ADDENDUM NUMBER 3

TO THE CONTRACT DOCUMENTS

Date: March 31, 2021
JACOBS Project No.: 674133CH

for the
2016 AMP06 - Leeds Parkway Drive Pump Station SSO Abatement

To All Plan Holders:
The following changes, additions, and/or deletions are hereby made part of the Contract Documents for the 2016 AMP06 – Leeds Parkway Drive Pump Station SSO Abatement Project dated February 2021, as fully and completely as if the same set forth fully therein:

The following provides a summary of questions, answers, and clarifications:

Specifications

1. **DELETE** the following Specification Sections:
    a. 33 05 23 Guided Auger Boring
    b. 31 80 00 Geotechnical Instrumentation and Monitoring

2. **ADD** Specification 31 26 10 Horizontal Auger Boring, attached to this Addendum.

3. **REPLACE** the following Specification Sections with the attached revised Sections:
    a. 00 01 10 Table of Contents
    b. 31 20 00 Baseline Subsurface Conditions (Supplements remain unchanged)
    c. 31 23 13 Subgrade Preparation
    d. 31 23 16 Excavation
    e. 31 23 19 Control of Water
    f. 31 23 23 Fill and Backfill

4. **DELETE** paragraph 1.20 of Specification 01 25 00 Measurement and Payment related to Buy American Clause.

Drawing Modifications

1. On Drawings C-04, C-06, C-07, and C-08, **CHANGE** "GUIDED AUGER BORING" references to "AUGER BORING".

2. At the proposed workshafts shown on Drawings C-07 and C-08, **ADD** the following note: CONTRACTOR SHALL OBTAIN PERMISSION FROM LAND OWNERS FOR ANY TEMPORARY ACCESS AND WORK SPACES OUTSIDE OF THE ROW. THE CONTRACTOR MAY REPOSITION WORKSHAFT WITH APPROVAL FROM THE ENGINEER.

3. On the left-hand side of Detail 1 on Drawing D-02, **CHANGE** the Specification Section 33 05 23 reference to 31 26 10, and **CHANGE** Note 1 to, "TRENCHLESS CROSSINGS SHALL BE

BY HORIZONTAL AUGER BORING IN ACCORDANCE WITH SPECIFICATION SECTION 31 26 10.

4. Regarding Drawing C-04, Contractor shall provide facility monitoring and vibration monitoring per the points shown in the attached sketch.

5. Drawing C-18: In the plan view near MH-35, **DELETE** the following callout, "TIE INTO MANHOLE BELOW 12" GRAVITY SEWER W/45 BEND".

Clarifications

1. Re. Specification 01 31 13 – 1.02.D. Jefferson County has cleared some trees along the sewer alignment that were suitable for bat roosting. The trees cleared by Jefferson County had to be cleared prior to March 31. Therefore, the contractor will be able to clear any other remaining trees necessary for construction at any time during the Contract Times.

2. Please note, the alignment shown on C-18 is near (2) existing power poles that will need to be temporarily supported or relocated during construction. This work and coordination effort shall be included in the 12-inch Direct Bury Along Highway 78 bid item.

Questions and Answers

The following questions were asked during the Pre-Bid Conference or emailed to the engineer with Jacobs responses provided:

#	Question	Answer
1	Dwg Sh 33 has a Traffic Control Sequence Table that has column labeled "Duration for Completion of Work Within ROW (Weeks)". Please clarify specifically what 'work' is expected to be performed under this description as the weeks listed do not appear to be adequate for the location/work required.	The table is a proposed sequence / schedule by the Engineer. Contractor shall provide traffic control plan and construction progress schedule.
2	We recently did a railroad bore for NFS in Bessemer that originally had been handled by AECOM however during the course of the project NFS contracted with RailPros to assume the duties previously performed by AECOM. This apparently took place 5/1/2020. Please confirm if the successful bidder will have to interface with AECOM or RailPros during the course of construction.	Some coordination will be required. Coordination requirements are provided in Appendix F of the Contract Documents.

#	Question	Answer
3	a. Will the railroad bore be required to a continuous 24-hour operation? b. If not, will flagmen/monitors be required to be onsite during the non-working hours? If Flaggers are required, who will be responsible for paying?	a. For bid purposes, assume no. b. Flagmen are not anticipated to be required at the elevated railroad as personnel should not need to cross over elevated portion of the railroad. Re. Drawing C-07. If flagmen are required for the short trenchless crossing shown on Drawing C-06, it will be paid via the Owners Allowance.
4	Would micro tunneling be an option?	Yes, the specifications state, "The Contractor shall not utilize any other tunneling method without written authorization from the Engineer. The Contractor will be required to demonstrate that the proposed alternate tunneling method is technically feasible and will result in settlement less than the shutdown values presented herein. The Contractor will be required to submit three examples of crossings of similar lengths and in similar soil conditions where the proposed alternate was successfully completed."
5	a. We have been able to find the railroad permit in the documents for the longer RR bore, but cannot find the permit for the shorter bore. Do you know if there is one? On that same note, the plans call for 119' of 24" casing bore at that RR spur, but the scale shows it to be 36" which is similar to the rest of the gravity bores. Is that bore a 24" or 36" bore? b. Should we use the geotechnical report provided as a "baseline" benchmark to build the job? If so, how will that subject be handled if we find differing conditions?	a. The Railroad permit is being revised to include the trenchless crossing of the railroad spur shown on Drawing C-06. The casing is 36-inch. See Addendum 1. b. See Specification Section 31 20 00 Baseline Subsurface Conditions attached to this Addendum.

#	Question	Answer
6	a. The aluminum stands and equipment racks are noted to have a clear anodized finish. This is an extended and expensive process that we haven't been required to do before. Is it necessary for this job? b. There is a conflict on the type of wet well junction boxes required. One sheet shows a detail with a Nema 4X aluminum box with an air gap, another sheet notes them to be explosion proof. The N4X aluminum box with the air gap is more common and costs less. c. A vendor has informed me that the SPD's integrally mounted in panelboards are an extended lead time item. Are exterior mounted acceptable?	a. No. b. Provide NEMA 4X Box with air gap per detail 4091-920. c. SPD's can be mounted externally to the panels, but will need to be inside a NEMA 4X enclosure.
7	At Manhole #6 there is an existing utility conflict with a gas line, 12" watermain, 6" watermain, potential communication cable, and guy wires from the overhead transmission power pole. Would there be an option to move that manhole further to the east, closer to state rd. 25, in an effort to find a safer location?	Moving Manhole 6 to a more convenient location can be considered after potholing to field verify location of existing utilities.
8	How will aid to construction cost be addressed (if there are any). Will contractor be responsible for these charges?	Contractor shall include all costs and fees for new utility services for power, water, and gas in the bid. Assume the 2" gas main along 11th Street is already live.
9	Please confirm that helical piles and grade beams are not required as recommended in the soils report for EQ Tank foundation, and that tank subgrade will be undercut to solid rock and backfilled with select fill materials (in lieu of helical piles and grade beams)	For the EQ Tank foundation, Contractor shall dig down to sound rock and fill with select fill per Specification 31 23 13.10 and 31 23 23.10.
10	Along Hwy 78 (C09 general area) there is a potentially recent MCI data utility cable directly on top of the existing sewer.	Additional work required to temporarily support or relocate unforeseen utilities will be paid for via the Owner's Allowance. Contractor shall notify Engineer of any differing / unforeseen conditions and must receive direction from Engineer prior to proceeding with any additional work.

#	Question	Answer
11	Please confirm the following permits and Agreements are in-hand: a. Railroad Crossing Agreement and Permits b. Alabama Corps of Engineers Permits c. ALDOT Permit for all road Bores and work along ROW d. ROW Promises and Agreements with Property Owners e. Easements	It is the Engineer's understanding that all permit and land agreements have been executed, except the railroad spur crossing shown on drawing C-06. A revised railroad permit is being processed.
12	Dwg Sh 3 Note 8 under General Notes states that all disturbed areas in ALDOT ROW shall be sodded.	See Addendum 1, question/answer No. 17. Sod is required to restore any grassy areas within ALDOT ROW (Dunnavant Road, Highway 78, Ashville Road), unless approved otherwise by ALDOT in writing.
13	Sh 16 Note 4 states to "full width ROW Pavement replacement, see Detail 3216-320 Dwg 0-01';. a. Spec 32 12 16 Paving - Denotes Paving to be 4" thick, please confirm. b. Please confirm that the 4" thick pavement is the Pavement Patch. c. Are we to then Mill & Overlay the roadway? d. The Bid Form currently has 2 Bid Items for Pvmt (Outside of ALDOT ROW and Within ALDOT ROW). Please provide a Detail for these different Pavement locations (thickness, etc ..). e. Obviously we will be patching our trench with Asphalt (Paid per Bid Items 11-b and 11- c?), but then later are we to Mill & Overlay? There is no Pay Item to Mill & Overlay. Please consider adding a SY Pay Item to Mill & Overlay (as the Contractor will be instructed the limits of this M&O in the field at each location and that quantity would be unknown to bidding Contractors now).	a. For new full depth paving at trenches, assume a minimum of 3 inches of binder course and 1.5 inches of surface course. Contractor shall restore pavement to match existing conditions if thicknesses are greater than these minimums. For paving outside of trench, mill existing pavement at least 1-inch minimum and repave per specifications. b. see answer to question a. c. see answer to question a. d. See Addendum 2. e. See answer to question a. If any settlement occurs, Contractor will be required to mill as needed to restore pavement to original condition. Full depth pavement shall be 18 inches beyond edge of trench per detail provided in Addendum 2.

#	Question	Answer
14	Dwg Sh 33 Note 'g' states "two-day detour from State Road 25 will be required per Dwg 39". Is the Contractor limited to only 2 days to make the diagonal crossing of Sate Road as shown on Sh 25? If so, that is not enough time to perform the work shown on Sh 25.	No. Traffic plans and notes are the Engineer's proposed traffic control plan and sequence. Contractor shall provide traffic control plan and construction progress schedule.
15	Can a Bid Item be added for Police Officers, as is typical for most Jefferson County JCESD projects? The dangerous location of this project (especially along Hwy 78} would be helped by the presence of Police Officers. With the Soil/Groundwater Testing required during the work (which will slow down pipelaying production) it is impossible for Bidders to accurately estimate the time required for Police Officers.	Any anticipated traffic control / traffic safety measures and devices should be included in Bid Item 5, Traffic Control Facilities and Traffic Control Plan.
16	Sh 30 has callouts for the new 16" line to be a 'Force Main'. Please confirm this is a new Gravity line.	The new 16-inch sewer on Dwg. C-18 is a gravity sewer.

#	Question	Answer
17	Specification 01 57 13-1.01, F - Soil and Groundwater Mgmt/Testing/Disposal states to perform the gravity and force main during the months of July-November and that "excavation should not be performed during the typical wet periods of the year when the groundwater table would be expected to be high". a. With the project bidding on March 31, 2021, and it typically is 60-75 days until the Commission awards projects, and then a month or so after that to execute Contracts. It would be reasonable to expect a Pre-Con and Notice to Proceed no sooner than mid-July. Then with extensive submittals required for, among other items, the boring workshafts, the Soil and Groundwater Mgmt and Testing Plan (with outside agency approvals that are out of Contractor/Owner/Engineers control) we would suggest that the Owner/Engineer consider this approval/submittal process could take months. This would place pipelaying not being able to start until later this year during the wet season. b. Please consider these schedule constraints, and advise if it would be reasonable to assume that the pipelaying may actual not occur until the 2022 dry season (summer/Fall 2022), which would obvious affect the 365 days currently setup as the Contract Time.	See question/answer No. 12 in Addendum 2. It is up to the Contractor to schedule the work and determine when this work should occur to complete the work within the Contract Times.
18	Please advise the name and contact info for the Property Owner at the new Pump Station site.	The new pump station site is Jefferson County's property.
19	Spec 00820, 1.06 - states that no payment will be made for Stored Material. Please confirm that Stored Material will be paid {per 01 25 00, 1.16).	Payment for stored materials will be considered if it's in the best interest for the project schedule and if such stored material is stored properly and protected.
20	Spec 00820, 1.20 states that this is a Buy American project. Please confirm, as this may affect delivery schedule and pricing.	This project is not a Buy American project. Delete paragraph 1.20 of Specification 01 25 00 Measurement and Payment.
21	Spec 01 57 28, 3.03-C states "obtain approval and secures all permits for placement of temporary bypass pumping system and pipeline within public ROW". Who does the Contractors need to obtain approval from and what permits are required?	Permits have been obtained along the sewer alignment. Contractor is responsible for any agreements with property owners outside of sewer easements or ROW.

#	Question	Answer
22	Spec 31 20 00, 3.06 - only provides Table 1 for the crossing noted at Hwy 78 {sta 2+90-4+10). Where are the Tables for other crossings to establish the "Defined Subsurface Conditions" at each crossing {as spec 31 20 00, 1.01-A states that the "conditions defined" in this section take preference over any geotechnical reports.	See Specifications attached to this Addendum 3.
23	Geotech Report - were there any geotechnical borings done west of 11th St?	All bores are included in Supplements 1 and 2 of Specification 31 20 00.
24	Spec 31 23 23, 303-A - states to use 12" Topsoil. Is the Contractor to strip and replace the existing topsoil, or are we required to bring in 12" of new Topsoil at all locations?	See specification 32 91 13 for topsoil requirements.
25	Spec 33 01 33 Sewer Cleaning - when and at what locations is this to be performed?	All new sewer pipelines prior to testing and CCTV inspections.
26	Spec 33 05 06, 2.03-H -Polyethylene Encasement-states to install where detailed on the drawings. Please clarify/note the locations where Poly Encasement is required.	Provide polyethylene encasement where pipe is to be concrete encased as shown on Drawings C-05, C-10, C-15, C-16, or other locations as determined by the Engineer that require concrete encasement or CLSM due a clearance less than 24-inches.
27	Spec 40 80 01, 3.2 -discusses water for testing. Who furnishes this water?	Contractor shall furnish water required for testing.
28	In appendix E, CBM Plan -Table 1-1 on page 4 states Mobilization and the project starting in June 2019. Will the actual later start date be an issue with any regulating agency?	This schedule was the Engineer's proposed schedule. The Contractor will be required to prepare all required ADEM permit applications per Specification 01 57 13.
29	As discussed at the PreBid, will the Contractor be reimbursed for the cost associated with holding existing poles, existing guy wires, existing obstructions, existing utility conflicts, etc ... from the Allowance Pay Item?	Yes if shown on the Drawings. See also question/answer No. 10 of this Addendum.
30	Wrapidseal -are exterior applied WrapidSeal wraps to manholes required for this project? If so, at what locations/joints on manholes?	See paragraph 2.02.F of Specification 33 05 13 for joint wrap requirements and see manhole table in Addendum 2.

Jacobs

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SECTION 31 20 00
BASELINE SUBSURFACE CONDITIONS

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section includes the baseline of subsurface conditions expected during the construction of the tunnels and workshafts required for the proposed alignment. The Contractor shall base all bids and select all equipment based on the soil and groundwater conditions defined in this section. In no case shall any geotechnical reports take precedence over soil and groundwater conditions defined for the tunneled crossings and associated shafts in this section.

B. The Contractor shall make independent investigations that he deems necessary or prudent to satisfy himself as to the actual subsurface conditions, subject to Owner and Engineer to review and at no additional cost to the Owner.

1.02 RELATED SECTIONS

A. Section 31 23 19, Control of Water.

~~B. Section 31 80 00, Geotechnical Instrumentation and Monitoring.~~

~~C.~~B. Section ~~33 05 23~~31 26 10, ~~Guided~~ Horizontal Auger Boring.

1.03 REFERENCES

A. The following document contains geotechnical information, which was used in evaluating the baseline subsurface conditions for the Project.

1. Preliminary Geotechnical Data Report~~Geotechnical Data Report~~, Parkway Drive Pump Station SSO Elimination Project, prepared by Contour Engineering, ~~March 2017~~March 2017.

~~1.~~2. Geotechnical Data Report, Parkway Drive Pump Station SSO Elimination Project, prepared by Contour Engineering, October 2018[MR1]

B. "Earth Tunneling with Steel Supports" by Proctor, R. V. and White, T. L., 1977, published by Commercial Shearing, 1775 Logan Avenue, Youngstown, Ohio, 45501.

1.04 DEFINITIONS

A. Tunneled areas are shown in the Contract Drawing Plans and Profiles.

B. Boulders are defined as particles of rock that cannot be made to pass a 12-inch square opening when rotated in any orientation (Modified from ASTM D2487). When a boulder diameter is defined in these Specifications, the diameter shall be defined as a boulder that can be made to pass the listed size square opening, even if the boulder is larger in some dimension.

C. Cobbles are defined by ASTM D2487 as particles of rock that will pass a 12-inch square opening and be retained on a 3-inch U.S. standard sieve.

D. Nests are defined as cobbles and boulders in contact with each other.

E. This section uses definitions of the expected reaction of the ground to tunneling. These definitions were taken from Chapter 3 of "Earth Tunneling with Steel Supports" by Proctor, R. V. and White, T. L., 1977, published by Commercial Shearing, 1775 Logan Avenue, Youngstown, Ohio, 45501.

1. According to its behavior within the ground movement period, ground can be assigned to one of the following categories: firm, raveling, running, flowing, squeezing or swelling.
2. In firm ground, tunneling can be constructed without inducing perceptible ground movement of any kind.
3. In raveling ground, chunks or flakes of soil begin to drop out at some point during the ground movement period.
4. In running ground, the removal of lateral support on any surface rising at an angle of more than about 34 degrees is immediately followed by a running movement of the soil particles. This movement does not stop until the slope of the moving soil becomes roughly equal to 34 degrees. If running ground has a trace of cohesion, then the run is preceded by a brief period of progressive raveling.
5. Flowing ground acts as a thick liquid and differs from running ground in that it invades the tunnel not only from above and from the sides, but also through the bottom. If the flow is not arrested, it continues until the tunnel is completely filled.
6. Squeezing ground slowly advances into the tunnel without any signs of fracturing. Yet the loss of ground caused by squeeze and the resulting settlement of ground surface can be substantial.
7. Swelling ground slowly advances into the tunnel partly or chiefly because of an increase in the volume of the ground.

F. Often ground conditions are some combination of raveling and running. These may create subcategories of fast, medium and slow raveling or running. Most raveling ground can become running ground given sufficient time with no support or other factors such as vibrations or agitation or drying out."

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Soil conditions to be encountered during construction of the shafts and tunnels are presented in Table 1. The table defines the subsurface conditions on which the Contractor shall base all bids and develop all schedules. The soils are classified according to the Unified Soil Classification System (USCS) in accordance with ASTM D2488, including fines content and particle size, and the relative density or consistency is based on the correlations presented in Table 6. In addition, for fine-grained soils (clays and silts) the unconfined compressive strength is defined according to the consistency presented in Table ~~6~~ 5 as well.

B. Groundwater: The defined groundwater levels for the shafts and tunnel are shown in the applicable tables.

3.02 GEOTECHNICAL CONDITIONS

A. The primary purpose of the defined subsurface conditions presented herein is to establish a contractual understanding of the geotechnical conditions anticipated to be encountered during construction of the tunneled portions of the Project in order to provide a basis for bidding and assist in resolution of disputes that may arise over subsurface conditions during tunneling. Secondarily, the definitions:

1. Present the geotechnical and construction conditions that formed the basis of tunnel design.
2. Provide information to assist the Contractor in evaluating requirements for excavating and supporting the ground.
3. Provide guidance to the Engineer in administering the Contract.

B. The defined subsurface conditions contained herein provide the basis for identifying geotechnical and geologic conditions that qualify as "Changed Conditions," as defined in the General Conditions. The defined subsurface conditions contained within this section, are not necessarily geotechnical fact. The defined conditions were developed using judgment to interpolate between borings and extrapolate beyond the boring logs and laboratory test data. The judgment applied in the interpolations and extrapolations reflects the view of the Owner and the Bidders shall use the defined conditions in defining the subsurface conditions and the surface conditions which can be observed during a Site visit as the basis for bids. It should be noted that the Project design was based on assumed construction methods and levels of workmanship. The behavior of the geologic materials present in the surface and subsurface excavations will be influenced by the Contractor's selected equipment, means, and methods.

C. The results of the Project geotechnical investigation are included in these Contract Documents. If there are disagreements or ambiguities between the defined conditions presented in this Section, and the data presented in the supplements of this Specification, Section 31 20 00, Baseline Subsurface Conditions, takes precedence.

D. Bidders have a Geotechnical Engineer or Engineering Geologist licensed in the State of Alabama review and explain the information to assure a complete understanding of the reported information as a basis for submitting a bid.

3.03 RISK ALLOCATION

A. Risks associated with subsurface conditions consistent with, or less adverse than, the conditions defined herein are allocated to the Contractor. The risk of higher construction costs associated with subsurface conditions more adverse than the conditions presented herein are accepted by the Owner. The definition of the subsurface conditions in the contract is not a warranty that the defined conditions will be encountered. The defined conditions are the contractual standard that the Owner and the will agree to use when interpreting the changed conditions clause, contained in the General Conditions.

B. In the event that Contractor believes more adverse conditions have been encountered, the Owner negotiate with the Contractor for additional compensation to the Contractor if the determines the following four conditions exist:

1. The Contractor notified the Owner of the differing conditions in writing in accordance with the General Conditions.
2. The actual subsurface conditions encountered are materially more adverse than the defined conditions.
3. The Contractor can document that the subsurface conditions are more adverse than those defined and that the conditions materially and increased the cost and/or time required to complete the Work.
4. The Contractor has made diligent efforts to complete the Work described in the Contract Documents, including any changes to methods, equipment, labor, and materials made necessary by the more adverse conditions.

C. If all of the foregoing conditions are satisfactorily met, additional compensation will be negotiated.

3.04 CONTAMINATION

A. The site investigation encountered soils having chemical constituents at locations indicated. If the tunneling operations should encounter contaminated materials, the Contactor shall follow requirements identified in Division 1, General Requirements.

3.05 OBSTRUCTIONS

A. If the tunneling operations should encounter an object or condition that impedes the forward progress of the pipe, the Contractor shall notify the Engineer immediately. The Contractor shall submit a plan to correct the condition, and remove, clear, or otherwise make it possible for the pipe to advance past any and all objects or obstructions that impede forward progress.

B. Upon written notification of the Engineer, the Contractor shall immediately proceed with removal of the object or obstruction by means as submitted by the Contractor.

C. The Contractor receive compensation for removal of obstructions, which consist of metallic debris, reinforced concrete, whole trees, rocks and other hard objects larger than 33 percent of the outer diameter of the cutter head, or tunneling shield for pipe jacking, which cannot be broken up by the cutting tools with diligent effort, and that are partially or wholly within the cross-sectional area of the bore.

D. Payment be negotiated with the Contractor by the Owner on a case-by-case basis. However, any removal process that does not allow direct inspection of the nature and position of the obstruction will not be considered for payment. The Contractor will receive no additional compensation for removing, clearing, or otherwise making it possible to advance past objects consisting of cobbles, boulders, wood, nonreinforced concrete, and other nonmetallic objects or debris with maximum lateral dimensions less than specified above.

3.06 DEFINED SUBSURFACE CONDITIONS

Table 1 Defined Subsurface Conditions – US Highway 78 Crossing (Station 2+90 to 4+10)			
Depth (ft)	**Elevation (ft)**	**Relative Density/ Consistency**	**Soil Type**
Shaft Station 2+90 (Groundwater Elevation: ~~620~~ 619.8 feet)			
0 to ~~13~~11.0	630.3 to 619.3	Stiff	Sandy Silty Clay (CL) w/ gravel~~Clay (CL)~~
11.0 to 14.5	619.3 to 615.8	Medium Stiff	Silty Clay (CL)
14.5 to 25.0	615.8 to 605.3	Medium Stiff	Silty Clay (CL)
~~13 to 25~~	~~to~~		~~()~~
Shaft Station 2+90 (Groundwater Elevation: 623.7 feet)			
0 to 8.5	632.2 to 623.7	Stiff	Sandy Clay (CL)
8.5 to 25.0	623.7 to 607.2	-	LIMESTONE
~~0 to~~	~~to~~		~~Clay ()~~
Tunnel (Groundwater Elevation: ~~feet~~623.7)			
Tunnel drive for the 24-inch will consist of the following: 1) 30% of tunneled length will be mined within a full face of LIMESTONE having a compressive strength of 14,000 psi and an RQD of 92%~~clay (CL) overlying~~. ~~The stability number of most of the lean clay soil – Nt ranges from to and will.~~ 2) 70% of the tunneled length will be mined in a full face of sandy Clay (CL) having a stability number N_t = 0.8 with very low overstress and creep (inward movement) potential. Little or no load will transfer to ground support system. ~~% of the tunneled length will be mined within a face of~~			

Table 2
Defined Subsurface Conditions – Dry Creek Railroad Crossing
(Station 11+00 to 12+20)

Depth (ft)	Elevation (ft)	Relative Density/ Consistency	Soil Type
Shaft Station 11+00 (Groundwater Elevation: 620.9 feet)			
0 to 13.5	633.9 to 620.4	Very Stiff	Silty Clay (CL/CH)
13.5 to 25.0	620.4 to 608.9	Medium Stiff	Silty Clay (CL) / gravel
Shaft Station 12+20 (Groundwater Elevation: 624.5 feet)			
0 to 8.5	635.5 to 627.0	Stiff	Silty Clay (CL)
8.5 to 13.5	627.0 to 622.0	Stiff	Silty Clay (CL)
13.5 to 25.0	622.0 to 610.5	Very Soft	Silty Clay (CL)
Tunnel (Groundwater Elevation: 624.5 feet)			
Tunnel drive for the 36-inch will consist of the following: 1) 100% of the tunneled length will be mined in a full face of silty Clay (CL) with trace gravel having a stability number N_t = 13.44 with dangerous overstress and high creep potential. Shear failure likely to occur ahead of tunnel face, causing large movements and subsidence. Maintaining line and grade will be difficult without steering control.			

Table 3
Defined Subsurface Conditions – Norfolk Southern Railroad Crossing
(Station 16+30 to 19+40)

Depth (ft)	Elevation (ft)	Relative Density/ Consistency	Soil Type
Shaft Station 16+30 (Groundwater Elevation: 625.1 feet)			
0 to 3.0	637.1 to 634.1	-	FILL
3.0 to 12.0	634.1 to 625.1	Very Stiff	Sandy Clay (CL) /w gravel
12.0 to 25.0	625.1 to 612.1	-	LIMESTONE
Shaft Station 19+40 (Groundwater Elevation: 631.3 feet)			
0 to 8.5	639.3 to 630.8	Stiff	Silty Clay (CL) w/ gravel
8.5 to 23.5	630.8 to 615.8	Hard	Silty Clay (CL) w/ gravel
23.5 to 25.0	615.8 to 614.3	Very Dense	Gravelly Sand (SW)
Tunnel (Groundwater Elevation: 631.3 feet)			
Tunnel drive for the 36-inch will consist of the following: 1) 20% of tunneled length will be mined within a full face of LIMESTONE having a compressive strength of 14,000 psi and an RQD of 58%. 2) 50% of the tunneled length will be mined in a full face of sandy Clay (CL) having a stability number N_t = 2.8 with moderate overstress with some creep potential. Some load likely to transfer to ground support system. Squeeze load should be considered. Creep movements and load generally not large in first 24 hours after exposure. 3) 30% of the tunneled length will be mined in a full face of clayey Sand (SC) that will behave as firm to flowing where a mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and walls, and can flow for great distances as it accumulates in the tunnel. Dewatering of this zone should be considered.			

Table 4
Defined Subsurface Conditions – Dry Creek Crossing
(Station 19+40 to 21+30)

Depth (ft)	Elevation (ft)	Relative Density/ Consistency	Soil Type
Shaft Station 19+40 (Groundwater Elevation: 631.3 feet)			
0 to 8.5	639.3 to 630.8	Stiff	Silty Clay (CL) w/ gravel
8.5 to 23.5	630.8 to 615.5	Hard	Silty Clay (CL) w/ gravel
23.5 to 25.0	615.8 to 614.3	Very Dense	Gravely Sand (SW)
Shaft Station 21+30 (Groundwater Elevation: 624.1 feet)			
0 to 18.5	635.6 to 617.1	Very Stiff	Silty Clay (CL)
18.5 to 25.0	673.1 to 610.6	Medium Stiff	Silty Clay (CL) /w gravel
Tunnel (Groundwater Elevation: 631.3 feet)			
Tunnel drive for the 36-inch will consist of the following: 1) 100% of the tunneled length will be mined in a full face of sandy silty Clay (CL) having a stability number $N_t = 0.96$ with very low overstress and creep (inward movement) potential. Little or no load will transfer to ground support system.			

Table 5 Defined Subsurface Conditions – Highway 67 Crossing (Station 24+80 to 25+40)			
Depth (ft)	**Elevation (ft)**	**Relative Density/ Consistency**	**Soil Type**
Shaft Station 24+80 (Groundwater Elevation: 621.8 feet)			
0 to 25.0	641.8 to 616.8	Very Dense	Clayey Sand (SC) w/ gravel
Shaft Station 25+40 (Groundwater Elevation: 620.9 feet)			
0 to 25.0	640.9 to 615.9	-	Silty Clay (CL) w/ gravel
Tunnel (Groundwater Elevation: 621.8 feet)			
Tunnel drive for the 36-inch will consist of the following: 1) 50% of the tunneled length will be mined in a full face of clayey Sand (SC) that will behave as firm to rapidly raveling where chunks or flakes of material begin to drop out of the arch or walls a few minutes after the ground has been exposed. 2) 50% of the tunneled length will be mined in a full face of sandy Clay (CL) having a stability number N_t = 1.2 with low overstress and low creep potential. Some load may transfer to ground support system. Squeeze load should be considered.			

Table ~~6~~6 Summary of Consistency or Relative Density			
Soil Type	**Description**	**SPT Blow Count (blows/ft)**	**Unconfined Compressive Strength (tons/ft²)**
Cohesive (silts and clays)	Very Soft	<2	<0.25
	Soft	2-4	0.25-0.50
	Firm	5-8	0.50-1.0
	Stiff	9-15	1.0-2.0
	Very Stiff	16-30	2.0-4.0
	Hard	>30	4.0-8.00
Noncohesive (sands and gravels)	Very Loose	0-4	Not Applicable
	Loose	5-10	
	Medium Dense	11-30	
	Dense	31-50	
	Very Dense	>50	

3.07 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are part of this Specification.

1. Preliminary Geotechnical Data Report: Parkway Drive Pump Station SSO Elimination Project by Contour Engineering, LLC., March 22, 2017.
2. Geotechnical Data Report: Parkway Drive Pump Station SSO Elimination Project- 200,000 Gallon Storage Tank and Supplemental Borings by Contour Engineering, LLC., October 31, 2018.

3.08 MEASUREMENT AND PAYMENT

A. All work and cost of this section shall be incidental to the project and included in the Total Bid.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).
   b. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition and Section 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.03 TESTING

A. Contractor shall retain an independent soil testing company to determine in-place density and moisture content.

B. One test every 300 square feet on ever lift of subgrade or one test per lift, whichever requires more tests.

3.04 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section covers the Work necessary to perform excavation for proposed structures, pipes, and roadways as specified herein and shown in the Contract Drawings. It is noted that rock will be required to be excavated for this Project.

B. Excavations associated with tunneling installation are covered in Section ~~33 05 23~~31 26 10, ~~Guided~~ Horizontal Auger Boring.

C. Blasting is not permitted.

D. The Contractor shall coordinate the excavation with the following sections:

1. Section 31 23 19, Control of Water.
2. Section ~~33 05 23~~31 26 10, ~~Guided~~ Horizontal Auger Boring.

1.02 GENERAL

A. See Conditions of the Contract and Division 1, General Requirements, which contain information and requirements that apply to the Work specified herein and are mandatory for this Project.

B. Where applicable, work included in this section shall be in accordance with the requirements of the International Building Code Special Inspections, Section 1704.7, and the Owner's scheduling constraints in relation to those requirements.

1.03 DEFINITIONS

A. Influence Area: As defined in Section 31 23 23, Fill and Backfill.

B. Common Excavation: Removal of material not classified as rock excavation.

C. Rock Excavation:

1. General: Removal of solid material within the limits defined, which by actual demonstration cannot, in Engineer's opinion, be reasonably loosened or ripped by single-tooth, hydraulically operated ripper mounted on crawler tractor in good condition and rated at minimum 300 flywheel horsepower; and which must be systematically broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal. This definition will form the basis of payment for rock, regardless of what the boring logs ~~and seismic refraction geophysical~~ indicate.

2. Trench: Removal of solid material within the limits defined, which by actual demonstration cannot, in Engineer's opinion, be reasonably excavated with minimum 195-horsepower backhoe in good condition and equipped with manufacturer's standard boom, two rippers, and rock points or similar approved equipment; and which must be systematically broken by power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means prior to removal.
3. Term "rock excavation" indicates removal of solid material, as specified above, and does not necessarily correspond to "rock" as implied by names of geologic formations.
4. Removal of boulders larger than 1/2 cubic yard will be classified as rock excavation, if breaking them apart with power-operated hammer, hydraulic rock breaker, expansive compounds, or other similar means is both necessary and actually used for their removal.

1.04 SUBMITTALS

A. Submittals shall be made in accordance with Section 01 33 00, Submittal Procedures. In addition, the following information is required:

1. Excavation Plan, Detailing:
   a. Methods and sequencing of excavation in soil and rock.
   b. Proposed locations of stockpiled excavated material.
   c. Proposed offsite spoil disposal sites.
   d. Numbers, types, and sizes of equipment proposed to perform excavations.
   e. Anticipated difficulties and proposed resolutions.
   f. Quality assurance plan, including survey control and stakeout plan.

1.05 QUALITY ASSURANCE

A. Contractor shall provide adequate survey control to avoid unauthorized overexcavation.

1.06 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.07 SEQUENCING AND SCHEDULING

A. Where applicable, install excavation support systems in accordance with Section 31 41~~0~~ 00, Shoring, prior to excavating.

B. Excavation Support: Install and maintain, as specified in Section ~~33 05 23~~31 26 10, ~~Guided~~ Horizontal Auger Boring prior to excavating. Support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, roadways, adjacent property, and completed Work.

1.08 EXCAVATION SAFETY

A. The Contractor shall be solely responsible for making all excavations in a safe manner. Contractor shall provide appropriate measures to retain excavation sideslopes and prevent rock falls to ensure that persons working in or near the excavation are protected, as specified in Section ~~33 05 23~~31 26 10, ~~Guided~~ Horizontal Auger Boring.

B. The Contractor shall adhere to OSHA and other applicable governmental regulations and agencies' safety standards.

1.09 CODES, ORDINANCES, AND STATUES

A. Contractors shall familiarize themselves with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Contractor shall excavate to within tolerance of plus or minus 0.1 foot except where dimensions or grades are shown or specified as maximum or minimum. Contractor shall allow for forms, working space, granular fill, topsoil, and similar items, wherever applicable. Contractor shall trim to neat lines where concrete is to be deposited against earth.

B. Contractor shall not overexcavate without written authorization of Engineer.

C. Unauthorized overexcavation under proposed structures shall be backfilled at no additional cost to the Owner with ~~the following materials:~~CLASS B.

~~1. Overexcavations under structures designed to bear on rock shall be backfilled with either cement-treated aggregate or flowable fill.~~

~~2. Any overexcavation greater than 4 feet shall be backfilled with either cement-treated aggregate or flowable fill.~~
~~3. All other overexcavations shall be backfilled with granular fill.~~

D. Contractor shall remove or protect obstructions as shown and as specified in Section 01 50 00, Temporary Facilities and Controls, Article Protection of Work and Property.

E. Use of explosives is prohibited.

F. For shaft excavations exceeding 5 feet in depth, provide safety system ~~consisting of an 8-foot tall chain link fence, or one~~ meeting requirements of applicable state and local construction safety orders, and federal requirements, whichever is more stringent.

3.02 CONTROL OF WATER (DEWATERING)

A. In accordance with Section 31 23 19, Control of Water.

3.03 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.04 EXCAVATION FOR FORCEMAIN AND UTILITY TRENCHES

A. Unless otherwise noted, trenches for all utilities shall be to a depth to provide a minimum of 5 feet of cover from the top of the utility to finished grade.

B. Contractor shall excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit.

C. Maximum Trench Width: As specified below, unless otherwise shown or specified, or unless excess width will cause damage to existing force mains, existing facilities, adjacent property, or completed Work.

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
   a. Less than 4-inch Outside Diameter or Width: 18 inches.
   b. Greater than 4-inch Outside Diameter or Width: 18 inches greater than outside diameter or width of pipe, conduit, direct-buried cable, or duct bank.
2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
3. Increase trench width by thicknesses of sheeting.

D. Trench Bottoms:

1. Contractor shall:
   a. Excavate trenches deeper than bottom of pipe elevation to allow for bedding course.
   b. Excavate by hand for bell of pipe.

3.05 UNAUTHORIZED EXCAVATION

A. Contractor shall replace material that is removed below the depths indicated, without specific direction of the Engineer, at Contractor's expense, as specified in Part 3, Article General of this section to the indicated excavation grade.

3.06 EMBANKMENT AND CUT SLOPES

A. Contractor shall shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Contractor shall remove stones and rock that exceed 3 inches in diameter and that are loose and may roll down slope. Contractor shall remove exposed roots from cut slopes.

C. Contractor shall round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.

3.07 STOCKPILING EXCAVATED MATERIAL

A. Contractor shall stockpile excavated material that is suitable for use as fill or backfill until material is needed and shall place, grade, and shape stockpiles to drain surface water. All other excavation material shall be immediately disposed off site at no additional cost.

B. Contractor shall confine stockpiles to within approved limits of disturbance and erosion control perimeter. Do not obstruct roads or easements.

C. Contractor shall not stockpile excavated material adjacent to trenches and other excavations unless excavation sideslopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

D. Contractor shall not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work. Contractor shall not stockpile excavated materials near or over existing utilities at any time.

E. Contractor shall not stockpile rock removed from the excavations, unless it is processed to 3-inch minus and is mixed with other material for use as earthfill.

F. Erosion and sediment control is required around stockpile material. Contractor shall have a silt fence in place around stockpile material at all times.

G. Allaying Dust: As needed, provide water tanker for dust control.

H. All roads shall be kept clean of mud at all times.

3.08 DISPOSAL OF SPOIL

A. Contractor shall dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

END OF SECTION

SECTION 31 23 19
CONTROL OF WATER

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section addresses the provisions for controlling, handling, disposing and treating groundwater and surface water, including contaminated water, that may be encountered in trenched excavations, tunnels, workshafts, and ancillary structure excavations, as required for performance of the work, including all equipment, tools, materials and labor required for constructing, operating, and maintaining water control systems such as the pumps, disposal of sludge from settling basins and treatment plants; and work necessary to repair or replace property damaged due to groundwater disturbance.

B. Control of water includes lowering the groundwater table and intercepting seepage which would otherwise emerging from slopes or bottoms of excavations and disposing of collected water. The intent of controlling the water is to increase stability of excavations and associated slopes; prevent dislocation of material from slopes, sidewalls and bottoms of excavations; and to provide suitable conditions for placement of backfill materials and construction of structures and other installations.

C. The Contractor is responsible for the continuous control of water at all times during the course of construction, and shall provide adequate backup systems to accomplish control of water. The method of control, handling, and disposal of groundwater and surface water shall be by whatever means necessary and in conformance with this section to obtain satisfactory working conditions and to maintain the progress of the work.

D. All required drainage, pumping, treatment, and disposal shall be done without damage to adjacent property or structures and without interference with the operations of other contractors, the rights of public and private owners, or pedestrian and vehicular traffic.

E. The Contractor shall modify the water control system at his own expense if, after installation and while in operation, it causes or threatens to cause damage to adjacent property or to existing buildings, structures, or utilities.

F. General control of water and lowering of the groundwater table for the purpose of stabilization of the tunnel face during mining will not be permitted.

G. Localized dewatering and lowering groundwater table inside of workshaft or trenched excavation is permitted; however, the groundwater table shall not be lowered by more than 1 foot below the bottom of the excavation.

H. The Contractor is responsible for the design of all water control systems.

I. The Contractor shall obtain all necessary permits for the control of water as required.

1.02 REFERENCES

A. Code of Federal Regulations (CFR):

1. 29 CFR 1926, Standards – Excavation, Occupational Safety and Health Administration (OSHA).
2. 40 CFR 122 (Vol. 55, No. 222), EPA Administered Permit Programs (NPDES).

1.03 DISCHARGE PERMITS

A. Submit discharge and well permit applications to Alabama Department of Environmental Management (ADEM) if dewatering wells are to be used, as required.

B. Submit design and calculations for the sedimentation tank or clarifier system to be utilized to reduce sediment levels to minimum levels required to the ADEM and the Engineer prior to discharging.

1.04 WATER CONTROL PLAN

A. Water control plan shall be coordinated with requirements of:

1. Section 01 33 00, Submittal Procedures.
2. Section 31 23 16, Excavation.
3. Section ~~33~~ 31 ~~05~~ 26 ~~23~~10, ~~Guided~~ Horizontal Auger Boring.
4. ~~Section 31 80 00, Geotechnical Instrumentation and Monitoring.~~

B. As a minimum, include:

1. Names of equipment suppliers and installation subcontractors.
2. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; installation; standby equipment and power supply, pollution control facilities including silt removal facilities, discharge locations to be utilized; removal of water control systems; provisions for immediate temporary water supply as required by this section.
3. The Contractor shall submit Shop Drawings showing locations, dimensions, and relationships of elements of each water control system. The submittal shall include design calculations demonstrating adequacy of proposed water control or isolation systems and their components. The Contractor shall provide manufacturer's literature describing installation, operation, and maintenance procedures for all components of the water control system.

4. Design calculations demonstrating adequacy of proposed water control systems and components. The Contractor may be required to demonstrate the systems proposed in the water control plan and to verify that adequate equipment, personnel, and materials are provided to dewater the excavations at all locations and times required.
5. Monitoring plans including measurement of: pumping rates at shafts and wells, reading of piezometers, and water quality sampling of discharge.
6. Contingency plan describing how to continue dewatering in the event of a failure of the primary dewatering system, including pumps, primary electric, etc. or instances where water quality does not meet the effluent requirements of the discharge permit.
7. Handling and disposal of sludge from settling basins.

C. If system is modified during installation or operation, revise or amend and resubmit Water Control Plan to the Engineer.

1.05 QUALITY CONTROL SUBMITTALS

A. During construction, submit pumping rate measurements, water level readings taken at design and construction phase piezometers and groundwater quality data. Contractor readings shall be performed on a weekly basis at a minimum, in addition to any readings taken by the Engineer. Submit the data within 24 hours of readings.

1.06 REGULATORY REQUIREMENTS

A. Obtain discharge permit for water disposal from ADEM.

B. Direct dewatering flows to receiving streams or dedicated storm sewer systems rather than to combined sewer systems or sanitary sewers as required by the discharge permit and local regulations.

C. Treat water collected by dewatering operations to meet effluent limitations and other requirements as required by ADEM, prior to discharge. Monitor effluent limitation parameters as required by the discharge permit.

D. Discharge water as required by the discharge permit and in a manner that will not cause erosion or flooding or otherwise damage existing facilities, completed Work or adjacent property.

PART 2 PRODUCTS

2.01 MATERIALS

A. The Contractor is responsible to determine materials required to meet these Specifications.

2.02 GEOTECHNICAL INSTRUMENTATION

A. Conform to the requirements of Section 31 80 00, Geotechnical Instrumentation and Monitoring.

PART 3 EXECUTION

3.01 GENERAL

A. Coordinate with Section ~~33~~ 31 ~~05~~ 26 ~~23~~10, ~~Guided~~ Horizontal Auger Boring.

B. Geotechnical settlement control instrumentation shall be installed and baseline surveyed in accordance with Section 31 ~~80~~ 26 ~~00~~10, ~~Geotechnical Instrumentation and Monitoring~~Horizontal Auger Boring, at least two weeks prior to starting any dewatering activities.

C. Continuously control, handle, treat and dispose water at all times during the course of construction, and provide adequate backup systems to accomplish control of water in conformance with this section to obtain satisfactory working conditions and to maintain the progress of the work.

D. Water to be controlled includes groundwater, contaminated groundwater; surface water (precipitation and run-off), Contractor service water; and wastewater from combined or separated sewers or related facilities.

E. Obtain all permits required from ADNR and any other agencies for installation and operation of water control systems and discharging of collected water into water courses, water bodies, sewers or the ground.

F. Perform the work without damage to adjacent property or structures and without interference with the operations of other contractors, or the rights of public and private owners, or pedestrian and vehicular traffic. Modify the water control system if, after installation and while in operation, it causes or threatens to cause damage to adjacent property or to existing buildings, structures, or utilities. Modifications are at the Contractor's expense.

G. Immediately repair any structure damaged as a result of the dewatering operations at no additional costs to the Owner.

3.02 WATER CONTROL PLAN

A. Submit the required documents as listed in paragraph 1.03. The Engineer will review the submittal(s) and will offer comments for the Contractor's consideration.

B. Resubmit as appropriate if the system or any part thereof is modified during installation or operation. Should requirements of any permit be different than requirements herein, the more stringent requirements shall control.

C. Provide the submittal at least 30 days prior to installation of water control systems. Resubmit as appropriate if the system is modified during installation or operation.

3.03 SURFACE WATER CONTROL

A. Intercept and divert surface drainage away from the work site by the use of dikes, curb walls, ditches, sumps, or other means.

B. Design surface drainage systems so that they do not cause erosion of soil off the site.

C. Surface runoff shall be controlled to prevent entry of water into excavations.

D. Remove surface runoff controls when no longer needed.

3.04 WATER CONTROL IN EXCAVATIONS

A. Use water control methods that are appropriate, as determined by the Contractor, to permit conditions, ground conditions, construction operations, and requirements of the Drawings and Specifications. The methods shall involve removal of water accumulating within excavations from precipitation and groundwater infiltration, and may involve removal of water outside excavations by means such as the use of dewatering or pressure relief wells.

B. Water control measures shall minimize adverse effects of elevated or reduced water pressure on the work, the surrounding ground and adjacent facilities and structures. The control of water shall not exceed the maximum drawdown level as specified herein. Design and operate the water control measures to prevent removal of in-situ materials (development of lost ground), or loosening or softening of subgrade soils within excavations.

C. Groundwater level shall be reduced no lower than 1 foot below the proposed invert elevation until the required work is complete.

D. Control groundwater and surface water such that the construction of tunnels, workshafts, open-cut excavations, trenches and other structures can be performed without adverse effects of water on the facilities being constructed, including prevention of hydrostatic uplift pressures on the new facilities until the work has been completed. If soil stratification is such that the water level cannot be maintained at the specified levels, Contractor shall, at no additional cost to the Owner, control seepage of groundwater by whatever means are necessary to assure that there is no loss of ground by erosion or piping of fines with seepage through shoring or lagging into workshafts or tunnels and no

instability of slopes due to seepage. Control water during periods when excavating, installing ground support systems, installing subgrade protection measures, placing concrete (except tremie concrete), placing pipe, and at such other times as is necessary for efficient and safe execution of the work.

E. Should water enter the excavation in amounts that could adversely affect the performance of the work, or that has the potential to cause loss or damage to adjacent structures or property, the Contractor shall take immediate steps to control the water inflow.

F. Provide standby pumps and standby power supply where disruption of water control systems could allow water inflows to threaten the Work or the safety of personnel.

3.05 MONITORING OF GROUNDWATER LEVELS

A. Monitor groundwater levels as necessary to evaluate the sufficiency of the control of water system using installed piezometers and monitoring wells. A system of construction piezometers is required to monitor free water surface elevations and piezometric elevations to evaluate the effectiveness of the water control system in fulfilling the requirements specified herein.

B. Piezometers shall be of adequate numbers and in suitable arrangements and depths for determining the free water surface elevations and piezometric elevation over the area. A minimum of one piezometer per four dewatering wells or one per excavation location shall be installed with the dewatering system at locations and depths proposed by the Contractor and /or directed by the Engineer.

C. Piezometer materials and installation shall conform to the requirements of Section 31 80 00, Geotechnical Instrumentation and Monitoring. Determination of baseline water levels and monitoring of water levels by the Engineer and Contractor shall be in accordance with Section ~~31 80 00~~31 26 10, ~~Geotechnical Instrumentation and Monitoring~~Horizontal Auger Boring.

D. The Contractor shall make a minimum of one reading at each piezometer, per 24-hour period, 5 days per week during the period of dewatering activities (including dewatering by pumping seepage from sumps within workshafts and tunnels) and one reading at each piezometer per week until the end of construction during periods of no dewatering. These piezometer readings shall be recorded on an approved form and reported to the Engineer within 24 hours after they are obtained.

3.06 DEWATERING WELLS

A. Obtain a site-specific dewatering discharge or construction site storm water discharge permit if the ADEM has specific concerns that are not addressed by other permits that might otherwise apply.

B. Obtain a permit from ADEM for operation and discharge of any dewatering well or well system. For purposes of permitting, a dewatering well is defined as a well constructed and used solely for the purpose of lowering the ground water table elevation.

C. Comply with ADEM regulations regarding disposal of contaminated groundwater in the event that contaminated waters are encountered. Obtain additional permits, if required. Notify the Owner for any discharge of contaminated water into the sewer system, and provide laboratory test results documenting contaminant concentrations.

D. Keep dewatering from wells to the minimum necessary for execution of the work. Obtain any additional geotechnical information necessary for design of a dewatering well system, including performing pump tests, grain size analyses, groundwater chemical analyses, and subsurface investigations. Design and operate wells so as to prevent removal of fine soils with seepage through backpack material and screens. Provide means by which water discharge from each well can be measured and flow rates adjusted. Construct and operate wells in accordance with ADEM requirements, including obtaining permits, as required.

E. The wells shall be designed, installed and operated in a manner that will preclude removal of materials from the ground by the pumping operation (hereafter referred to as "piping of fines"). After installation, each well shall be individually pump-tested at maximum design flow to verify acceptability with respect to piping of fines (sediment mostly consisting of silt and sand) as measured using a centrifugal tester. Any well or wellpoint segment found to be causing piping of fines at a rate exceeding two parts per million (ppm) by volume during the individual pump-test at the maximum design flow shall be replaced at no additional cost to the Owner. Each well shall be checked for sediment piping using a centrifugal tester immediately after installation and at least once per month during operation.

F. Contractor shall measure the sediment content of the total dewatering effluent using a centrifugal tester at least every 30 days. If the sediment content of the total effluent is greater than 1 ppm, Contractor shall identify and abandon wells that are producing excessive fines and replace them if necessary. All sediment content tests shall be performed in the presence of the Engineer. Sediment content test results shall be furnished to the Owner within 24 hours.

G. Monitor the rate of discharge from each well on a daily basis with an accuracy of at least 2 percent of the flow and make records available to the Engineer on a weekly basis or as requested. Abandon dewatering wells as required by local and state authorities.

H. Provide sufficient redundancy in each system to keep excavation free of water in event of component failure.

3.07 PROPERTY LOSS FROM REMOVAL OR DISTURBANCE OF GROUNDWATER

A. Immediately support any structure including, but not limited to, buildings, bridges, streets, and utilities, or portions of such structure, including footings, foundations, basements, walls or concrete driveways that become unstable or vulnerable to settlement due to removal or disturbance of groundwater. Cease excavation and other construction operations that result or have the potential to result in further settlement until corrective measures are implemented. Support shall include but not be limited to shoring; sheeting; bracing; underpinning; compaction grouting; driving piles; excavating, backfilling, and placing new structural concrete beneath or adjacent to the unstable structure; or other means necessary to rectify the particular problem involved.

B. The Contractor shall bear the costs of all loss or damage arising from removal or disturbance of groundwater including, but not limited to claims for subsidence and loss of structure support that may occur in the prosecution of the work. If the Contractor fails to correct the damage resulting from his operations, the Engineer may deem the work to be unacceptable work.

3.08 TREATMENT AND DISPOSAL OF WATER

A. Discharge all water removed from the construction site through pipes or hoses in accordance with ADEM permit requirements. Do not convey water in open ditches or trenches. Discharge water in a manner that will not cause soil erosion at the discharge point. Discharge shall not cause sediment accumulation or flooding in any stream, storm sewer, or on adjacent properties.

B. Treat all water to remove suspended solids, oils, cement, bentonite, and other contaminants by use of settling basins, on-site treatment plant, or other means selected by the Contractor. Select treatment systems that can accommodate expansion if greater capacity becomes necessary during the course of the work. Provide to the Engineer copies of all records required by ADEM.

C. Obtain permission to use storm sewers or drains for water disposal purposes from the authority having jurisdiction. Any requirements and costs for such use shall be the responsibility of the Contractor. The Contractor shall not cause flooding by overloading or blocking the flow in the drainage facilities, and he shall leave the facilities unrestricted and as clean as originally found. Document the condition of the drainage facilities prior to and subsequent to their use. The Engineer may independently verify the condition of such facilities. Repair or restore any damage to facilities as a result of the Contractor's operations as directed by the authority having jurisdiction, at the Contractor's expense.

D. Remove suspended solids from water discharged from excavations, sufficient to preclude sediment deposition in the receiving sewer.

E. Ventilate enclosures around wells and water discharge points to prevent the accumulation of combustible gas that may escape from solution in groundwater.

F. Should requirements of any permit be different than requirements herein, the more stringent requirements shall control.

G. On completing the work, clean out and dispose of all sediments and residues in settling basins, treatment facilities, and the like. Dispose of sediments and residues in accordance with applicable regulations.

3.09 ABANDONMENT OF PIEZOMETERS

A. At the conclusion of all tunnel and workshaft construction, abandon ~~all design and construction phase~~ piezometers in accordance with ~~Section 31 80 00, Geotechnical Instrumentation and Monitoring, and in accordance with requirements of~~ local and state authorities, whichever is more stringent.

PART 4 MEASUREMENT AND PAYMENT

A. Control of water shall be considered as part of Bid Item XX – "Dewatering" and paid for at the contract lump sum price (LS). The contract lump sum price shall include all work necessary to control, handle, dispose and treat groundwater and surface water that may be encountered in trenched excavations, tunnels and workshafts to allow for construction of the project. Dewatering shall include all equipment and labor necessary for installation of wells and piezometers, providing pumps and equipment necessary for discharge, and monitoring and treatment necessary to meet effluent limitations for silt and sediment.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   e. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   f. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   h. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

E. Completed Course: A course or layer that is ready for next layer or next phase of Work.

F. Lift: Loose (uncompacted) layer of material.

G. Geosynthetics: Geotextiles, geogrids, or geomembranes.

H. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

I. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1 foot outside outermost edge at base of foundations or slabs.
2. 1 foot outside outermost edge at surface of roadways or shoulder.
3. 0.5 foot outside exterior at spring line of pipes or culverts.

J. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

K. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

L. Imported Material: Materials obtained from sources offsite, suitable for specified use.

M. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

N. Standard Specifications: When referenced in this section, shall mean Alabama Department of Transportation Standard Specifications for Highway Construction, Latest Edition.

1.03 QUALITY ASSURANCE

A. Notify Engineer when:

1. Structure is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
3. Fill material appears to be deviating from Specifications.
4. Contractor is responsible for contracting the services of a independent testing agency to complete all required geotechnical testing and monitoring required as part of this Project.

1.04 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02 41 00, Demolition, Section 31 23 16, Excavation, and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 10, Structural Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 31 23 13, Subgrade Preparation.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests: By Contractor's testing laboratory as necessary to locate acceptable sources of imported material.

2.02 EARTHFILL

A. Excavated material from required excavations free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

B. Provide imported material of equivalent quality, if required to accomplish Work.

2.03 CLASS B

A. 1-inch minus crushed gravel or crushed rock.

B. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 200 sieve.

2.04 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.

D. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

E. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 UNDER MANHOLES AND PIPES AND PAVEMENT

A. Within influence area beneath piping and other facilities, backfill with structural fill, unless otherwise shown. Place ~~granular~~ Class B fill in lifts of 6-inch maximum thickness and compact each lift to minimum of 98 percent relative compaction as determined in accordance with ASTM D698.

3.03 OTHER AREAS

A. Outside Influence Areas beneath Piping and Manholes: Unless otherwise shown, place E~~e~~arthfill as follows:

1. Allow for 12-inch thickness of topsoil where required.
2. Maximum 8-inch thick lifts.
3. Place and compact fill across full width of embankment.

4. Compact to minimum 95 percent relative compaction as determined in accordance with ASTM D698. If any two of the four most recent tests falls below 94 percent or any one of the four preceding tests falls below 94 percent, additional compactive effort will be required.
5. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.04 SITE TESTING

A. Gradation:

1. One sample from each 500 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.

B. In-Place Density Tests: In accordance with ASTM D6838. During placement of materials a minimum of once per lift.

3.05 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by Engineer as follows:

1. Beneath Footings: Structural fill.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Trenches:
   a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 31 23 23.15, Trench Backfill.
   b. Authorized Overexcavation: Trench stabilization material, as specified in Section 31 23 23.15, Trench Backfill.

3.06 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill and shall be correct by the Contractor at their own expense to the satisfaction of the Owner and Engineer.

END OF SECTION

SECTION 31 26 10
HORIZONTAL AUGER BORING

PART 1 GENERAL

1.01 WORK INCLUDED

A. This section covers the complete installation of 24- and 36-inch OD steel casing pipe installed using Horizontal Auger Boring along the proposed alignment, furnishing of all labor, materials, equipment and incidentals and all other related work necessary for the trenchless installation to include but is not limited to, dewatering and requirements for furnishing, installing, and maintaining geotechnical instrumentation to monitor vibrations and ground movements around, and above the proposed alignments.

B. The Contractor shall not utilize any other tunneling method without written authorization from the Engineer. The Contractor will be required to demonstrate that the proposed alternate tunneling method is technically feasible and will result in settlement less than the shutdown values presented herein. The Contractor will be required to submit three examples of crossings of similar lengths and in similar soil conditions where the proposed alternate was successfully completed.

C. The Contractor shall confirm location of all known existing utilities by potholing prior to start of work shaft excavations and horizontal auger boring operations.

D. The Contractor shall be responsible for the final constructed product, materials, and tools used, and for furnishing the labor and qualified superintendents necessary for the selected method of construction.

E. In the event of a conflict between these Specifications and permit requirements, the more stringent requirement shall apply.

F. Only the Contractor who has met the qualification requirements of Article Quality Assurance, may perform the work described in this section.

1.02 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. Where conflicts between these Specifications and the referenced specification, code, or standard occur, the more restrictive specification shall govern. The publications are referenced in the text by basic designation only. Where a date is given for referenced standards, that edition shall be used. Where no date is given for referenced standards, the latest edition available on the date of issue of Contract Documents shall be used.

B. The following is a list of standards which may be referenced in this section:

1. American Petroleum Institute (API): 5L, Line Pipe.
2. American Water Works Association (AWWA): C200, Steel Water Pipe - 6 in. (150 mm) and Larger.
3. ASTM International (ASTM): A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).

C. Occupational Safety and Health Administration (OSHA):

1. Code of Federal Regulations; Title 29 - Labor; Chapter XVII - Occupational Safety and Health Administration; Department of Labor (Parts 1900-1999), "Revised Excavation Standards" (29 CFR 1926.650 Subpart P).
2. Code of Federal Regulations; Title 29, Labor; Chapter XX - Occupational Safety and Health Administration; Department of Labor (Parts 2200-2499).

1.03 SUBMITTALS

A. Qualifications: Submit the name of the Contractor that will perform the horizontal auger boring work and submit qualifications for the Contractor and superintendent that meet the requirements of Article Quality Assurance. In addition, submit names and training/ qualifications of personnel that will perform air quality monitoring, the site safety representative, and the professional land surveyor.

B. Horizontal Auger Boring Operations:

1. Submit a Horizontal Auger Boring Work Plan with complete Contractor’s construction drawings and written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction, as required by the method of installation. Sufficiently detail the Drawings and descriptions to demonstrate whether the proposed materials and procedures will meet the requirements of this section. Include the following items, at a minimum, in the Horizontal Auger Boring Work Plan, (including Drawings):
   a. Arrangement drawings and technical specifications of the horizontal auger boring machine (ABM) and experience record with this type of machine. Include the following information concerning the horizontal auger boring machine:
      1) Dimensions and specifications.
      2) Cutting head adaptor. (if used)
      3) Cutter type and arrangement.
      4) Cutter head position relative to casing.

5) Casing and band diameters.
6) Cut diameter based on wing cutter position and casing band diameter and resulting excavation diameter
7) Torque, speed, and thrust.
8) Auger and muck casing diameters.
9) Mucking system for ABM
10) Guidance System or Steering Head. (if used)

b. Method and frequency of establishing, maintaining and controlling line and grade of horizontal auger boring operation. Include any related manufacture information for equipment being proposed to achieve the contract requirements.
c. Method and details of spoil removal, including equipment type and numbers, processing, and disposal.
d. Details of the horizontal auger boring machine and operation.
e. Plans for storage and handling of casing.

C. Work Shafts

1. Submit for information written documentation as supporting evidence of the qualifications of the Contractor's engineer.
2. Drawings and calculations shall be prepared and sealed by a professional civil engineer registered in the State of Alabama with at least 5 years experience in design and construction of ground support systems similar to those planned.
3. Submit for information drawings and computations for work shaft excavations, excavation support systems, and other related information. As a minimum, the submittal shall contain the following information:
   a. Name and qualifications (including evidence of professional registration in the State of Alabama) of person responsible for excavation support system design.
   b. Construction method to be used for the installation of each system, including sequence of installation and equipment description.
   c. Shop Drawings and design calculations showing assumed loading conditions, codes and reference standards used as a basis for design, estimated ground movements, system component design, arrangement of supports and construction sequence for proposed support system(s). Provide maximum allowable spacing between bracing points on compression members to maintain stability and alignment. Show the elevation of struts, braces, or other supports as related to the depth of excavation at intermediate stages of construction. Provide details of bottom slab, drains, and sump construction. Indicate sizes, shapes, and material specifications for all support elements including lagging, if used. Calculations shall include estimates of likely deflections or deformations of the

support system and maximum tolerable values. Calculations shall also show the thrust block design and an adequate structural factor of safety for the thrust block-wall system when subjected to the anticipated maximum jacking forces during pipe jacking.

d. Water Control Plan defining well or sump locations, pump sizes, installation sequence and timing, piping layout, and discharge locations.

e. Plans and procedures for protecting adjacent structures, utilities, and facilities including: excavation, control of water, ground improvement, underpinning, monitoring and restoration of any damage.

f. Plans and procedures for covering all work shafts when not actively being utilized consisting of road plates, fencing, netting, or other methods determined by the Contractor to prevent access to the public.

g. Quality Control Procedures: address materials testing requirements and excavation monitoring provisions.

h. Work shaft abandonment plans, including backfilling and removal of support elements.

4. Submit for information the following data and reports during the work:

a. Summary of ground and groundwater conditions encountered.

b. As-builts of abandoned excavation support system, if left in place.

c. Any excavation monitoring analysis, including: horizontal and vertical deflections of supports, horizontal and vertical movements of adjacent ground and facilities, and measurements of strut loads being collected by the Contractor as specified in this section.

D. Pre- and Post-Construction Surveys: Submit Pre- and Post-Construction survey to include date stamped photos of the site prior to any work being completed in the vicinity of the crossing and as specified herein.

E. Quality Control Methods. At least 30 days prior to the start of horizontal auger boring, the Contractor shall submit to the Engineer a description of the quality control methods proposed for the horizontal auger boring operations. The Submittal shall include:

1. Supervision: Supervisory control to ensure that Work is performed in accordance with the Plans and Specifications, and horizontal auger boring work plan and Drawings.

2. Line and Grade: Procedures for surveying, controlling, and checking line and grade, including field forms. Procedures for resetting guidance system if its alignment shifts or is moved off design alignment and grade for any reason.

3. Movement Monitoring: Procedures for monitoring settlement along the tunnel alignment as specified herein.

4. Horizontal Auger Boring Observation and Monitoring: Procedures for preparing and submitting daily logs of horizontal auger boring operations, including example field forms.
5. Products and Materials: A plan for testing and submittal of test results to demonstrate compliance with the Specifications and Contractor's criteria for permanent products, materials, and installations. The plan shall identify all applicable standards and procedures for testing and acceptance.

F. Casing Pipe: Submit detailed drawings of the casing pipe indicating casing pipe material including the standard to which it is manufactured, outside diameter, wall thickness, and any joint details. Indicate the ultimate and allowable jacking capacity, the required fabrication tolerances to prevent damage to the pipe during installation, and provide a certification indicating that the pipe meets these tolerances and is designed to meet all anticipated loading conditions with an adequate factor of safety.

G. Carrier Pipe Installation:

1. Describe methods, procedures, and equipment for installing carrier pipe inside the casing.
2. Provide manufacturer information and installation details for end seals.

H. Safety Plan: A safety plan for horizontal auger boring operations including air monitoring equipment and procedures. The plan should also include at a minimum:

1. Protection against soil instability and groundwater inflow.
2. Safety for work shaft access and exit including ladders, stairs, walkways, and hoists.
3. Protection against mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.
4. Monitoring for hazardous gases.
5. Protection of work shaft as shown on the Drawings including traffic barriers, accidental or unauthorized entry, and falling objects.

I. Vibration Monitoring Plan:

1. Submit at least 30 days prior to commencement of rock excavation along 11th Street, a plan for monitoring vibrations at adjacent structures to assure compliance with the vibration limitations. Provide the following in the plan as a minimum:
   a. Recommended vibration limitation at the structure located on Parkway Drive and 11th Street.
   b. Coordination requirements with structure owner for inspecting the structure and monitoring vibrations during rock excavation.

c. Description of and specifications for seismographs and other monitoring equipment for monitoring and recording peak particle velocities during rock excavation.
d. Identification of monitoring locations for vibration and frequency of monitoring.
e. Measures taken to couple the vibration transducers to the surface to be monitored,
f. Mitigation Plan for when the vibration of eighty percent (80 percent) and one-hundred percent (100 percent) limits specified are reached or exceeded. The plan shall also include means and methods of providing warning when these values are reached.

J. Calculations: Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in this section. All calculations shall be prepared by professional engineer licensed in the State of Alabama, who shall stamp and sign calculations.

1. Design calculations demonstrating that the proposed casing pipe is capable of supporting the maximum stresses to be imposed during jacking. The calculations shall take into account earth and hydrostatic loads, jacking forces, external loads such as live loads due to the traffic loads, railroad loads, and any other loads that may be reasonably anticipated during jacking. All loads shall be shown and described. Include assumed maximum drive length.
2. Calculations demonstrating that the soils behind the thrust block can transfer the maximum planned jacking forces exerted by the jacks to the ground during pipe installation with a factor of safety, without excessive deflection or displacement.

K. Schedule: Provide a schedule for all horizontal auger boring work, identifying all major construction activities as independent items. The schedule shall include, as a minimum, the following activities: mobilization, Alabama “One Call” utility locate requests, confirmation of underground utilities by potholing as required on the Plans and in the Specifications, groundwater control at launching and receiving work shafts, work shaft excavation and support, working slab construction, thrust block construction, jacking equipment setup, auger boring, installation of the carrier pipe, backfill of work shaft, site restoration, cleanup and disposal, and demobilization. The schedule shall also include the work hours and workdays for each activity, and a written description of the construction activities. The schedule will be reviewed by the Engineer and shall be updated and resubmitted by the Contractor every 2 weeks, or more frequently if requested by the Engineer.

L. Before the Drive: Submit the following to the Engineer at least 24 hours prior to the start:

1. Results of line and grade survey to ensure that the thrust block, jacking frame, and guide rails are installed properly prior to launch.

M. Daily Records: The following daily records shall be submitted to the onsite Engineer by noon on the day following the shift for which the data or records were taken:

1. Horizontal Auger Boring Records: The Contractor shall provide complete horizontal auger boring records to the Engineer. These records shall include, at a minimum: date, time, name of operator, trenchless crossing identification, installed ground support element/pipe number and corresponding tunnel length, rate of advance, jacking forces, torque, auger rates, subsurface conditions encountered, line and grade offsets, any movement of the guidance system, with the horizontal auger boring machine or other components or equipment, and durations of and reasons for delays. Manually recorded observations should be made at intervals of not less than once per 5 feet, as conditions change, and as directed by the Engineer. At least 7 days prior to the start of augering, the Contractor shall submit samples of manual horizontal auger boring records to be used.
2. Survey Measurements: Survey measurements of casing alignment, and monitoring data of all surface and subsurface settlement monitoring points as required herein.

N. Contingency Plans: The following list includes problem scenarios that may be encountered during the horizontal auger boring operations. The Contractor shall submit contingency plans for dealing with each problem scenario while satisfying the Specifications. These Plans shall include the observations and measurements required to clearly identify the cause of the problems.

1. Machine unable to advance:
   a. Possible obstructions (including intact rock, boulders, trees, old foundations, metallic debris, reinforced concrete; i.e., jammed cutterhead).
   b. Insufficient auger torque or jacking capacity.
   c. Machine malfunction.
2. Spoil Feed Problems: Strong hydrocarbon smell is detected in the spoils or in the shaft.
3. Jacking Forces:
   a. Jacking forces increase dramatically or suddenly.
   b. Jacking forces reach design capacity of casing, jacking frame, or thrust wall (treat these scenarios as separate incidents).

4. Settlement and Subsidence:
   a. Survey measurements indicate deformations exceed limits as defined herein.
   b. Excavated volumes significantly exceed tunnel or casing volume installed, as applicable.
   c. Rapid excess lost ground results in large voids or sinkholes.
   d. Uncontrollable groundwater inflow through the casing.
5. Line and grade tolerances being exceeded.
6. Pipe has been damaged or has been found to be out of compliance with Specifications during, or after installation.
7. Thrust block deforms excessively under jacking loads, or provides insufficient capacity to advance casing.

O. Abandonment Contingency Plan: The Contractor shall prepare an abandonment contingency plan to handle the possibility that the Contractor cannot complete the trenchless crossing. The Contractor shall follow all provisions of the approved plan.

1.04 DEFINITIONS

A. Carrier Pipe: Permanent pipe for operational use that is used to convey flows.

B. Casing: A pipe installed by horizontal auger boring that supports the ground and provides a stable underground excavation for the installation of a carrier pipe.

C. Facility Settlement Marker (FM): A readily identifiable existing feature or new paint marking on an existing building; or an inscribed marking, approved surveyor's nail, or brass or stainless steel rod (pin) installed onto a manhole, vault, or other similar structure at predetermined locations to measure vertical elevation changes of a facility or structural element.

D. Ground Surface Settlement Marker (GM): GMs are stakes, rods, or nails installed in unpaved or paved areas at predetermined locations to measure vertical (elevation) changes of the ground surface.

E. Horizontal Auger Boring: Trenchless installation method utilizing an auger boring machine to bore a hole and remove spoil via auger flights and jacks to advance casing.

F. Jacking Record: A manually recorded report that contains information on horizontal auger boring operations and includes recorded data specified in this Section.

G. Open Ground: Ground without any above or below-grade facilities, paved or unpaved roads, and utilities within a 25-foot horizontal radius.

H. Radial Overcut: Radial overcut is defined as the difference between the maximum diameter created by the cutting teeth, cutting shoe, or overcut band on the machine or auger (whichever is greater) and the outer diameter of the casing, divided by two.

I. Shaft: The term "shaft" shall mean the manholes or other permanent vertical structures with a final shaft lining placed relatively close to a work shaft excavation. In conventional usage a “shaft” is a structure that is deeper than it is wide, but in the context of these Specifications the term “shaft” includes miscellaneous concrete structures that may be wider than they are deep that are constructed within work shaft excavations as defined below.

J. Work shaft: The term "work shaft" shall mean the temporary ground excavation requiring an excavation support system until the shaft structure to be constructed within the excavation is complete and the excavation around and over the structure is backfilled.

1.05 DESIGN CRITERIA

A. Horizontal Auger Boring Equipment:

1. Horizontal auger boring equipment selected for the Project shall be suitable for, and capable of, efficiently advancing through the geologic conditions described herein, and the geologic conditions anticipated by the Contractor.
2. Provide a horizontal auger boring machine with a reversible drive system so that the head can rotate in either direction.
3. Provide means to measure the line and grade of the casing during augering to verify compliance with the contract documents. The Contractor can chose to remove augers from the casing every 40 feet of casing installed and use a pipe laser to measure the line and grade of the casing for verification if a water level or similar is not used.
4. The maximum radial overcut is 3/4 inch. The maximum allowable radial overcut value has been selected to minimize potential settlements of the ground and subsurface facilities.
5. The face of the cutting head shall be arranged to provide a reasonable obstruction to the free or uncontrolled flow of material. The auger and cutting head arrangement shall be removable from within the casing pipe in the event an obstruction is encountered.

B. Methods and equipment shall control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. Any ground movements (settlement/heave) shall be limited to values that do not cause damage or distress to surface features, utilities, or improvements. The Contractor shall comply with the monitoring requirements in this section. In no case shall ground movements exceed the limits specified herein.

C. Design steel casing to withstand full overburden pressure, potential hydrostatic pressures, applicable traffic loads, railroad loads, possible construction surcharge loads, and jacking forces. Maximum jacking forces shall not exceed 67 percent of the allowable pipe jacking load at all pipe locations or of the jacking/thrust block system, or the maximum design strength of the casing pipe as established by the manufacturer, whichever is lower.

D. If Contractor elects to increase the casing diameter from the dimension shown on Drawings, the Contractor shall match casing crown elevation such that the depth of cover is not decreased.

E. Use a thrust block to transfer jacking loads to the soil behind the jacking shaft. Construct the thrust block face perpendicular to the proposed casing alignment. Design the thrust block to withstand the maximum jacking forces developed by the main jacks, without excessive deflection or displacement. The thrust pressures transmitted to the soil adjacent to the thrust block shall not exceed an allowable passive earth pressure based on a minimum factor of safety of 2.0 relative to the computed maximum passive earth pressure.

F. Work Shaft Excavation Support Design:

1. The design of the excavation support systems shall be prepared for the Contractor by a professional engineer licensed in the State of Alabama, and employed or retained by the Contractor. This individual is referred to herein as the Contractor's engineer. The Contractor's engineer shall have at least 5 years of experience with design and construction of similar types of ground support systems and excavations. The Contractor's engineer shall maintain involvement and responsibility from design through installation, performance and abandonment or removal of ground support systems.
2. All ground support system elements including sheeting, shoring, and bracing of excavations shall conform to the requirements of Subpart P, Excavations (Standard Number 1926.650 and 1926.651 of 29 CFR) of the Occupational Safety and Health Administration (OSHA).
3. The design shall provide groundwater control or cut-off, bottom stability and system stiffness sufficient to meet the Contract requirements for control of water and for protection of adjacent work and property as specified. The design shall be compatible with the Contractor's selected methods of excavation. The design shall provide for placement of excavation support systems along ALDOT roadways prior to starting any excavation in the vicinity without damaging existing property or utilities. The design shall address the removal of such support systems where required and feasible. The design shall provide for construction of the permanent work, and all other construction operations and requirements.

4. The Contractor's engineer shall design the work shaft excavation support systems and working slabs to withstand earth pressures, groundwater pressures, bottom heave, equipment loads, thrust block loads from pipe jacking, loads from making a portal for tunneling, applicable traffic and construction loads, and other surcharge loads to allow the safe construction of the tunnel without excessive movement or settlement of the ground, and to prevent damage to or movement of adjacent structures, streets, and utilities.
5. Design excavation support systems to be compatible with the geologic conditions described herein, and in accordance with AISC and ACI code provisions, as applicable. Potentially acceptable excavation support methods include but are not limited to the use of soldier piles and lagging, interlocked driven sheet piles, liner plate, or slide rail shoring system.
    a. Design each member or support element to support the maximum loads that can occur during construction with appropriate safety factors. Provide a minimum factor of safety of 1.5 for all structural members when subjected to the maximum combination of loads or stresses. The thrust block, if used, shall be normal (square) with the proposed pipe alignment and shall be designed to withstand the maximum jacking pressure anticipated with a factor of safety of at least 2.0, without excessive deflection or displacement.
    b. Design the excavation support system to minimize horizontal and vertical movements, and to protect adjacent utilities from damage. The type and stiffness of each ground support system and the methods of ground support installation shall be designed and constructed in order to meet the ground movement limits and adjacent property protection requirements specified in this Section.
    c. Design the excavation support system to maintain the stability of the excavation against piping or bottom heave. Provide a minimum factor of safety against piping of 1.5. Provide a minimum factor of safety against bottom heave due to adjacent surcharge pressures and hydrostatic uplift pressures or upward seepage pressures of 1.5.
    d. Employ combinations of walers, struts and chamfers for bracing and lateral support as required to support excavation faces. Control groundwater and prevent loss of ground with soldier piles and lagging, sheeting systems or other methods of excavation support. Provide struts with intermediate vertical and horizontal supports as required to prevent buckling. Provide timber lagging or steel sheeting as required to retain soil between supports. Trench shields and/or speed shores other than the slide rails shoring system are only permitted if stability can be demonstrated.

e. Design a gravel pad or concrete working slab equipped with a sump to pump out construction water and storm water for shaft excavation bottoms to provide stable support for construction operations.

f. Locate work shafts as required to complete the trenchless installation between the stations indicated on the Drawings.

g. The excavation support system shall be designed to positively ensure that no earth or other loading will be placed on the new work prior to the completion and until design strength has been reached. The Contractor shall be solely and completely responsible for any loss due to premature loading of the new work.

h. The design shall specify the following items as a minimum: the quality of materials to be used for ground support systems; constraints on maximum excavation limits relative to support installation steps; tolerances for size and position of ground support elements; required preloading of ground support elements; restrictions on surcharge loads and other loads that may act on the ground support system such as jacking forces and grouting, ground freezing and groundwater pressures; ground support system and adjacent ground movement limits; provisions for subgrade stability and protection; and constraints on removal of support system elements as the permanent work is constructed and backfilling is completed.

i. The Contractor's engineer shall periodically observe the installation of support systems to determine that the work is being put in place in accordance with the design. Site observations shall be made by the Contractor's engineer as often as necessary, to ascertain the installation conformance thereto. The Contractor's engineer shall provide the Contractor, and the Engineer on a monthly basis, a signed and sealed certification of the consistency of the installation with the design, as determined from his site observations and available geotechnical instrumentation data. The Contractor’s engineer shall also indicate any significant concerns with the performance of excavation support systems and his recommendations for mitigating these concerns.

G. Vibration Monitoring

1. Conduct all rock excavation in such a manner as to reduce vibrations that reach adjacent structures, facilities, etc. at or below acceptable limits as established by the Contractor's Vibration Monitoring Professional, but which shall not exceed the peak particle velocity limits specified below:
   a. Maximum peak particle velocity:
      1) 0.2 inch per second at frequencies of 1 Hertz or less.

2) 0.5 inch per second at frequencies between 2.6 Hertz and 40 Hertz.
3) Velocities less than that defined by a straight line variation between 1 Hertz and 2.6 Hertz, per (1) and (2) above.
4) 2 inches per second at frequencies above 40 Hertz.

H. All excavated materials must be completely contained within the limits of construction as identified in the Contact Documents. Onsite disposal is not permitted.

1.06 QUALITY ASSURANCE

A. The Contractor hired to perform the Guided Boring Installation shall have a record of success with similar construction for a minimum of 5 years and a minimum of five similar projects with an outside diameter of at least 36-inches and a total installation length of more than 300 feet per installation and a demonstrated ability and capacity to perform the work under this contract to the satisfaction of the Engineer. The Contractor may be rejected if qualifications stated herein are not met.

B. Supervision: Each shift shall be supervised by at least one person with previous experience of the Work. The superintendent must have at least 5 years and 1,000 feet of experience in similar-sized projects (minimum three projects). Contractor shall submit documentation summarizing the experience of superintendents. Application for acceptance of named supervisors shall be made to the Engineer prior to commencement of Work.

C. Operation: System operators shall be experienced personnel with prior knowledge and ability in the proper operation of the systems being employed. Operators must have at least 5 years' experience and have completed at least 1,000 feet of trenchless installation with similar equipment on at least three projects. Contractor shall submit documentation summarizing the experience of system operators. Application for acceptance of named system operators shall be made to the Engineer prior to commencement of Work.

D. Provide a Professional Land Surveyor licensed in the State of Alabama who has prior experience in similar underground projects to be responsible for line-and-grade control.

E. Provide a Vibration Monitoring Professional responsible in the deployment and operation of the seismographs to operate each instrument when excavating rock and to provide initial interpretation of the results. Provide names and resumes of the personnel for approval as part of the required Vibration Plan submittal.

F. Provide a water level system (Dutch level) on the casing or guidance system to permit measurement of the casing grade from within the jacking shaft. Protect the equipment from damage during tunneling and attach it to the casing securely. In the event the water level or guidance system is damaged, completely remove the auger from the casing every 40 feet and perform a manual measurement of casing line and grade using surveying techniques.

G. Provide at least 72 hours advance written notice to Engineer of the planned launch of the ABM. The Contractor shall immediately notify the Engineer, in writing, when any problems are encountered with equipment or materials. All Work by the Contactor shall be done in the presence of the Engineer, unless the Engineer grants prior written approval to perform such Work in Engineer's absence.

H. Allow access to the Engineer and shall furnish necessary assistance and cooperation to aid the Engineer in observations, measurements, data, and sample collection, including, but not limited to the following:

1. Allow Engineer full access to the jacking and reception shafts prior to, during, and following jacking operations. Access includes, but is not to be limited to, visual inspection of installed casing and verification of line and grade. Provide safe access in accordance with safety regulations.
2. Allow Engineer full access to the spoil material. Allow the Engineer to collect soil samples from the spoil removal system a minimum of once per installed casing section, or every 8 feet, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.

1.07 PRECONSTRUCTION AND POST-CONSTRUCTION INSPECTIONS

A. In accordance with Section 01 31 13, Project Coordination.

1.08 SAFETY

A. The Contractor is responsible for Site Safety. Utilize methods of construction to ensure the safety of the Work, personnel onsite, and the public. Perform Work in accordance with current applicable regulations and safety requirements of the federal, state, and local agencies. Comply with applicable provisions of 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations, by OSHA.

B. The preconstruction underground classification according to OSHA is "Potentially Gassy" for this project. Classifications may change during construction depending on air quality monitoring results.

C. No gasoline powered equipment is permitted in work shafts. Diesel, electrical, hydraulic, and air powered equipment is acceptable, subject to applicable local, state, and federal regulations.

D. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are in the shaft or in the casing. Perform required air and gas monitoring. Provide a ventilation system to provide a sufficient supply of fresh air and maintain an atmosphere free of toxic or flammable gasses in underground Work areas.

E. Blasting will not be permitted.

PART 2 PRODUCTS

2.01 STEEL CASING PIPE

A. Fabricated in sections in accordance with AWWA C200, ASTM A139 Grade B, API 5L Grade B, or API 5L Grade X42.

B. Pipe ends shall be beveled for welding.

C. Minimum steel casing diameter and wall thickness are indicated on the Drawings.

D. All casing pipe shall be newly manufactured. No recycled or rehabilitated casing pipe will be accepted.

2.02 CARRIER PIPE

A. In accordance with Specification Section 40 27 01, Ductile Iron Pipe and Fittings.

2.03 CASING SPACERS

A. Fabrication:

1. Spacer Band Material: Type 304 stainless steel.
2. Spacer Liner Material: PVC or neoprene.
3. Spacer Width: As recommended by spacer manufacturer for the specific application.
4. Spacer Runners:
   a. Suitable for supporting weight of carrier pipe.
   b. Manufactured of material having a low coefficient of friction and designed to support the carrier pipe without damage or excessive wear.
5. Size: Sufficient to provide a minimum clearance of 2 inches between outside of carrier pipe bells or couplings and inside of casing.

B. Manufacturers:

1. Pipeline Seal and Insulator, Inc. (PSI), Houston, TX.
2. Advance Products and Systems, Inc., Lafayette, LA.
3. Cascade Waterworks Mfg. Co., Yorkville, IL.

2.04 CASING END SEALS

A. Synthetic rubber, conical shape, pull-on or wrap-around style with Type 304 stainless steel bands.

B. Manufacturers:

1. Pipeline Seal and Insulator, Inc. (PSI), Houston, TX.
2. Advance Products and Systems, Inc., Lafayette, LA.
3. Cascade Waterworks Mfg. Co., Yorkville, IL.

2.05 SETTLEMENT MARKERS

A. Ground surface settlement markers (GM) in unpaved areas shall consist of a 2-inch by 2-inch by 12-inch long hardwood stake or a 12-inch long, 1-inch diameter (No. 8) reinforcing bar driven approximately 10 inches below grade. In paved areas GMs shall be hardened surveyor “PK” nails that are securely fastened by driving or epoxy grouting within a properly sized hole, flush with the pavement.

B. Facility settlement markers (FM) on buildings shall be if possible a readily identifiable existing feature, otherwise FMs shall be a durable paint marking on the building. Facility settlement markers on manholes and similar structures shall be distinct, durable markings located on a high point or other point that is suitable for consistent survey accuracy.

C. Provide each monitoring point with a tag or marking indicating the station and offset from centerline. Assign each point a unique identification number and protect from damage or burial. Flag each point so as to remain visible.

2.06 VIBRATION MONITORING EQUIPMENT

A. Recording seismographs instruments: 4-component waveform recorders (seismographs), measuring and recording the three components (longitudinal, transverse, and vertical) of the particle velocity waveform (amplitude time history). The specific make and model of the instruments to be employed shall be as recommended by the Vibration Monitoring Professional and approved by the Engineer.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. The Contractor's selection of means and methods for excavation is integral to the planning and execution of the work of the project as specified. The selection of means and methods is the responsibility of the Contractor and the selected means and methods shall be capable of coping with subsurface conditions identified Section 31 20 00, Baseline Subsurface Conditions.

B. Install the casing pipe to meet requirements of authority or agency having jurisdiction over the undercrossing.

C. Horizontal auger boring shall not begin until the following tasks have been completed:

1. All required Submittals have been provided, reviewed, and approved.
2. Locations and elevations of all existing utilities have been verified and confirmed that they are not in conflict with the proposed trenchless installation.
3. Pre-construction survey has been completed including installation of the geotechnical instrumentation.
4. Baseline values for geotechnical instrumentation has been established as required herein.
5. Approved Traffic Control Plan in accordance with ALDOT Standard Specifications is executed and in place.
6. All required permits and notice(s) to proceed have been received.
7. Work shaft excavations and support systems have been completed in accordance with approved Submittals.
8. Locations and elevations of shafts shall have been surveyed to confirm that Work can be completed in accordance with alignment and grade shown on Plans.
9. The location, orientation and grade of guide rails have been surveyed to ensure they are on the proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails in the launching shaft to ensure stability and accuracy of the alignment and grade. Guide rails shall be secured to prevent movement or shifting during the work.
10. A startup inspection of all mechanical and hydraulic systems associated with the horizontal auger boring operations has been completed. The system shall be tested on the surface to ensure that the horizontal auger boring machine and supporting equipment is functioning properly.

D. Properly manage and dispose of groundwater and surface water inflows to the shafts in conformance with approved Dewatering and Construction Stormwater Discharge Permits. Do not discharge surface water inflows into storm sewers, sanitary sewers, drainage ditches, or streets without an approved discharge permit.

E. Conduct all operations such that trucks and other vehicles do not interfere with traffic into or out of the site or create a mud, dust, or noise nuisance in the streets and to adjacent properties. Promptly clean up, remove, and dispose of mud and spoils spillage, and any material discharges.

F. All Work shall be done so as not to disturb roadways, adjacent structures, landscaped areas, or existing utilities. Any damage shall be immediately repaired to original or better condition and to the satisfaction of Engineer, at no additional cost to the Owner.

G. Operate with a full crew 24 hours a day whenever there is a condition that is likely to endanger the stability of the excavation or adjacent structures, including weekends and holidays, without interruption, until those conditions no longer jeopardize stability

3.02 GEOTECHNICAL INSTRUMENTATION

A. General:

1. Instrumentation shall be installed at the locations indicated in this Specification or approved Shop Drawings, and as approved by the Engineer. All instrumentation shall be installed in the presence of the Engineer.
2. Engineer shall have access to instrument locations, and Contractor's cooperation is required in obtaining monitoring data, including the provision of assistance, as required.
3. All instruments shall be clearly marked, permanently labeled, and protected to avoid being obstructed or otherwise damaged by construction operations or the general public.
4. Geotechnical instrumentation shall be installed and initial baseline readings completed before commencing any excavation for work shafts and casing installation.
5. Location Surveying: Promptly following installation, the Contractor shall survey and provide horizontal coordinates and vertical elevations of the ground surface and top of all instruments.
6. Initial Reading: Following instrument installation and prior to the start of any construction activity within 100 feet of the tunnel alignment centerline or edge of the work shafts, the Contractor's surveyor, shall take a minimum of two sets of initial readings to provide baseline readings and to demonstrate the adequacy of the completed installation.
    a. Installation of the instrumentation by the Contractor does not preclude the Owner, through an independent contractor, from installing instrumentation in, on, near, or adjacent to the construction work.
    b. Elevations shall be recorded to a precision of 0.005 of a foot. Horizontal survey accuracy shall be at least 0.01 foot.

c. The Contractor shall take additional survey(s) as requested by the Engineer if in the opinion of the Engineer the two sets of initial readings do not adequately establish the baseline level. After initial readings are approved by the Engineer, the average of the two sets of initial readings shall be used to establish the baseline level of the instrument, unless otherwise directed by the Engineer.

B. Surface Settlement Markers (GM):

1. GMs shall be installed where indicated in this Specification, and approved submittals. Markers shall be installed firmly to prevent loosening in a manner and location that allows survey rods to be consistently placed on the high point of the marker head or point being measured.
2. The method of installation of GMs shall be the Contractor's option; however, the marker shall be rigidly affixed so as not to move relative to the surface.

C. Facility Monitoring Points (FM):

1. FMs shall be installed where indicated on the Drawings, and approved submittals. Markers shall be installed firmly to prevent loosening and in a manner and location that allows survey rods to be consistently placed on the high point of the marker head or point being measured.
2. All FM locations on buildings shall be approved by the Engineer. If on a building foundation a readily identifiable feature cannot be identified for an FM, the Contractor shall use a durable paint that will not damage the surface finish.

D. Protection of Property and Ground Movement Limits

1. The Contractor shall use whatever means and methods are necessary to limit ground movements, settlements and damage of utilities, structures and other facilities. These means and methods include, but are not limited to ground support systems, tunneling methods, underpinning of vulnerable facilities, grouting and other forms of ground improvement.
2. The ground movement limits for all instruments are established as follows:

Facility	Action Limit (inch)	Displacement Limit (inch)
Railroad	0.25	0.50
Existing utilities, general roadway pavement	0.50	0.75
Open Ground	1.00	1.50

3. If settlement of an instrument reaches an Action Limit, the likely cause of the settlement shall be reported to the Engineer and actions shall be promptly taken to limit further settlements and to prevent Settlement Limits from being exceeded. Actions to be taken in response to measured settlements shall be reported to the Engineer before being taken, except in emergency situations. The cost of actions required to comply with settlement limits and to repair any damage to adjacent facilities shall be borne by the Contractor with no cost to the Owner.

E. Instrument Protection, Maintenance and Repair:

1. Flag and protect all locations. Exercise care during construction so as to avoid damage to instrumentation. Repair or replace instrumentation that is damaged as a result of the Contractor's operation at his expense. The Engineer will determine whether repair or replacement is required. Complete the repair or replacement as soon as practical after notification by the Engineer as to whether a repair or replacement is required.
2. Instruments shall be maintained by draining any accumulated water, removing any debris from under protective covers and keeping covers locked and sealed at all times.

F. Abandonment of Instruments: The Contractor shall remove all geotechnical instrumentation during the cleanup and restoration work, or sooner as allowed or required by the Engineer.

3.03 EXISTING UTILITIES

A. Confirm location of all existing utilities by potholing prior to start of work shaft excavation and casing installation.

3.04 CONTROL OF WATER

A. In accordance with Section 31 23 19, Control of Water.

B. The Contractor shall not discharge groundwater inflows into storm sewers, sanitary sewers, drainage ditches, water bodies, or streets without an approved discharge permit.

3.05 WORK SHAFT INSTALLATION

A. Notify Engineer not less than 10 working days before beginning work shaft excavation.

B. Do not start any rock excavation at the 11th Street work shaft without an approved vibration monitoring plan. Complete at least 3 days of background vibration monitoring to establish a baseline vibration prior to rock excavation.

C. Support systems shall be installed to permit the safe execution of the work, and to ensure that no ground loading or other loading will be placed on the new work prior to completion and until design strength of the structure being constructed has been reached.

D. Excavation support systems shall be installed in a manner to control groundwater inflow into work shaft excavations; minimize loss of soil into excavations; minimize ground movements outside the excavations; maintain stability of the excavations; and preserve the in situ strength of surrounding soils.

E. Install initial support systems in advance of excavation, within 5 feet of bottom of excavation, or closer if required for safety or by regulation, and as necessary to conform to these Specifications.

F. During periods of shutdown, fully support the face, walls, and bottom of excavation to prevent heave and/or lost ground.

3.06 EQUIPMENT SELECTION

A. Select necessary equipment and methods to install casing and carrier pipe as shown on Plans. Selected equipment shall be capable of accurate alignment and grade control, and shall protect against subsidence or other disturbance of ground, existing utilities, existing road surfaces, and other existing structures.

3.07 CASING INSTALLATION

A. Provide a suitable jacking frame and thrust block to carry out the Work.

B. Transport the casing pipe from storage to the launching work shaft without damage. Transport methods shall be acceptable to casing pipe manufacturer. Damaged casing pipe shall not be used in the Work, unless permitted in writing by the Engineer. Set the pipe to be jacked on properly braced and supported guide rails.

C. The axial forces from the thrust jacks shall be distributed to the casing pipe uniformly through a thrust ring and cushion material to prevent damage to the ends of the pipe. Jacking forces applied to the pipe shall not exceed the specified allowable compressive stresses.

D. Casing pipe sections shall be jacked into position following the design line and grade without damaging the pipe.

3.08 VIBRATION MONITORING

A. Furnish, install, calibrate, maintain and operate seismograph instrumentation for measuring and recording vibrations.

B. All instruments shall be periodically checked for proper calibration and shall be maintained in first-class working order. Instruments shall be replaced, repaired or recalibrated when needed and when directed by the Contractor's Vibration Monitoring Professional or the Engineer.

C. Instrument vibration transducers shall be firmly anchored to the measurement surface such that they will remain firmly in contact with the measuring surface.

D. The recordings shall be taken under the supervision of the Contractors Vibration Monitoring Professional. In addition, the Vibration Monitoring Professional shall interpret the readings and shall establish the vibration limitations at the structure being monitored. Under no circumstances shall the limits exceed the values stated herein.

E. Provide the Engineer instrumentation readings within 24 hours of collecting the data.

F. If peak particle velocity exceeds 80 percent of the controlling ground vibration level specified in this Section for any single axis measured, the Contractor shall immediately, within less than 4 hours, notify the Engineer.

G. If the Contractor exceeds 100 percent of the controlling ground vibration level specified in this Section for any single axis measured, the Contractor shall cease all rock excavation immediately and submit a written report to the Engineer include any necessary proposed corrective action to ensure that the specified vibration limits will not be exceeded. This report shall be given to Engineer within 24 hours of the incident that Contractor exceeded 100 percent of the controlling ground vibration level specified in this Section. Rock excavation activities shall not resume until the Engineer acknowledges, in writing, that a change is being attempted by the Contractor. The loss of time and effort for ceasing and restarting the rock excavation operation to meet the specified limits are incidental to the Work.

H. Monitoring Locations:

1. At least one instrument shall be available to record ground vibrations during rock excavation.
2. Instrument location shall be proposed by the Vibration Monitoring Professional and approved by the Engineer, or as directed by the Engineer.

3.09 OBSTRUCTIONS

A. In accordance with Section 31 20 00, Baseline Subsurface Conditions.

3.10 HORIZONTAL AUGER BORING

A. Horizontal auger boring shall be completed in accordance with approved Submittals, and all applicable permit conditions.

B. Provide means of steering casing to ensure allowable tolerance can be achieved.

C. Horizontal auger boring operations shall control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. The Contractor shall repair any damage resulting from construction activities, at no additional cost to Owner and without extension of schedule for completion. The Contractor shall pressure grout any voids caused by or encountered during the shaft construction or horizontal auger boring. The Contractor shall modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.

D. The advance of the auger and casing shall be controlled so as to restrict the excavation of the materials to a volume equal to the pipe jacked plus allowance for the allowable radial overcut, to prevent loss of ground and settlement or possible damage to overlying structures. Control the advance rate and monitor the volume of material excavated and adjust advance rate, as required, to avoid loss of ground, over excavation, or surface heave. Unsupported ground at the tunnel heading shall not extend beyond the end of the casing by more than 12 inches.

E. Completely contain, transport, and dispose of all excavated materials and fluid additives away from the construction site as required in Article Cleanup and Disposal. All spoils must be contained in within the defined work area all times. Discharge into sewers or ditches, or discharge into the shafts is not permitted.

F. If necessary to abandon a bored hole, remedial measures shall be taken by Contractor, subject to review by Engineer and approval of owner of facility being crossed.

3.11 CONTROL OF LINE AND GRADE

A. Contractor shall establish and protect benchmarks as necessary prior to the start of construction.

B. After establishing all required benchmarks, use these benchmarks to furnish and maintain all reference lines and grades for horizontal auger boring. The horizontal coordinates and elevation of survey point shall be to an accuracy of 0.01 foot. The Contractor shall use these lines and grades to establish the precise location of the casing pipe using a laser guidance system. Submit to Engineer copies of field notes used to establish all lines and grades and allow

Engineer to check guidance system setup prior to beginning each horizontal auger boring drive. Provide access for Engineer to perform survey checks of guidance system and line-and-grade of casing pipe as necessary. The Contractor is fully responsible for the accuracy of the Work and the correction of it, as required.

C. The casing pipe shall be installed in accordance with the following tolerances:
   1. Variations from Design Line: 4 inches maximum.
   2. Variations from Design Grade: 4 inch maximum.

D. The tunnel advancement shall be controlled to maintain line and grade within the tolerances specified with no reverse grade. If the installation is off line or grade, attempt to make the necessary corrections, as identified in the Contractor's contingency plans.

E. The guidance system, if used, shall be mounted independently from the thrust block and rails to maintain alignment if there is movement of equipment during jacking. Stop horizontal auger boring operations and reset guidance system if its alignment shifts or is moved off design alignment and grade for any reason. Check guidance system setup at least once per shift. Guidance system should only be reset by experienced, competent surveying personnel in accordance with approved procedures outlined in the Submittals.

F. Monitor line and grade continuously during horizontal auger boring operations. Record deviation with respect to design line and grade at least once per 40 feet maximum and submit records to Engineer as requested. Control line and grade of the casing pipe to within the specified tolerances.

G. If the casing pipe installation does not meet the specified tolerance, the Contractor shall correct the installation including any necessary redesign of the pipeline or structures and acquisition of necessary easements. All corrective Work shall be performed by the Contractor at no additional cost to the Owner and without schedule extension, and is subject to the written approval of the Engineer and owner of the facility being crossed.

3.12 MONITORING OF SURFACE MOVEMENT

A. Perform a Pre- and Post-Construction Survey of road surfaces, and all structures or facilities within 50 feet of the trenchless crossing and document with video and / or digital images. Record horizontal coordinates and elevations. Mark location of where measurements were taken.

B. Monitor geotechnical instrumentation at least once every 8 hours, but not less than once per day beginning with the start of the shaft excavation. Continue monitoring at the same frequency until the trenchless installation is completed (i.e. boring head and casing completely enters the receiving shaft).

C. Provide the Engineer instrumentation readings within 24 hours of collecting the data.

D. Continue to monitor geotechnical instrumentation weekly until the work shafts are backfilled and excavation support is removed or until directed by the Engineer to end monitoring.

E. Actions to Mitigate Excessive Ground Movements:

1. If displacement of a settlement marker reaches an action limit, the likely cause of the displacement shall be promptly discussed with the Engineer. The Engineer may increase the monitoring where the displacement action limit was exceeded. Review excavation and ground support operations and make operational changes or implement ground improvement or underpinning measures as appropriate to limit further displacements and to prevent displacement limits from being exceeded. Actions to be taken in response to action limits being exceeded shall be reported to the Engineer before being taken, except in emergency situations.
2. If displacement of a settlement marker reaches a displacement limit, cease excavation or other construction operations that result in further displacement until additional operational changes are made to reduce ground loss around excavation. The likely cause of the displacement shall be immediately discussed with the Engineer. The Engineer may further increase the monitoring frequency. Review excavation and ground support operations and make operational changes or implement ground improvement or underpinning measures as appropriate to limit further displacements and to prevent displacement limits from being exceeded. Actions to be taken in response to displacement limits being exceeded shall be discussed with and approved by the engineer before being taken, except in emergency situations.
3. The cost of actions required for complying with displacement limits and to repair any damage to adjacent facilities shall be borne by the Contractor with no additional cost to the Owner.

F. Perform a post construction survey of road surfaces, and all structures or facilities within 50 feet of the trenchless crossing and document with video and / or digital images. Record horizontal coordinates and elevations. Mark location of where measurements were taken.

3.13 CARRIER PIPE INSTALLATION

A. Entire length of casing shall be installed complete and inspected and approved by Engineer before any carrier pipe is placed therein. Repair defects in casing pipe or leakage at joints.

B. Thoroughly inspect each joint prior to insertion into the steel casing.

C. Spans between spacers shall be per casing spacer manufacturer's recommendations.

D. Check each joint makeup and pipe segment prior to pushing carrier pipe segments into casing.

E. Install joint bonds prior to pushing carrier pipe into casing.

F. Install end seals in accordance with manufacturers recommendations and approved submittal.

3.14 BACKFILLING OF WORK SHAFTS

A. Seal work shaft opening and backfill at shafts when no longer required.

B. Backfill materials and methods shall be in accordance with Section 31 23 23.15, Trench Backfill.

3.15 CLEANUP AND DISPOSAL

A. After completion, all construction debris, spoils, oil, grease, and other materials shall be removed from the installed pipe, launching and receiving shafts, and all Contractor Work Areas.

B. Cleaning shall be incidental to the construction. No separate payment shall be made for cleanup.

C. Restoration shall follow construction as the work progresses and shall be completed as soon as possible. Restore and repair any damage resulting from surface settlement caused by shaft excavation, dewatering, or trenchless installation.

D. Any property damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction. Restoration shall be completed no later than 30 days after the pipe is in place. This provision for restoration shall include all property affected by the construction operations.

E. Dispose of all spoils off site. All spoils must be transported off site. Dumping of spoil on the ground, discharge into sewers or ditches, or discharge into the shafts is not permitted.

END OF SECTION

Re. Drawing C-04: Facility Monitoring and Vibration Monitoring Points