Limit	High Limit	RPD Ref Val	%RPD	RPD Limit	Qual
Oxidation-Reduction Potential	265.5	1.0	240.0		111	80	120				

Oxidation-Reduction Potential	265.5	1.0	240.0		111	80	120				
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Qualifiers:	>	Greater than Result value	<	Less than Result value	B	Analyte detected in the associated method blank
BRL		Below reporting limit	E	Estimated (value above quantitation range)	H	Holding times for preparation or analysis exceeded
J		Estimated value detected below Reporting Limit	N	Analyte not NELAC certified	R	RPD outside limits due to matrix
Rpt Lim		Reporting Limit	S	Spike Recovery outside limits due to matrix		



**End of Report**

# Important Information about This Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

## Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

## Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

## Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

## Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

## Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

## A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

## A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

### Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

### Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.*

### Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.*

### Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

### Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

### Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.



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