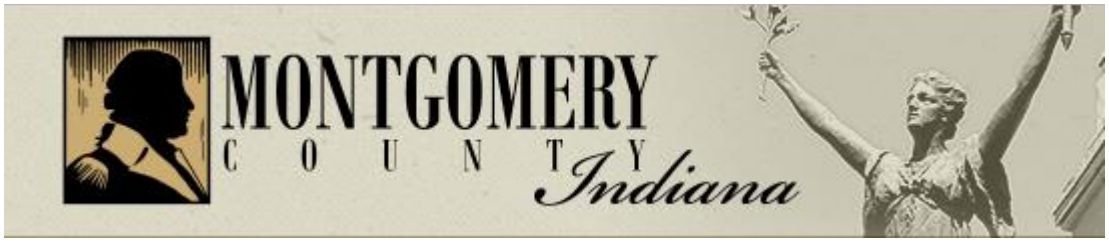
Project Manual

For

S.R. 32/Nucor Road Area Sanitary Sewer Collection System
Montgomery County, Indiana



June 2018

VS ENGINEERING
4275 North High School Road • Indianapolis, Indiana 46254 • 317.293.3542
www.vsengineering.com

SAMUEL J. WEBER
REGISTERED
NO.
11300002
STATE OF
INDIANA
PROFESSIONAL ENGINEER

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ADVERTISEMENT FOR BIDS

Notice is hereby given that the Montgomery County, ("Owner") acting by and through the President of the Regional Sewer Board will receive sealed bids for the **S.R. 32/Nucor Road Sanitary Sewer Collection System** ("Project") at the Montgomery County Regional Sewer District, 110 West South Blvd, Crawfordsville, Indiana 47933 until **2:00 p.m. local time on Tuesday, July 10, 2018**, at which time the sealed bids will be publicly opened and read aloud. **Bids received after 2:00 pm will not be considered and will be returned to the bidder unopened.**

The Scope of Work ("Work") includes, but is not limited to, the open-cut installation of sewer within the road right-of-ways of two different roads: S.R. 32 Right-of-Way, 5620' west of C.R. 400E and 1360' east of Nucor Road and along the Right-of-Way of Nucor Road from Barbara Drive, north to S.R. 32. This project also lies within an easement-R/W of C.R. 400 E, from Nucor Road north to S.R. 32. All gravity sewer pipe installed shall be SDR 26 PVC ASTM D3034. All pressure sewer pipe installed shall be SDR 21 PVC ASTM D3034 or HDPE-DR 11 DIPS ASTM F714-97 PE 4710. The lengths and sizes of pipe to be installed includes 14,192 feet of 6-inch force main, 5,249 feet of 4-inch force main, 5,153 feet of 3-inch low pressure sewer, 679 feet of 2-inch low pressure sewer, and 6,196 feet of 12-inch gravity sewer. Included with the Work shall also be all clearing and grubbing, demolition, a pre-construction audio/video survey, erosion and sediment control measures, and surface restoration, including roadway replacement, driveway replacement, sidewalk replacement, curb replacement, tree removal, fence removal and replacement, sanitary sewer lateral, check valves, plug valves, air release valves and water service repair, if necessary. Additional information regarding the Work included in the Bid is contained within the Contract Documents. No substitution of pipe materials will be considered.

The project Plans and Contract Documents may be examined at the following locations:

Montgomery County Regional Sewer District	VS Engineering
110 West South Blvd	4275 North High School Road
Crawfordsville, IN 47933	Indianapolis, IN 46254

The project Plans and Contract Documents may be purchased at the following location:

Repro Graphix, Inc.
437 North Illinois Street
Indianapolis, Indiana 46204

Copies of such Drawings and Project Manual will be available on the online planroom operated by Repro Graphix at https://www.reprographix.com/plans_and_specs#eplanroom. Planroom registration is free. The plan charge will be listed on the online planroom. Payment may be made by check, credit card, or cash. NO DEPOSITS ACCEPTED. Make checks payable to Repro Graphix. All payments and costs of Contract Documents and related supplemental materials are non-refundable.

DOCUMENTS WILL NOT BE AVAILABLE FOR SALE AT MONTGOMERY COUNTY REGIONAL SEWER DISTRICT OR VS ENGINEERING OFFICES.

The work to be performed and the bid to be submitted shall include sufficient and proper sums for all general construction, mechanical installation, labor, materials, permits, licenses, insurance, and so forth, incidental to and required for the construction of the facilities.

Each bid must be enclosed in a sealed envelope bearing the title of the Project and the name and address of Bidder. All bids must be submitted on the bid forms as identified in the Contract Documents and Specifications. Bids which are incomplete or not in compliance with the requirements of the Contract Documents will not be accepted.

Each bid shall be accompanied by a certified check or acceptable bidder's bond made payable to the Owner, in a sum of not less than five percent (5%) of the total amount bid, which check or bond will be held by the Owner as evidence that the bidder will, if awarded the contract, enter into the same with the Owner upon notification from Owner to do so within ten (10) days of said notification.

Approved performance and payment bonds guaranteeing faithful and proper performance of the Work and materials, to be executed by an acceptable surety company, will be required of the Contractor at the time of contract execution. The bonds shall be in the amount of 100% of the Contract Price and must be in full force and effect throughout the term of the Construction Contract plus a period of twelve (12) months from the date of substantial completion. Any contractor awarded work as part of this project shall be required to submit an executed E-Verification Affidavit.

An approved maintenance bond guaranteeing the Work to be executed by an acceptable surety company will be required of the Contractor. The maintenance bond in the amount of 100% of the final Contract price must be in effect at the date of final completion of the Project and acceptance by the Owner and remain in effect for a period of three (3) years from the date of Owner's acceptance.

The Owner reserves the right to reject any or all bids, and to waive any and all informalities in bidding.

Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified shall not be considered. Failure of a Bidder to enter into the Agreement, execute same and furnish an acceptable Payment Bond and Performance Bond, as hereinafter required, shall be cause for forfeiture of Contractor's certified check or Bid Bond as liquidated damages to the Owner. No bid may be withdrawn after the scheduled closing time for receipt of bids for at least ninety (90) days. A conditional or qualified Bid will not be accepted.

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the Project throughout.

Bids shall be properly and completely executed on bid forms included in the Contract Documents. Bids shall include all information requested by Indiana Form 96 (Revised 2010), including the non-collusion affidavit, included with the Contract Documents. Under Section III of Form 96, the Bidder shall submit a financial statement. The Owner may make such investigations as deemed necessary to determine the ability of the Bidder to perform the Work and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the Agreement and to complete the Work contemplated therein.

Each Bidder is responsible for inspecting the Project site(s) and for reading and being thoroughly familiar with the Plans and Contract Documents. The failure or omission of any Bidder to do any of the foregoing shall in no way relieve any Bidder from any obligation with respect to its Bid.

All out-of-state corporations must have a certificate of authority to do business in the State. Application forms may be obtained by contacting the Secretary of State, State of Indiana, Statehouse, Indianapolis, Indiana 46204.

Bidders shall ensure that all employees and applicants for employment are not discriminated against because of their race, creed, color, sex or national origin. An Affirmative Action Statement shall be submitted with the bid.

Phillip Bane
Montgomery County Regional Sewer Board

SECTION 00 21 15

INSTRUCTIONS TO BIDDERS

OWNER:	Montgomery County Regional Sewer District 110 W South Blvd Crawfordsville, IN 47933
PROJECT/WORK:	S.R. 32/Nucor Road Crawfordsville, IN 47933
ENGINEER:	VS Engineering, Inc. 4275 North High School Road Indianapolis, IN 46254

ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Bid Date* – The date when Bids are to be received, opened and publicly read aloud as established by the Advertisement To Bidders as may be modified by Addenda.

B. *Bid Submission* – All documents presented by a Bidder for receipt and opening on the Bid Date.

C. *Issuing Office* – The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the advertisement for bid may be obtained from the Issuing Office. The deposit is non-refundable.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To enable the OWNER to determine the ability, experience, and capital resources of the Bidder, each Bidder shall execute completely and accurately in all respects Form 96 Contractor's Bid for Public

Works of the Indiana State Board of Accounts, including Section III, "Contractor's Financial Statement". Said Form 96 shall be included in the Bid Submission.

3.02 To demonstrate Bidder's qualifications to perform the Work, within five (5) days of Owner's request, Bidder shall submit written evidence as may be called for below, including financial data, previous experience, and present commitments.

3.03 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 *Subsurface and Physical Conditions*

A. The Supplementary Conditions identify:

1. The Geotechnical Evaluation Report of explorations and tests of subsurface conditions at or contiguous to the Site, dated May 31, 2018, prepared by Terracon Consultants, Inc./Earth Exploration, Inc., Indianapolis, Indiana, titled "Geotechnical Evaluation Report, SR 32 Wastewater Collection System, Montgomery County, Indiana" and consisting of 41 pages.

2. Those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. Copies of reports and drawings referenced in Paragraph 4.01.A are included in the Project Manual. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions has been identified and established in Paragraph 4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 *Underground Facilities*

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 *Hazardous Environmental Condition*

A. No known Hazardous Environmental Conditions have been identified at the Site.

4.04 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning

responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Contract Documents or Specifications to be within the scope of the Work, appear in Paragraph 4.06 of the General Conditions.

4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.

4.06 A. Reference is made to Article 7 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.

B. Paragraph 6.13.C of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.07 It is the responsibility of each Bidder before submitting a Bid to:

A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;

D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 4.02 of the Supplementary Conditions as containing reliable "technical data", and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Paragraph 4.06 of the Supplementary Conditions as containing reliable "technical data",

E. consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder’s safety precautions and programs;

F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;

H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.08 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE

5.01 A pre-Bid conference for the **S.R. 32/Nucor Road Sanitary Sewer Collection System** ("Project") at the Crawfordsville District Public Library, Classroom D, 205 S. Washington St., Crawfordsville, Indiana 47933 at **10:00 am local time on Thursday, June 21, 2018**. Bidders may submit questions to the Engineer, in writing, to Samuel Weber, P.E. at sweber@vsengineering.com or VS Engineering, 4275 North High School Road, Indianapolis, IN 46254 by **noon** local time on **Monday, June 25, 2018**. Engineer will transmit before **noon** on **Thursday, June 28, 2018** to all prospective Bidders of record such Addenda as Engineer considers necessary in response to written questions received. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered (via facsimile or email) to all parties recorded by

Engineer as having received the Bidding Documents. Questions received less than **nine (9) days** prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 8 – BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of **five percent (5%)** of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a Bid bond (on the form attached) issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the General Conditions.

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within ten (10) days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 91 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.

8.03 Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within seven days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

9.01 The number of days within which the Work is to be substantially completed and ready for final payment are set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five (5) days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, in which case apparent Successful Bidder shall submit an acceptable substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.

12.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Form is included with the Bidding Documents. Additional copies may be obtained from the Engineer.

13.02 All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each unit price item listed therein.

13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.

13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.

13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

13.06 A Bid by an individual shall show the Bidder's name and official address.

13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.

13.08 All names shall be printed in ink below the signatures**.**

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.

13.10 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 *Unit Price*

A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.

B. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price for the base bid and any alternate bid items. Bids will then be compared on the basis of the sum of the total of all estimated prices for the base bid and any alternate bids as applicable. The final quantities and Contract Price will be determined in accordance with Paragraph 11.03 of the General Conditions.

C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

ARTICLE 15 – SUBMITTAL OF BID

15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Proposal Form, and the Bid Bond Form. The unbound copy of the Bid Proposal Form is to be completed and submitted with the Bid security and the following documents:

A. Proposed Subcontractors Form;

B. Form 96, "Contractor's Bid for Public Works";

15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement for Bids and shall be enclosed in a plainly marked package with the Project title, the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID

ENCLOSED." A mailed Bid shall be addressed to the Montgomery County Regional Sewer Board, 110 South Blvd, Crawfordsville, Indiana 47933.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

16.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement for Bids and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

19.06 If the Contract is to be awarded, Owner will award the Contract to the lowest, responsive, and responsible Bidder whose Bid is in the best interests of the Project.

19.07 The Owner reserves the right to award any Alternate Bids in their entirety, portions of Alternate Bids or not to award Alternate Bids at all. Because a Bidder is successful does not guarantee that Alternate Bids will be awarded and subsequently completed.

ARTICLE 20 – CONTRACT SECURITY AND INSURANCE

20.01 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within **10 days** thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within **10 days** thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Contract Documents with appropriate identification.

ARTICLE 22 – SALES AND USE TAXES

22.01 Owner is exempt from Indiana state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Refer to Paragraph 6.10 of the Supplementary Conditions for additional information.

ARTICLE 23 – COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS

23.01 The Contractor and Subcontractors shall comply with all applicable Local, State, and Federal laws and regulations applicable during the conduct of this project. This project does <u>not</u> involve Federal funding.

23.02 All open excavations and trenches shall be accomplished in conformance with all State and Federal regulations and laws.

23.03 The procurement of <u>all</u> steel products for this project shall conform to IC 5-16-8 which requires American made products. This includes cast iron and ductile iron products.

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BID PROPOSAL FORM

S.R. 32/NUCOR ROAD SANITARY SEWER COLLECTION SYSTEM
MONTGOMERY COUNTY, INDIANA

ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

Montgomery County Regional Sewer Board
110 W South Blvd
Crawfordsville, IN 47933

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in SC-

4.02 as containing reliable "technical data", and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable "technical data".

E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; and the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

G. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

H. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. “collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the price(s) on the Unit Price Bid Tabulations. Bidders have an option to submit an Alternate Bid, described as the extension of a 3” low pressure sewer (a portion of Line LPS-2), as additional work to the Base Bid.

To place a Base Bid for the SR 32/Nucor Road Sanitary Sewer Collection System, complete the Base Bid Unit Price Bid Tabulation. To place an Alternate Bid the SR 32/Nucor Road Sanitary Sewer Collection System, complete the Base Bid and Alternate Bid Unit Price Bid Tabulations.

The Base Bid project will be awarded with or without the Alternate Bid project, as deemed to the advantage of the Owner. The project will be awarded to the lowest and most responsible Bidder based on the lowest single or combined total Base Bid, as selected by the Owner.

Unit Prices have been computed in accordance with Paragraph 11.03.B of the General Conditions.

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

Total Base Bid (Unit Price Work) $_____ _____

Total Alternate Bid (Unit Price Work) $_____

Total Bid (Base + Alternate) $_____

(This portion of page intentionally blank)

5.02 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

UNIT PRICE WORK

Base Bid

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	BID UNIT PRICE	BID PRICE
1	2" Low Pressure System, PVC SDR 21 or HDPE DR-11	675	LFT		
2	3" Low Pressure System, PVC SDR 21 or HDPE DR-11	3,653	LFT		
3	Air Release Valve for Low Pressure System	3	EA		
4	4" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11	4,487	LFT		
5	4" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11, HDD	789	LFT		
6	6" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11	13,092	LFT		
7	6" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11, HDD	1,072	LFT		
8	8" Jack and Bore with 18" Casing	43	LFT		
9	12" Gravity Sewer, PVC SDR 26, Opencut	3,931	LFT		
10	12" Gravity Sewer, PVC SDR 26, 24" Casing Pipe, Jack and Bore	126	LFT		
11	15" Gravity Sewer, PVC SDR 26, Opencut	253			
12	48" Manhole	17	EA		
13	Force Main Discharge Connection	3	EA		
14	72" Wet Well Coating	2	EA		
15	48" Manhole Coating, Force Main Discharge Manhole	2	EA		
16	Flushing Station	2	EA		
17	East Lift Station Electrical Service	1	LS		
18	East Lift Station	1	LS		
19	West Lift Station Electrical Service	1	LS		
20	West Lift Station	1	LS		
21	42" Concrete Culvert Removal and Replacement	150	LFT		
22	Concrete End Sections	2	EA		
23	6" Lateral Connection, Opencut	2,200	LFT		

24	1.25” Lateral Connection	6,000	LFT		
25	1.25” Lateral Connection, HDD	8,156	LFT		
26	Grinder Pump Station, Installation, Controls, Electrical, Complete in Place	45	EA		
27	Decommission Septic Tank	51	EA		
28	Air Release Valve & Structure for 4” Force Main	6	EA		
29	Air Release Valve & Structure for 6” Force Main	5	EA		
30	Erosion Control Measures & Temporary Seeding	1	LS		
31	Mob/Demob, MOT, Clearing ROW, Construction Engineering	1	LS		
			TOTAL BASE BID		

Alternate Bid – Includes the extension of a 3” low pressure sewer along SR 32 (a portion of Line LPS-2).

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	BID UNIT PRICE	BID PRICE
1	3” Low Pressure System, PVC SDR 21 or HDPE DR-11	1500	LFT		
2	Air Release Valve for Low Pressure System	1	EA		
3	Flushing Station	1	EA		
4	1.25” Lateral Connection	275	LFT		
5	1.25” Lateral Connection, HDD	85	LFT		
6	Mob/Demob, MOT, Clearing ROW, Construction Engineering	1	LS		
			TOTAL ALTERNATE BID		

Unit Prices have been computed in accordance with Paragraph 11.03.B of the General Conditions.

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete within **365 calendar days** after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and will be completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within **395 calendar days** after the date when the Contract Times commence to run.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security in the form of a certified check payable to the Montgomery County Regional Sewer Board, or an acceptable Bidder's Bond binding the Bidder and surety to the Montgomery County Regional Sewer Board in the amount of _____ _____ Dollars _____/100 ($_____) which amount is not less than five percent (5%) of the Total of all Bid Prices as set out above, guaranteeing that the undersigned will enter into Contract for the performance of the Work if this Bid Proposal is accepted;

B. Proposed Subcontractors Form;

C. Form 96, "Contractor's Bid for Public Works"; and

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids.

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

9.01 This Bid is submitted by:

Bidder's Business Address _____

_____

Phone No. _____ Fax No. _____

E-mail _____

SUBMITTED on _____, 2016.

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____
(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____

By: _____
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____
Type (General Business, Professional, Service, Limited Liability):_____

By: _____
(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____
(CORPORATE SEAL)

Attest _____

Date of Qualification to do business in *Indiana* is ____/____/____.

A Joint Venture

Name of Joint Venture: _____

First Joint Venturer Name: _____ (SEAL)

By: _____
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____(SEAL)

By: _____
(Signature of second joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

SECTION 00 43 13

BID SECURITY FORM

1.1 SUMMARY

A. Document Includes:
   1. Bid Bond – EJCDC Penal Sum Form

B. Related Documents:
   1. Document 00 21 15 - Instructions to Bidders – Bid Submission
   2. Document 00 42 13 – Bid Proposal Form

BID BOND FOLLOWS (Two-Page Document)

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address):*

SURETY *(Name and Address of Principal Place of Business):*

OWNER *(Name and Address):*
Montgomery County Regional Sewer Board
110 W South Blvd
Crawfordsville, IN 47933

BID
Bid Due Date:

Description *(Project Name and Include Location):*

BOND
Bond Number:

Date *(Not earlier than Bid due date):*

Penal sum _____ $ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

_____ (Seal)
Bidder's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF DOCUMENT

00 43 36

PROPOSED SUBCONTRACTORS FORM

The Bidder shall submit a completed Proposed Subcontractors Form with their Bid submission. Failure to do so shall constitute grounds for rejection of the Bid as non-responsive. The Bidder shall enter the names and the type of work to be done in the Subcontractors List for each Subcontractor that the Bidder proposes to use for the Work. Except as otherwise specifically stated by the Bidder in this Part, omission of any names of Subcontractors herein shall constitute an affirmative representation and statement that the Bidder proposes to use his own work force for that portion of the Work.

Bidder's attention is directed to paragraph 6.06 of the General Conditions as it relates to use of Subcontractors.
(copy sheet if more than four subcontractors are planned.)

Name	Name
Address	Address
Telephone Number	Telephone Number
Work Items	Work Items
Work Items	Work Items
Amount	Amount
Name	Name
Address	Address
Telephone Number	Telephone Number
Work Items	Work Items
Work Items	Work Items
Amount	Amount

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SECTION 00 45 19

NON-COLLUSION AFFIDAVIT, PLAN AND EQUIPMENT QUESTIONNAIRE, AND CONTRACTOR'S FINANCIAL STATEMENT (FORM 96)

PART 1 GENERAL

1.1 DESCRIPTION

A. "Contractor's Bid for Public Works"

1.2 SUMMARY

A. As prescribed by the Indiana State Board of Accounts, including Part I to be completed for all bids, Section I of Part II, "Experience Questionnaire", and Section II of Part II, "Plan and Equipment Questionnaire" to be completed for all Bids in excess of $100,000, and Section III of Part II "Contractor's Financial Statement" properly executed and attached to the Bid Proposal. A Non-collusion Affidavit, as required by the statutes of the State of Indiana, shall be properly executed and included in Part II of Form 96. Such form will be used in consideration of a Bidder's ability to perform its obligations under the terms of the Contract Documents and in determining other material factors bearing upon a Bidder's responsibility.

FORM 96 (Six-Page Document) FOLLOWS

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SECTION 00 51 00

NOTICE OF AWARD

Project: **S.R. 32/Nucor Road Area Sanitary Sewer Collection System**

Owner: **Montgomery County Regional Sewer District**
110 West South Blvd
Crawfordsville, IN 47933

Bidder: _____

Bidder's Address: _____

_____

(Send Notice of Award Certified Mail, Return Receipt Requested)

You are notified that your Bid dated _____ _____, 2018 for the above Contract has been considered. You are the Successful Bidder and are awarded a Contract for the open-cut installation of sewer within the road right-of-ways of two different roads: S.R. 32 Right-of-Way, 5620' west of C.R. 400E and 1360' east of Nucor Road and along the Right-of-Way of Nucor Road from Barbara Drive, north to S.R. 32. This project also lies within an easement-R/W of C.R. 400 E, from Nucor Road north to S.R. 32. All gravity sewer pipe installed shall be SDR 26 PVC ASTM D3034. All pressure sewer pipe installed shall be SDR 21 PVC ASTM D3034 or HDPE-DR 11 DIPS ASTM F714-97 PE 4710. The lengths and sizes of pipe to be installed includes 14,192 feet of 6-inch force main, 5,249 feet of 4-inch force main, 5,153 feet of 3-inch low pressure sewer, 679 feet of 2-inch low pressure sewer, and 6,196 feet of 12-inch gravity sewer. Included with the Work shall also be all clearing and grubbing, demolition, a pre-construction audio/video survey, erosion and sediment control measures, and surface restoration, including roadway replacement, driveway replacement, sidewalk replacement, curb replacement, tree removal, fence removal and replacement, sanitary sewer lateral and water service repair, if necessary. Additional information regarding the Work included in the Bid is contained within the Contract Documents.

The Total of all Bid Prices of your Contract is _____

_____ Dollars and _____/100

($ _____) which is based upon accepted Bid prices for Unit Price Work and estimated quantities as provided in the Agreement and in Paragraphs 9.07 and 11.03 of the General Conditions.

_____ copies of the proposed Contract Documents accompany this Notice of Award.

You must comply with the following conditions precedent within ten (10) of the date you receive this Notice of Award.

1. Deliver to the Owner 3 fully executed counterparts of the Contract Documents.

2. Deliver with the executed Contract Documents the Contract security as specified in the Instructions to Bidders, General Conditions, and Supplementary Conditions.

3. Other conditions precedent:

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare you Bid security forfeited.

Within ten days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

MONTGOMERY COUNTY REGIONAL SEWER DISTRICT

By: _____
Authorized Signature

_____
Print Name

_____
Title

Copy to Engineer

END OF DOCUMENT

00 52 15

AGREEMENT FORM

This AGREEMENT is by and between Montgomery County Regional Sewer District ("OWNER") and

_____ ("CONTRACTOR")

OWNER and CONTRACTOR hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

The open-cut installation of sewer within the road right-of-ways of two different roads: S.R. 32 Right-of-Way, 5620' west of C.R. 400E and 1360' east of Nucor Road and along the Right-of-Way of Nucor Road from Barbara Drive, north to S.R. 32. This project also lies within an easement-R/W of C.R. 400 E, from Nucor Road north to S.R. 32. All gravity sewer pipe installed shall be SDR 26 PVC ASTM D3034. All pressure sewer pipe installed shall be SDR 21 PVC ASTM D3034 or HDPE-DR 11 DIPS ASTM F714-97 PE 4710. The lengths and sizes of pipe to be installed includes 14,192 feet of 6-inch force main, 5,249 feet of 4-inch force main, 5,153 feet of 3-inch low pressure sewer, 679 feet of 2-inch low pressure sewer, and 6,196 feet of 12-inch gravity sewer. Included with the Work shall also be all clearing and grubbing, demolition, a pre-construction audio/video survey, erosion and sediment control measures, and surface restoration, including roadway replacement, driveway replacement, sidewalk replacement, curb replacement, tree removal, fence removal and replacement, sanitary sewer lateral and water service repair, if necessary. Additional information regarding the Work included in the Bid is contained within the Contract Documents.

ARTICLE 2 – THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

S.R. 32/Nucor Road Area Sanitary Sewer Collection System

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by **VS Engineering, Inc.** (Engineer), which is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Days to Achieve Substantial Completion and Final Payment*

A. The Work will be substantially completed within 365 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 395 days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $1,000.00 for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $1,500.00 for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 – CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A below:

A. For all Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the actual quantity of that item:

UNIT PRICE WORK

Base Bid

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	BID UNIT PRICE	BID PRICE
1	2" Low Pressure System, PVC SDR 21 or HDPE DR-11	675	LFT		
2	3" Low Pressure System, PVC SDR 21 or HDPE DR-11	3,653	LFT		
3	Air Release Valve for Low Pressure System	3	EA		
4	4" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11	4,487	LFT		
5	4" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11, HDD	789	LFT		
6	6" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11	13,092	LFT		
7	6" Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11, HDD	1,072	LFT		
8	8" Jack and Bore with 18" Casing	43	LFT		
9	12" Gravity Sewer, PVC SDR 26, Opencut	3,931	LFT		
10	12" Gravity Sewer, PVC SDR 26, 24" Casing Pipe, Jack and Bore	126	LFT		
11	15" Gravity Sewer, PVC SDR 26, Opencut	253			
12	48" Manhole	17	EA		
13	Force Main Discharge Connection	3	EA		
14	72" Wet Well Coating	2	EA		
15	48" Manhole Coating, Force Main Discharge Manhole	2	EA		
16	Flushing Station	2	EA		
17	East Lift Station Electrical Service	1	LS		
18	East Lift Station	1	LS		
19	West Lift Station Electrical Service	1	LS		
20	West Lift Station	1	LS		

21	42” Concrete Culvert Removal and Replacement	150	LFT		
22	Concrete End Sections	2	EA		
23	6” Lateral Connection, Opencut	2,200	LFT		
24	1.25” Lateral Connection	6,000	LFT		
25	1.25” Lateral Connection, HDD	8,156	LFT		
26	Grinder Pump Station, Installation, Controls, Electrical, Complete in Place	45	EA		
27	Decommission Septic Tank	51	EA		
28	Air Release Valve & Structure for 4” Force Main	6	EA		
29	Air Release Valve & Structure for 6” Force Main	5	EA		
30	Erosion Control Measures & Temporary Seeding	1	LS		
31	Mob/Demob, MOT, Clearing ROW, Construction Engineering	1	LS		
			TOTAL BASE BID		

Alternate Bid – Includes the extension of a 3” low pressure sewer along SR 32 (a portion of Line LPS-2).

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	BID UNIT PRICE	BID PRICE
1	3” Low Pressure System, PVC SDR 21 or HDPE DR-11	1500	LFT		
2	Air Release Valve for Low Pressure System	1	EA		
3	Flushing Station	1	EA		
4	1.25” Lateral Connection	275	LFT		
5	1.25” Lateral Connection, HDD	85	LFT		
6	Mob/Demob, MOT, Clearing ROW, Construction Engineering	1	LS		
			TOTAL of All Bid Prices		

The Bid prices for Unit Price Work set forth as of the Effective Date of the Agreement are based on estimated quantities. As provided in Paragraph 11.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer as provided in Paragraph 9.07 of the General Conditions.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the _____ day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

a. 95 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and

b. 0 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 7 – INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of 3 percent per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data", and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data".

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

H. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages 1 to 9, inclusive).

2. Performance bond (pages 1 to 4, inclusive).

3. Payment bond (pages 1 to 4, inclusive).

4. Maintenance bond (pages 1 to 4, inclusive).

5. General Conditions (pages *i* to 62, inclusive).

6. Supplementary Conditions (pages *i* to 8, inclusive).

7. Specifications as listed in the table of contents of the Project Manual.

8. Plans consisting of 40 sheets with each sheet bearing the following general title: S.R. 32/Nucor RD. Area Sanitary Sewer Collection System.

9. Addenda (numbers _____ to _____, inclusive).

10. Exhibits to this Agreement (enumerated as follows):

    a. Contractor's Bid (pages _____ to _____, inclusive).

    b. Documentation submitted by Contractor prior to Notice of Award (pages _____ to _____, inclusive).

11. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

    a. Notice to Proceed (pages _____ to _____, inclusive).

    b. Work Change Directives.

    c. Change Orders.

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement. Counterparts have been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or have been identified by OWNER and CONTRACTOR or on their behalf.

This AGREEMENT will be effective on _____ day of _____, 20___ (which is the Effective Date of the Agreement).

OWNER	CONTRACTOR
Montgomery County Regional Sewer District	_____
By: _____	By: _____
Title: _____	Title: _____
or	(If Contractor is a corporation, a partnership, a joint venture, attach evidence of authority to sign.)
Attest: _____	Attest: _____
Title: _____	Title: _____
Address for giving notices:	Address for giving notices:
Montgomery County Regional Sewer District	_____
110 W South Blvd	_____
Crawfordsville, IN 47933	_____
(If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)	

SECTION 00 52 25

ADDITIONAL FORMS SUPPLEMENTAL TO AGREEMENT FORM

1.1 SUMMARY

A. Document Includes:
   1. Field Order Form
   2. Work Directive Change Form
   3. Request for Proposal Form
   4. Contract Change Request Form
   5. Contract Change Order Form

Following are specimen forms proposed to be used for the issuance of change orders, field orders, and work directive changes. Procedure for the development, submittal and processing of these forms will be discussed during the preconstruction conference.

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FIELD ORDER FORM

OWNER: TOWN OF ZIONSVILLE

FIELD ORDER NUMBER: _____
DATE: _____
PROJECT NAME: S.R. 32/Nucor Road Area
Sanitary Sewer Collection System
PROJECT NO: _____

You are hereby directed to execute promptly this Field Order which interprets the Contract Documents or orders minor changes in the Work without change in Contract Sum or Contract Time.

If you consider that a change in Contract Sum or Contract Time is required, please submit your itemized proposal to the Engineer immediately and before proceeding with this Work. If your proposal is found to be satisfactory and in proper order, this Field Order will in that event be superseded by a Change Order.

Description:

Attachments:

_____
PROJECT MANAGER:

By: _____

Date: _____

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WORK DIRECTIVE CHANGE FORM

TO:

WORK DIRECTIVE CHANGE NO. _____
DATE: _____
PROJECT NAME: S.R. 32/Nucor Road Area
Sanitary Sewer Collection System
PROJECT NO.: _____

Specification Reference: _____

Drawing Reference: _____

DESCRIPTION OF WORK COVERED BY THIS DIRECTIVE CHANGE:

REASON FOR THIS ORDER:

AUTHORIZATION:
THIS WORK DIRECTIVE CHANGE AUTHORIZES THE WORK TO BE COMPLETED AS OUTLINED. A Contract Change Order in the amount of $_____ will be issued to you in the near future to cover this Work Directive Change.

PROJECT COMPLETION DATE: ADD/DEDUCT/UNCHANGED _____ DAYS.

By: _____ By: _____
Project Manager (Engineering) Resident Project Representative

By: _____ By: _____
Project Manager (Construction) Administrator of Construction Services

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REQUEST FOR PROPOSAL FORM

TO:

REQUEST FOR PROPOSAL NO.: _____
DATE: _____
PROJECT NAME: S.R. 32/Nucor Road Area
Sanitary Sewer Collection System
PROJECT NO.: _____

Specification Reference: _____

Drawing Reference: _____ Drawing Date: _____

Identification of Attachments: _____

Please submit within fifteen calendar days of this request date a proposal showing increase, decrease or no change in contract price and/or contract time. Proposal shall be accompanied by four (4) copies of breakdown showing quantities, cost of material, equipment, labor, overhead, profit and basis for the additional time if any.

DESCRIPTION OF PROPOSED CHANGE COVERED BY THIS REQUEST:

REASON FOR CHANGE:

SPECIAL INSTRUCTIONS:

THIS REQUEST DOES NOT AUTHORIZE YOU TO PROCEED WITH THE ABOVE WORK NOR STOP PREVIOUSLY SCHEDULED WORK. Upon approval a Contract Change Order and a Notice To Proceed for the Proposed Work will be issued.

Please state in your proposal the effect the acceptance of this REQUEST will have on the project completion, if accepted within ___ days of proposal due date.

YOUR PROPOSAL DUE DATE: _____

By: _____ _____
Project Manager Date

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CONTRACT CHANGE FORM

TO:

CONTRACT CHANGE REQUEST NO.: _____
DATE: _____
PROJECT NAME: : S.R. 32/Nucor Road Area
Sanitary Sewer Collection System

FROM:

IT IS REQUESTED THAT A CONTRACT CHANGE BE MADE TO THE ABOVE REFERENCED CONTRACT.

1. SCOPE OF WORK (USE ADDITIONAL PAGES IF REQUIRED. ALSO LIST OTHER CONTRACTS INVOLVED.)

2. REASON FOR CHANGE:

3. APPROXIMATE COST CHANGE TO CONTRACT PRICE: $_____

4. WILL THE CONTRACT NEED ADDITIONAL CONTRACT TIME TO COMPLETE THE CHANGE IN WORK SCOPE? _____ -YES _____ -NO _____ -(CALENDAR DAYS)

5. WILL THE CONTRACTOR NEED ADDITIONAL PERSONNEL TO COMPLETE THE CHANGE IN WORK SCOPE? _____ -YES _____ -NO

   IF NO, TRADE(S): _____

   NO. OF PERSONNEL: _____

   DURATION: _____

6. IDENTIFICATION OF ATTACHMENTS:

PREPARED BY: _____ REVIEWED BY: _____
Project Manager

Date: _____ Date: _____

Comments and Recommendation:

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CONTRACT CHANGE ORDER FORM

TO:

CONTRACT CHANGE ORDER NO.:_____
DATE: _____
PROJECT NAME: S.R. 32/Nucor Road Area
Sanitary Sewer Collection System
ORIGINAL P.O. NO.: _____

I. You are directed to make the following changes in this contract:

ITEM	AMOUNT	SCHEDULED ADJUSTMENT (+) OR (-) DAYS

II. The following referenced documents further describe the changes outlined in Paragraph I, and are to be considered a part of this Change Order:
R.F.P.: _____ W.D.C.: _____

III. The changes result in the following adjustment of Contract Price and Contract Time:

Contract Sum prior to this Change Order $_____
Contract Sum will be increased/decreased by this Change Order $_____
New Contract Sum including this Change Order $_____
Contract Time Prior to this Change Order _____ Substantial Completion Date
_____ Final Completion Date
Net increased/decreased resulting from this Change Order _____ Days
Current Contract Time including this Change Order _____ Substantial Completion Date
_____ Final Completion Date

This Change Order is for full and final settlement of all direct, indirect, impact costs and time extension incurred at any time resulting from the performance of the changed work.

The Above Changes Are Recommended:	The Above Changes Are Accepted:	Approved:
_____	_____	Montgomery County Regional Sewer Board
Engineer	Contractor	Owner
_____	_____	110 W South Blvd
Address	Address	Address
_____	_____	Crawfordsville, IN 47933
City/State/Zip	City/State/Zip	City/State/Zip
By: _____	By: _____	By: _____
Phone: _____	Phone: _____	Phone: _____
Date: _____	Date: _____	Date: _____

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SECTION 00 55 00

NOTICE TO PROCEED

Project: **S.R. 32/Nucor Road Area Sanitary Sewer Collection System**

Owner: **Montgomery County Regional Sewer District**
110 W South Blvd
Crawfordsville, IN 47933

Contractor: _____

Contractor's Address: _____

_____
(Send Notice to Proceed Certified Mail, Return Receipt Requested)

You are notified that the Contract Times under the above Contract will commence to run on ____ _____, 20___. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 4 of the Agreement, the number of days to achieve Substantial Completion is 90, and the number of days to achieve readiness for final payment is 105.

Before you may start any Work at the Site, Paragraph 2.01 of the General Conditions as modified in the Supplementary Conditions provides that you must deliver to the OWNER (with copies to Engineer and other identified additional insured and loss payees) a certificate of insurance which shall be purchased and maintained in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must:
(to be completed at time of notice)

MONTGOMERY COUNTY REGIONAL SEWER DISTRICT

By: _____
Authorized Signature

_____
Print Name

_____
Title

Copy to Engineer

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SECTION 00 61 13.13

PERFORMANCE BOND FORM

1.1 SUMMARY

A. Document Includes:
   1. Performance Bond – EJCDC

B. Related Documents:
   1. Document 00 21 15 - Instructions to Bidders – Bid Submission
   2. Document 00 42 13 – Bid Proposal Form
   3. Document 00 52 15 – Agreement Form

PERFORMANCE BOND FOLLOWS (Three-Page Document)

PERFORMANCE BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR *(Name and Address):*

SURETY *(Name and Address of Principal Place of Business):*

OWNER *(Name and Address):*
Montgomery County Regional Sewer District
110 West South Blvd
Crawfordsville, IN 47933

CONTRACT
Effective Date of Agreement:

Amount:

Description *(Project Name and Include Location):*

BOND
Bond Number:

Date *(Not earlier than Effective Date of Agreement):*

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ (Seal)	_____ (Seal)
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	_____
Title	Title

Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.

1. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 2.1.

2. If there is no Owner Default, Surety's obligation under this Bond shall arise after:

2.1 Owner has notified Contractor and Surety, at the addresses described in Paragraph 9 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor, and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and

2.2 Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 2.1; and

2.3 Owner has agreed to pay the Balance of the Contract Price to:

1. Surety in accordance with the terms of the Contract; or
2. Another contractor selected pursuant to Paragraph 3.3 to perform the Contract.

3. When Owner has satisfied the conditions of Paragraph 2, Surety shall promptly, and at Surety's expense, take one of the following actions:

3.1 Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or

3.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or

3.3 Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or

3.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
2. Deny liability in whole or in part and notify Owner citing reasons therefor.

4. If Surety does not proceed as provided in Paragraph 3 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 3.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

5. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 3.1, 3.2, or 3.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To the limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

5.1 The responsibilities of Contractor for correction of defective Work and completion of the Contract;

5.2 Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions of or failure to act of Surety under Paragraph 3; and

5.3 Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

6. Surety shall not be liable to Owner or others for obligations of Contractor that are unrelated to the Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than Owner or its heirs, executors, administrators, or successors.

7. Surety hereby waives notice of any change, including changes of time, to Contract or to related subcontracts, purchase orders, and other obligations.

8. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located, and shall be instituted within two years after Contractor Default or within two years after Contractor ceased working or within two years after Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

9. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the address shown on the signature page.

10. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

11. Definitions.

11.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.

11.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

11.3 Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.

11.4 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or otherwise comply with the other terms thereof.

FOR INFORMATION ONLY – (*Name, Address and Telephone*)
Surety Agency or Broker:
Owner's Representative (*Engineer or other party*):

END OF SECTION

SECTION 00 61 13.16

PAYMENT BOND FORM

1.1 SUMMARY

A. Document Includes:
   1. Payment Bond – EJCDC

B. Related Documents:
   1. Document 00 21 15 - Instructions to Bidders
   2. Document 00 42 13 – Bid Proposal Form
   3. Document 00 52 15 – Agreement Form

PAYMENT BOND FOLLOWS (Three-Page Document)

PAYMENT BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

CONTRACTOR *(Name and Address):*

SURETY *(Name and Address of Principal Place of Business):*

OWNER *(Name and Address):*
Montgomery County Regional Sewer District
110 West South Blvd
Zionsville, Indiana 46077

CONTRACT
Effective Date of Agreement:

Amount:

Description *(Project Name and Include Location):*

BOND
Bond Number:

Date *(Not earlier than Effective Date of Agreement):*

Amount:

Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

_____ (Seal)
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2 Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:

6.1 Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.

6.2 Pay or arrange for payment of any undisputed amounts.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

9. Surety shall not be liable to Owner, Claimants, or others for obligations of Contractor that are unrelated

to the Contract. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

10. Surety hereby waives notice of any change, including changes of time, to the Contract or to related subcontracts, purchase orders, and other obligations.

11. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by Paragraph 4.1 or Paragraph 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to Surety, Owner, or Contractor shall be mailed or delivered to the addresses shown on the signature page. Actual receipt of notice by Surety, Owner, or Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.

13. When this Bond has been furnished to comply with a statutory requirement in the location where the Contract was to be performed, any provision in this Bond conflicting with said statutory requirement shall be deemed deleted herefrom and provisions conforming to such statutory requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond.

14. Upon request of any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

15. Definitions

15.1 Claimant: An individual or entity having a direct contract with Contractor, or with a first-tier subcontractor of Contractor, to furnish labor, materials, or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Contract, architectural and engineering services required for performance of the Work of Contractor and Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

15.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.

15.3 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract, or to perform and complete or otherwise comply with the other terms thereof.

FOR INFORMATION ONLY – (*Name, Address and Telephone*)
Surety Agency or Broker:
Owner's Representative (*Engineer or other party*):

END OF SECTION

SECTION 00 61 13.19

MAINTENANCE BOND FORM

1.1 SUMMARY

A. Document Includes:
   1. Maintenance Bond

B. Related Documents:
   1. Document 00 21 15 - Instructions to Bidders – Bid Submission
   2. Document 00 42 13 – Bid Proposal Form
   3. Document 00 52 15 – Agreement Form

MAINTENANCE BOND FOLLOWS (Two-Page Document)

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MAINTENANCE BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

Instructions:

Successful Bidder must use this form or other form(s) containing the same material conditions and provisions as approved by OWNER:

Date of Bond must not be prior to date of Contract. If CONTRACTOR is a Partnership, all partners shall execute bond.

Surety company executing this bond shall appear on the most current list of "Surety Companies Acceptable on Federal Bonds", as specified in the "U.S. Treasury Department Circular 570", as amended, and be authorized to transact business in the State of Indiana.

KNOW ALL MEN BY THESE PRESENTS that:

CONTRACTOR *(Name and Address):*

and

SURETY *(Name and Address of Principal Place of Business):*

a corporation chartered and existing under the laws of the State of _____, and authorized to do business in the State of Indiana,

are held and firmly bound unto the Montgomery County Regional Sewer Board, 110 W South Blvd, Crawfordsville, Indiana 47933, hereinafter called OWNER, in the penal sum of _____ _____ Dollars, ($_____) in lawful money of the United States, for the payment of which sum well and truly to be made, together with interest at the maximum legal rate from date of demand and any attorney fees and court costs incurred by Obligee to enforce this instrument, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the CONTRACTOR has entered into a certain Agreement with the OWNER, dated as of the _____ day of _____, 20___, by which CONTRACTOR has agreed to perform and furnish certain Work for or in furtherance of construction of public improvements described generally as:

S.R. 32/Nucor Road Area Sanitary Sewer Collection System

Which Agreement, and the "Contract Documents" as referred to therein, are hereby incorporated herein by reference.

WHEREAS, CONTRACTOR has installed and completed and met all improvements, installations, and requirements applicable to the above described Work, but said improvements and installations have not yet

been accepted for public maintenance; and

WHEREAS, the OWNER requires a guarantee from the CONTRACTOR against defective materials and workmanship in connection with such maintenance.

NOW, THEREFORE, CONTRACTOR warrants the workmanship and all materials used in the construction, installation, and completion of said Work, including all improvements and installations thereof, to be of good quality and constructed and completed in a workmanlike manner in accordance with the Agreement and "Contract Documents" and all local, state and federal laws, ordinances, rules, standards and regulations applicable to said Work;

FURTHERMORE, the conditions of the SURETY'S obligation hereunder are such that if CONTRACTOR at his own expense, for a period of three (3) years after said Work, improvements, and installations are accepted for public maintenance by the OWNER, shall make all repairs or replacements thereto which may become necessary by reason of improper or defective workmanship or material, or any failure thereof to conform to the provisions of the Agreement or "Contract Documents", then SURETY'S obligation is to be null and void; otherwise such obligation shall remain in full force and effect. Any repairs or replacements made under this bond shall in like manner be subject to the terms and conditions hereof.

CONTRACTOR and SURETY covenant that all action required by law to be taken by them to authorize the execution and delivery of this bond have been previously taken, that the officers whose signatures appear below have been fully empowered to execute and deliver this instrument and that once executed and delivered, it shall represent the lawful and binding obligation of the parties.

IN WITNESS WHEREOF, this instrument is executed in _____ (number) counterparts, each one of which shall be deemed an original, this _____ day of _____, 20___.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ (Seal)	_____ (Seal)
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	Attest: _____
Signature	Signature
_____	_____
Title	Title

END OF SECTION

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation , (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

   a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the

Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

   b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

   c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

   a. reviewing and checking all such information and data;

   b. locating all Underground Facilities shown or indicated in the Contract Documents;

   c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

   d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to

permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

   a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

   b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners,

employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

   a. Such insurance shall remain in effect for two years after final payment.

   b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of

them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

   a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

   b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

   c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

   d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

      1) shall certify that the proposed substitute item will:

         a) perform adequately the functions and achieve the results called for by the general design,

         b) be similar in substance to that specified, and

         c) be suited to the same use as that specified;

      2) will state:

         a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

         b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

         c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

      3) will identify:

         a) all variations of the proposed substitute item from that specified, and

         b) available engineering, sales, maintenance, repair, and replacement services; and

      4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or

entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its

use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner

and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts

any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the

Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe

access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws

and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations

on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of,

and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of

executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

    d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

    e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

    f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

    g. The cost of utilities, fuel, and sanitary facilities at the Site.

    h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

    i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances:*

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in

the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

   a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

   b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

   c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

   d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

   e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

   f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers,

architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's

review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

a. the Work has progressed to the point indicated;

b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

a. to supervise, direct, or control the Work, or

b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

c. there are other items entitling Owner to a set-off against the amount recommended; or

d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other

dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 14

SUPPLEMENTARY CONDITIONS

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These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC C-700 (2007 Edition). All provisions which are not so amended or supplemented remain in full force and effect.

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

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

SC-1.01 ***Defined Terms***

Add the following to the end of Paragraph 1.01 A:

A. "Command" type language is used in the Contract Documents. This command language refers to and is directed to the CONTRACTOR.

Add the following items after Paragraph 1.01 A:

B. Whenever in the Contract Documents the terms "furnish" or "install" or "provide" are used, they shall mean CONTRACTOR shall perform the following:

1. *Furnish* (materials or equipment) – To supply and deliver to the Project ready for installation and in acceptable operable condition.

2. *Install* (services or labor) – To place in final position, complete, anchored, connected, and in acceptable operable condition.

3. *Provide* – To furnish and install complete. When neither furnish, install, nor provide is stated, provide is implied. All products, materials or equipment identified in the Contract Documents, and products and all products incidental to the identified products, shall be provided by the CONTRACTOR unless specified otherwise.

SC-2.01 ***Delivery of Bonds and Evidence of Insurance***

Add the following to the beginning of Paragraph 2.01 A:

B. CONTRACTOR shall deliver executed Agreements to OWNER within ten (10) days of receipt of such Agreements from OWNER.

Delete Paragraph 2.01 B in its entirety and insert the following in its place:

C. *Evidence of Insurance:* When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR also shall deliver to OWNER, with a copy to the ENGINEER, certificates of insurance (and other evidence thereof as required by OWNER) which CONTRACTOR is required to purchase and maintain in accordance with Article 5 as amended in these Supplementary Conditions.

SC-4.06 ***Hazardous Environmental Conditions at Site***

Delete Paragraphs 4.06 A and 4.06 B in their entirety and insert the following in their place:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to OWNER.

B. Not Used.

SC-5.04 ***CONTRACTOR'S Insurance***

Add the following new paragraph immediately after Paragraph 5.04 B:

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 5.04 A.1 and A.2 of the General Conditions:

a.	State:	Statutory
b.	Employer's Liability	Statutory

2. Contractor's General Liability under Paragraphs 5.04 A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of CONTRACTOR:

a.	General Aggregate	$2,000,000
b.	Products – Completed Operations Aggregate	$2,000,000
c.	Personal & Advertising Injury	$1,000,000
d.	Bodily Injury & Property Damage (Each Occurrence)	$1,000,000

e.	Fire Damage (any one fire)	$ 50,000
f.	Medical Expense (any one person)	$ 5,000
g.	Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.	
h.	Excess or Umbrella Liability	$5,000,000 each occurrence and aggregate

3. Automobile Liability under Paragraph 5.04 A.6 of the General Conditions:

a.	Combined Single Limit of	$1,000,000 each accident

4. The OWNER, the Engineer, their consultants, and each of their officers, agents, and employees shall be covered as additional insured under the comprehensive general liability insurance required.

SC-5.05 ***Owner's Liability Insurance***

Delete Paragraphs 5.05 A in its entirety and insert the following in its place:

A. OWNER'S Protective Insurance: CONTRACTOR shall procure and maintain OWNER'S Protective Insurance as will, in OWNER'S opinion, protect OWNER from any contingent liability to others or damages because of bodily injury, including death and property damage, which may arise from operations under this Contract. Said insurance shall be procured from the same insurance company as is providing insurance for CONTRACTOR'S Commercial General Liability Insurance. The limits of the insurance to be procured shall be $5,000,000 per occurrence and $5,000,000 aggregate. CONTRACTOR shall furnish OWNER the original policy.

SC-5.06 ***Property Insurance***

Delete Paragraphs 5.06 A in its entirety and insert the following in its place:

A. CONTRACTOR shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. CONTRACTOR shall be responsible for any deductible or self-insured retention. This insurance shall:

1. include the interests of OWNER, CONTRACTOR, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by these Supplementary Conditions;

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by OWNER prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by OWNER;

6. include testing and startup;

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by OWNER, CONTRACTOR, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

8. comply with the requirements of Paragraph 5.06 C of the General Conditions.

Delete Paragraphs 5.06 B and replace with the following:

B. CONTRACTOR shall purchase and maintain equipment breakdown insurance and any other additional property insurance required by Laws and Regulations, which insurance will include the interest of OWNER, CONTRACTOR, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

Delete Paragraphs 5.06 E in its entirety.

SC-6.06 ***Concerning Subcontractors, Suppliers and Others***

Add a new sub-paragraph immediately after Paragraph 6.06 B:

1. The Bidder shall submit with his bid the identity of all Subcontractors proposed for the project. Subcontractors may be changed only upon the CONTRACTOR'S written request to the OWNER and the OWNER'S subsequent approval.

Add a new paragraph immediately after Paragraph 6.06 G:

H. OWNER may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to CONTRACTOR on account of Work performed for CONTRACTOR by a particular Subcontractor or Supplier.

SC-6.08 ***Permits***

Add new paragraphs immediately after Paragraph 6.08 A:

B. The OWNER has obtained the Rule 5 NOI permit for the Project and anticipates obtaining the IDEM Sanitary Sewer Construction Permit and INDOT ROW Permit before Notice to Proceed is provided to CONTRACTOR. CONTRACTOR is responsible for maintaining and meeting all permit requirements.

C. CONTRACTOR shall obtain any permits that may be required by Law and/or Regulation. CONTRACTOR shall appropriately display all permits in the manner required by the permitting authorities. CONTRACTOR shall abide by all provisions, conditions and requirements of each permit required for the Project.

SC-6.10 ***Taxes***

Add new paragraphs immediately after Paragraph 6.10 A:

B. OWNER is exempt from payment of sales and compensating use taxes of the State of Indiana and of cities and counties thereof on all materials to be incorporated into the Work.

1. OWNER will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.

2. OWNER'S exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by CONTRACTOR, or to supplies or materials not incorporated into the Work.

SC-6.17 ***Shop Drawings and Samples***

Add the following new paragraphs immediately after Paragraph 6.17 E:

F. CONTRACTOR shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and CONTRACTOR shall reimburse OWNER for Engineer's charges for such time.

G. In the event that CONTRACTOR requests a change of a previously approved item, CONTRACTOR shall reimburse OWNER for Engineer's charges for its review time unless the need for such change is beyond the control of CONTRACTOR.

SC-11.03 ***Unit Price Work***

Delete Paragraph 11.03 D in its entirety and insert the following in its place:

B. The unit price of an item of Unit Price Work shall be subject to reevaluation and adjustment under the following conditions.

1. if the Bid price of a particular item of Unit Price Work amounts to five (5) percent or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by CONTRACTOR differs by more than twenty-five (25) percent from the estimated quantity of such item indicated in the Agreement; and

2. if there is no corresponding adjustment with respect to any other item of Work; and

3. if CONTRACTOR believes that CONTRACTOR has incurred additional expense as a result thereof or if OWNER believes that the quantity variation entitles OWNER to an adjustment in the unit price, either OWNER or CONTRACTOR may make a Claim for an adjustment in the Contract Price in accordance with Article 10 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

SC-14.02 ***Progress Payments***

Add to the end of sub-paragraph A 2 the following:

1. In conformity with IC 36-1-12-13(a), the contract must provide for the payment of Subcontractors, laborers, material suppliers and those performing services. The OWNER may withhold from the contract price an amount sufficient to pay Subcontractors, laborers, material suppliers and those furnishing services should non-payment by the CONTRACTOR become evident.

SC-16.01 ***Methods and Procedures***

Delete Paragraph 16.01 C in its entirety and insert the following in its place:

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, OWNER or CONTRACTOR:

2. elects in writing to demand arbitration of the Claim, pursuant to Paragraph SG-16.02, or

3. agrees with the other party to submit the Claim to another dispute resolution process.

SC-16.02 ***Arbitration***

Add the following new paragraph immediately after Paragraph 16.01.

A. All Claims or counterclaims, disputes, or other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.09) including but not limited to those not resolved under the provisions of Paragraphs SC-16.01A and 16.01.B will be decided by arbitration in accordance with the rules of the American Arbitration Association, subject to the conditions and limitations of this Paragraph SC-16.02. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the 30 day period specified in Paragraph SC-16.01.C, and in all other cases within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statue of limitations.

C. No arbitration arising out of or relating to the Contract Documents shall include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity is necessary if complete relief is to be afforded among those who are already parties to the arbitration; and

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include: (i) a concise breakdown of the award; (ii) a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.

E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Controlling Law relating to vacating or modifying an arbitral award.

F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by OWNER and CONTRACTOR.

Terracon GeoReport

Geotechnical Evaluation Report

SR 32 Wastewater Collection System
Montgomery County, Indiana
May 31, 2018
Terracon Project No. CJ185238

Prepared for:
VS Engineering, Inc.
Indianapolis, Indiana

Prepared by:
Terracon Consultants, Inc./Earth Exploration, Inc.
Indianapolis, Indiana

May 31, 2018

Mr. Samuel Weber, P.E.
VS Engineering, Inc.
4275 North High School Road
Indianapolis, Indiana 46254

Re: Geotechnical Evaluation Report
SR 32 Wastewater Collection System
Montgomery County, Indiana
Terracon Project No. CJ185238

Dear Mr. Weber:

In accordance with your request, we have completed our Geotechnical Evaluation for the referenced project. This report presents the results of our subsurface exploratory and laboratory testing programs and provides geotechnical recommendations for the proposed wastewater collection system. Project authorization was provided by VS Engineering, Inc. (VS) via electronic mail on March 27, 2018. We are providing our report in electronic format for your use and distribution, and paper copies can be provided upon request.

We have enjoyed working with you on this project. If you have any questions regarding this report or require further assistance with the project, please contact us.

Sincerely,
Terracon Consultants, Inc.

Tanner Hill, E.I.
Staff Engineer

KELLEN PATRICK HEAVIN
REGISTERED
PE11011658
STATE OF INDIANA
PROFESSIONAL ENGINEER

Kellen P. Heavin, P.E.
Project Engineer

PROJECT DESCRIPTION

We understand that representatives of VS are in the design phase for a new wastewater collection system in Montgomery County. Based on information provided by VS via email and our correspondence via telephone on March 23 and 27, 2018, respectively, the improvements are planned to consist of the placement of approximately 23,000 lin. ft of gravity sewer and force main and two lift stations. The table below provides the approximate inverts/depths of each element.

Element	Approximate Element Inverts/Depths (ft)
Lift Stations	25
Trenchless Excavation Pits	15
Gravity Sewer	10 to 20
Force Main	8

The gravity sewer and force main are planned to be installed using conventional cut-and-cover techniques, except where it crosses US 136. At this location, the sewer line is planned to be installed using trenchless methods consisting of horizontal earth boring and pipe jacking. Additional project information such as pipe diameters and construction schedule was not available at the time of this report. In the event that the nature, design, or location of the proposed construction changes, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions are modified or confirmed in writing by Earth Exploration, Inc. (EEI), a Terracon company.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

A summary of the test boring locations and associated planned wastewater collection system elements is provided in the table below.

Element	Borings	Boring Depth (ft)
Lift Stations	SB-10 and SB-11	25
Trenchless Excavation Pits	SB-2 and SB-3	≈23¾
Gravity Sewer	SB-11, SB-12, SB-18, SB-19, and SB-20 SB-9 and SB-21	20 to 25 15
Force Main	SB-1, SB-4, SB-5, SB-6, SB-7, SB-8, SB-13, SB-14, SB-15, SB-16, SB-17, and SB-22	12½

Boring Layout and Elevations: The exploratory locations (indicated on the attached Test Boring Location Plan Drawing No. CJ185238.B1) were staked in the field by EEI personnel using hand-held GPS equipment with a horizontal accuracy of about 10 ft based on coordinates obtained by overlaying the sewer alignment shown an electronic drawing provided by VS on March 23, 2018 in Google Earth™. The exploration locations should be considered accurate only to the degree implied by the methods used.

Subsurface Exploration Procedures: The exploratory field activities were performed by EEI on April 30 through May 4, 2018 using truck-mounted equipment and 3¼-in. I.D. hollow stem augers to advance the boreholes. Relatively disturbed samples of the soil strata were obtained at 2½-ft intervals with a split-spoon sampler using Standard Penetration Test (SPT) procedures to the maximum depths explored (25 ft). Following the completion of our exploratory activities, the boreholes were backfilled with auger cuttings and a bentonite chip plug, and the roadway was restored with a pavement patch. Further details of the drilling and sampling procedures are provided in the attached Field Methods for Exploring and Sampling Soils and Rock.

The sampling depths, penetration distances, and other sampling information were recorded on the field logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification. Our exploration team prepares field logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples.

Laboratory Testing

Following the field activities, the soil samples were visually classified by an engineering technician and reviewed by a geotechnical engineer. Soil classifications on the boring logs are according to the Unified Soil Classification System (USCS). Further detail regarding the classification system are provided in the Unified Soil System Classification/General Notes. After classifying the samples, the following laboratory testing program was performed:

- Hand penetrometer readings (i.e., q_p, which provide an indication of the shear strength characteristics of cohesive-type soils)
- Natural moisture content tests (W%)
- Grain size distribution
- Atterberg limits (LL, PL)

Upon completion of our laboratory testing program, boring logs were prepared and are provided in the Attachments. The results of these tests are included on the test boring logs and/or laboratory test reports. It should be mentioned that the boring logs represent the approximate boundary between soil types; although the transitions may actually be gradual.

SITE CONDITIONS

The following description of the site conditions is derived from our site visit in association with the field exploration and our review of readily available aerial photographs.

Surface Conditions

The sewer alignment follows along Nucor Road and County Road 400 East to State Road 32. At this location is splits east and west along State Road 32 to where it terminates approximately 6,850 ft to the west and near the intersection of Nucor Road to the east. In general, about 4 to 12 in. of asphaltic concrete (HMA) overlying about 5 to 19 in of sand and gravel subbase was observed at the test boring locations. Per topographic information obtained from GoogleEarth™, the ground surface along the project alignment is moderately hilly with grades ranging from approximately El. 774 to 837 ft at the boring locations.

Subsurface Conditions

Based on the information gathered during our field activities, the subsurface conditions at the boring locations typically consisted of cohesive soils with interbedded layers of granular soils to the maximum depths explored (12½ to 25 ft). The cohesive soils consisted of lean clay, sandy clay, silty clay, and fat clay. The interbedded granular soils consisted of poorly graded sand with silt and silty sand and were typically observed at varying depths below the existing ground surface. Note that weathered shale was observed underlying the cohesive soils below depths of about 10 and 16½ at Borings SB-3 and SB-2, respectively. In addition, silty clay described as fill was noted at Borings SB-13, SB-17, SB-18, and SB-20 to depths of about 2 to 4 ft below the existing ground surface.

From our observations, the consistency of the fill was medium stiff to hard with hand penetrometer readings ranging from ½ to greater than 4½ tons/sq. ft (tsf). The moisture content of the fill varied from about 10 to 12 percent. Note that the fill soil in the upper 4 ft at Boring SB-13 contained asphalt fragments.

In general, the consistency of the naturally occurring sandy clay and lean clay was observed to be stiff to very stiff, the silty clay was generally stiff to hard, and the fat clay was stiff to very stiff. Hand penetrometer readings in the cohesive soils were typically no less than 1 tsf. Moisture contents for the lean and fat clays were typically over 20 percent and as high as about 31 percent, whereas the moisture content of the silty and sandy clays was generally less than 15 percent. Atterberg limit tests performed on samples of lean clay and sandy clay indicated liquid limits (LL) of 42 and 23 and plastic limits (PL) of 17 and 13, respectively. An Atterberg limit test performed on a sample of silty clay indicated a LL of 20 and a PL of 13. Note that layers of soft lean clay, sandy clay, and silty clay were observed at some of the borings locations at varying depths. A

summary of the soft cohesive soils observed at the test boring locations is provided in the following table.

Boring No.	Soil Type	Hand Penetrometer (tsf)	Approximate Depth [1] (ft)
SB-9	Sandy Clay (CL)	¼	3 – 8
SB-12	Silty Clay (CL-ML)	¼	13½ – 15
SB-13	Lean Clay (CL)	¼	4 – 5½
SB-15	Silty Clay (CL-ML)	¼	≈¾ – 3
SB-16	Sandy Clay (CL)	¼	6 – 10½
SB-21	Sandy Clay (CL)	¼	6 – 8

1. Below the existing ground surface.

The relative density of the poorly graded sand with silt and silty sand was typically observed to be loose to medium dense based on SPT N-values generally in the range of 7 to 27 blows per foot (bpf). A sieve analysis performed on a sample of the silty sand indicated a fines content (P_{200}) of about 20 percent.

As previously mentioned, weathered shale was observed at Borings SB-2 and SB-3 near depths of 16½ to 10 ft, respectively. The shale was described as soft based on the quality to scratch the samples recovered with a split-spoon sampler with a metallic object.

Groundwater Conditions

Groundwater level observations were made during and at completion of the sampling process. Groundwater was initially encountered at nine of the twenty-two test borings at depths ranging from about 4 to 19½ ft below the existing ground surface during drilling activities and about 2½ to 19 ft below the existing ground surface upon completion of the drilling activities. It is our opinion that the observed groundwater level is likely perched. A review of the *Soil Survey of Montgomery County* indicated that the soils in the project area are prone to a seasonal high groundwater level (i.e. perched) within 1 ft of the surface. As additional input, a review of readily available water well information indicated that the groundwater level near the southern portion of the project alignment is typically about 10 to 15 ft below the surface, whereas the groundwater level near the northern portion of the alignment is typically about 40 to 65 ft below the surface. The groundwater levels observed are noted on the bottom of the boring logs and are summarized below.

Boring No.	Approximate Groundwater Depth (ft) [1]		Boring No.	Approximate Groundwater Depth (ft) [1]	
	During Drilling	At Completion		During Drilling	At Completion
SB-1	NW	NW	SB-12	18	14
SB-2	NW	NW	SB-13	NW	NW
SB-3	12	19	SB-14	NW	NW
SB-4	NW	NW	SB-15	NW	NW
SB-5	NW	8	SB-16	9	9
SB-6	10	7½	SB-17	NW	NW
SB-7	4	2½	SB-18	15	NW
SB-8	NW	NW	SB-19	NW	16
SB-9	NW	NW	SB-20	19½	17½
SB-10	5	8	SB-21	NW	NW
SB-11	9½	9	SB-22	NW	NW

NW = No water encountered

It should be recognized that groundwater levels of any kind can fluctuate due to changes in precipitation, infiltration, surface run-off, and other hydrogeological factors. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

DISCUSSION AND RECOMMENDATIONS

General

In general, the subsurface conditions observed at the boring locations are suitable for support of the proposed wastewater collection system elements. However, the soft cohesive soils observed at Borings SB-9, SB-12, SB-13, SB-15, SB-16, and SB-21 increase the risk of differential support of the pipe along the alignment. This condition can result in misalignment of gravity-flow pipes, which can impede the function of the collection system. Undercuts should be anticipated in these areas. In addition, dewatering will be necessary to facilitate construction and prepare the subgrade of the proposed elements. The condition of the subgrade and the performance of the improvements will be, in part, a function of the care and workmanship of the contractor in protecting the subgrade from water. Due to the presence of granular soils, excavation support will also be required during construction. These construction-related issues are the responsibility of the contractor, and the project success will be affected by their means and methods. Additional discussion and recommendations regarding these and other design and construction considerations are provided in the following paragraphs.

Dewatering and Excavation

Based on the groundwater conditions and soil types observed at the boring locations, dewatering will be necessary during the construction of the improvements. It should be noted that the soil conditions varied along the alignment. As such the dewatering requirements will vary. Within the cohesive soils, dewatering is anticipated to consist of multiple pumps and filtered sumps possibly in combination with collection trenches. However, when excavations extend into the wet granular soils, the use of multiple deep wells, well points, and/or sump pits outside the limits of the excavation will be required. Based on our observations at the test borings, there was no discernible pattern or consistency to the presence of the sand layers. However, sand layers will likely be frequently encountered in isolated areas along the project. It should be noted that the sands observed at the test borings will flow if excavated in the wet. This will cause poor subgrade conditions for support of the pipe and will create unsafe conditions for construction. We recommend that the groundwater level be lowered a depth of 2 ft below the planned invert prior to the excavation activities.

The intent of our evaluation was to provide geotechnical design-related recommendations for the new sewer and lift station elements. The scope of this evaluation was not to provide dewatering recommendations for contractors. Based on a sieve analysis, the silty sand exhibits a P_{200} of about 20 percent. Dewatering is a responsibility of the contractor based on their means and methods and considers the requirements of subgrade preparation discussed herein. It may be necessary for the dewatering contractor to obtain additional subsurface information to assist with the design of their dewatering plan. The effectiveness of the subgrade preparation activities discussed below will be directly dependent on the adequacy of the contactor's dewatering efforts.

Based on our understanding of the existing grades and the proposed invert, rock excavation should be anticipated near the areas of Boring SB-2 and SB-3. Where the hollow-stem augers were able to penetrate the rock, the rock may be rippable and/or could possibly be broken with a hydraulic hammer or with conventional earthwork equipment with ripper teeth. The actual method of rock removal to be used cannot be speculated with certainty. However, from our experience with similar projects, methods have included hydraulic hammers and heavier mechanical equipment. We recommend that the contractor be prepared to perform rock excavation.

Considering the anticipated depth of the excavations, it is anticipated that the use of braced excavations will be required during construction. In our experience, excavation support typically includes trench boxes (for shallower excavations), braced or unbraced sheeting. Sheeting or boxes used in excavations should be placed in a manner not to disturb the embedment material. All excavations should comply with OSHA standards. Stockpiled soil should not be placed adjacent to the excavation. In addition, proper site drainage is recommended to help minimize unwanted surface water runoff into excavations during the construction process.

Sanitary Sewer Considerations

Cut-and-Cover

As previously discussed it is understood that the pipe is generally planned to be installed using conventional cut-and-cover techniques with planned inverts established about 8 to 20 ft below the existing grade. Based on information obtained at the boring locations, the subgrade at the invert is generally anticipated to consist of stiff to very stiff cohesive soils or loose to medium dense granular soils. Note that groundwater is anticipated to be present near or above the planned inverts along the southern portion of the alignment.

As previously mentioned, the condition of the subgrade will be a function of the care and workmanship of the contractor in protecting the subgrade from water. It should be noted that even stiff cohesive soils may quickly become disturbed due to foot traffic and soften in areas where wet granular layers are encountered near the subgrade. The following subgrade preparation recommendations are provided assuming the subgrade has been dewatered prior to excavation, where necessary. Where granular soils are encountered at the subgrade, we recommend that the granular soils be compacted via several passes of a vibratory plate compactor. As stated previously, moisture sensitive cohesive soils are anticipated at or near the subgrade along a majority of the alignment. In the event that these soils are exposed to water, they will be difficult to compact in-situ. If continued wet weather persist and continued difficult subgrade conditions are observed despite food faith efforts being made by the contractor to correct the condition, we recommend that the pipe subgrades be undercut a minimum of 2 ft and grade be reestablished by placing an open-graded crushed aggregate such as INDOT No. 8 stone. As discussed, soft soils were observed as summarized in a previous table. Based on our understanding of the inverts, we anticipate that soft soils will be present at the invert near Boring SB-16. However, the depth and thickness of soft soil layers varied at the test boring locations. As such, soft soils should be anticipated in unexplored areas. Where soft soils are encountered at the subgrade, these soils should be undercut and replaced as stated above. We recommend that fill placed for this purposed by compacted. Further, to reduces the potential for softening of the subgrade soils and additional undercutting, it is recommended that the construction activities in these areas by scheduled such that the pipe subgrade is undercut, then reestablished as soon as practical. This will require having all backfill materials present during the excavation activities.

Trenchless Methods

Based on the information obtained at Borings SB-2 and SB-3, performed near the planned launching and receiving pits, we anticipate that conditions similar to those discussed previously will be present as well as weathered shale. Groundwater is anticipated to be present above the planned invert near Boring SB-3. We recommend that the groundwater level be lowered 2 ft below the pit elevation prior to excavation. Dewatering on a continuous basis may be required through the trenchless activities and backfill of the launching and receiving pits. To preserve the subgrade integrity at the pit locations, we recommend placing 6 in. of compacted No. 8 crushed stone on a geotextile for separation, or a 4-in. thick mud mat consisting of lean concrete.

As you are aware, trenchless methods require a specialty contractor, and we recommend details of the methods and techniques be selected by the contractor based on the subsurface conditions and project requirements (i.e., performance-based contract language). These methods and techniques may also be influenced by the requirements of 3rd parties (e.g., regulators). As such, we recommend that our exploratory information be provided to the prospective contractors for their interpretation and use in preparing an installation plan and developing their means and methods. The previous discussion about soil conditions is from a geotechnical perspective for the benefit of you and the owner.

Bedding and Backfill

In areas where the pipe crosses beneath existing roads or other utilities (settlement sensitive areas), granular soils are recommended for backfill of the pit excavation and in the event that conventional cut-and-cover techniques are used. This is because of their ease of compaction as compared to cohesive soils which reduces the risk of settlement. In addition, periodic field density tests and observations by EEI are recommended during backfill placement to verify the adequacy of compactive effort. For bedding purposes, we recommend the use of a granular soil satisfying a USCS symbol of "SP," "SW," “SW-SM,” or “SP-SM.” The soils classified using these designations at the test boring locations are anticipated to be suitable for this purpose. However, given the limited quantity of granular soil layers observed at the test boring locations, we anticipate that imported granular fill will likely be required. The quantity of imported backfill with be a function of the contractor’s excavation method. A significant quantity of backfill could be required if the excavation slopes are laid back. Additionally, granular backfill should be placed and compacted around the pipe in uniform layers, not exceeding 6 in. in loose lift thickness. Furthermore, the use of cohesive soils for backfill above the pipe, if considered, should be limited to areas outside of the pavement, other utilities, and non-settlement sensitive areas.

We recommend that the imported granular soil at the base of the excavation, for the bedding material, and soils used for structural backfill surrounding the pipe elements be mechanically compacted to a minimum of 95 percent of the maximum dry density in accordance with ASTM D 1557 (modified Proctor). In other areas, the backfill could be compacted to 90 percent of the maximum dry density, provided some settlement of the backfill is tolerable. In addition, we recommend that the pipe manufacturer be contacted to discuss special bedding and backfill requirements.

Lift Station Considerations

The lift station improvements are planned to be located near the area of Borings SB-10 and SB-11. The lift stations are planned to be established about 25 ft below the existing ground surface. Very stiff to hard cohesive soils and/or very dense sand is anticipated to be present at the subgrade. Provided the subgrade is prepared as discussed above for the cut-and-cover sewer, the soils observed at the planned base of these new elements are anticipated to be suitable for

support of the foundations. Loading characteristics of lift station elements are typically such that there is no net increase in stress at the base level. If needed, these elements can be designed considering a net allowable bearing pressure of 5,000 lbs/sq ft (psf). Groundwater was observed at a depth range of about 5 to 9½ below existing ground surface in the area of the lift station improvements. Therefore, dewatering will be required during construction, and the success in preparing the subgrade for support of the elements will depend on the adequacy of the dewatering effort by the contractor.

In addition to downward forces, the effects of buoyancy should also be considered for design. As mentioned, groundwater was observed during drilling at about 5 to 9½ ft below the existing ground surface. However, to consider the potential fluctuation of the groundwater level, consideration should be given to utilizing a depth to groundwater of about 2 ft for buoyancy design. The weight of the structures in additional to the weight of the soils above the “lip” of the base of the structures should be considered to provide the necessary resistance to the uplift forces. We recommend that a unit weight of the soil of 120 and 60 lb/cu ft (pcf) be utilized for this purpose above and below the groundwater table, respectively.

The walls for the below-grade structures should be designed to resist both hydrostatic and lateral earth pressures. Based on the nature of the structures, relatively rigid conditions are anticipated such that an at-rest condition will develop. For these conditions, we recommend using an equivalent fluid pressure of 90 pcf. This condition assumes: that free-draining granular soils are used as wall backfill; that the backfill extends horizontally from the wall a distance equal to at least ½ of the depth of the wall below grade; a moist/saturated unit weight of 120/60 pcf; and an angle of internal friction of 30 degrees. In addition to lateral earth pressure, surcharges from temporary loads during construction (if any) should be taken into account in the wall design.

We recommend that the backfill behind the walls be placed in loose lift thicknesses not exceeding 8 in. and compacted to at least 90 percent of the modified proctor dry density to reduce long-term subsidence. However, if backfill will support other structures, utilities, or pavement, we recommend compaction of 95 percent of the modified dry density. Compaction of backfill within 3 ft of the walls should be performed with a hand-guided compactor to avoid over-stressing. Recommended backfill was discussed in a previous section.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. EEI should be retained as the Geotechnical Engineer, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and

supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

FIELD METHODS FOR EXPLORING AND SAMPLING SOILS AND ROCKS

TEST BORING LOCATION PLAN
(Drawing No. CJ185238.B1)

UNIFIED SOIL CLASSIFICATION SYSTEM/GENERAL NOTES

LOG OF TEST BORING (22)

GRAIN SIZE DISTRIBUTION CURVE

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

FIELD METHODS FOR EXPLORING AND SAMPLING SOILS AND ROCK

A. Boring Procedures Between Samples

The boring is extended downward, between samples, by a hollow stem auger, continuous flight auger, driven and washed-out casing, or rotary boring with drilling mud or water.

B. Standard Penetration Test and Split-Barrel Sampling of Soils
(ASTM* Designation: D 1586)

This method consists of driving a 2-in. outside diameter split-barrel sampler using a 140-lb weight falling freely through a distance of 30 in. The sampler is first seated 6 in. into the material to be sampled and then driven 12 in. The number of blows required to drive the sampler the final 12 in. is recorded on the Log of Test Boring and known as the Standard Penetration Resistance or N-value. Recovered samples are first classified as to texture by the field personnel. Later in the laboratory, the field classification is reviewed by a geotechnical engineer who observes each sample.

C. Thin-walled Tube Sampling of Soils
(ASTM* Designation: D 1587)

This method consists of hydraulically pushing a 2-in. or 3-in. outside diameter thin wall tube into the soil, usually cohesive types. Relatively undisturbed samples are recovered.

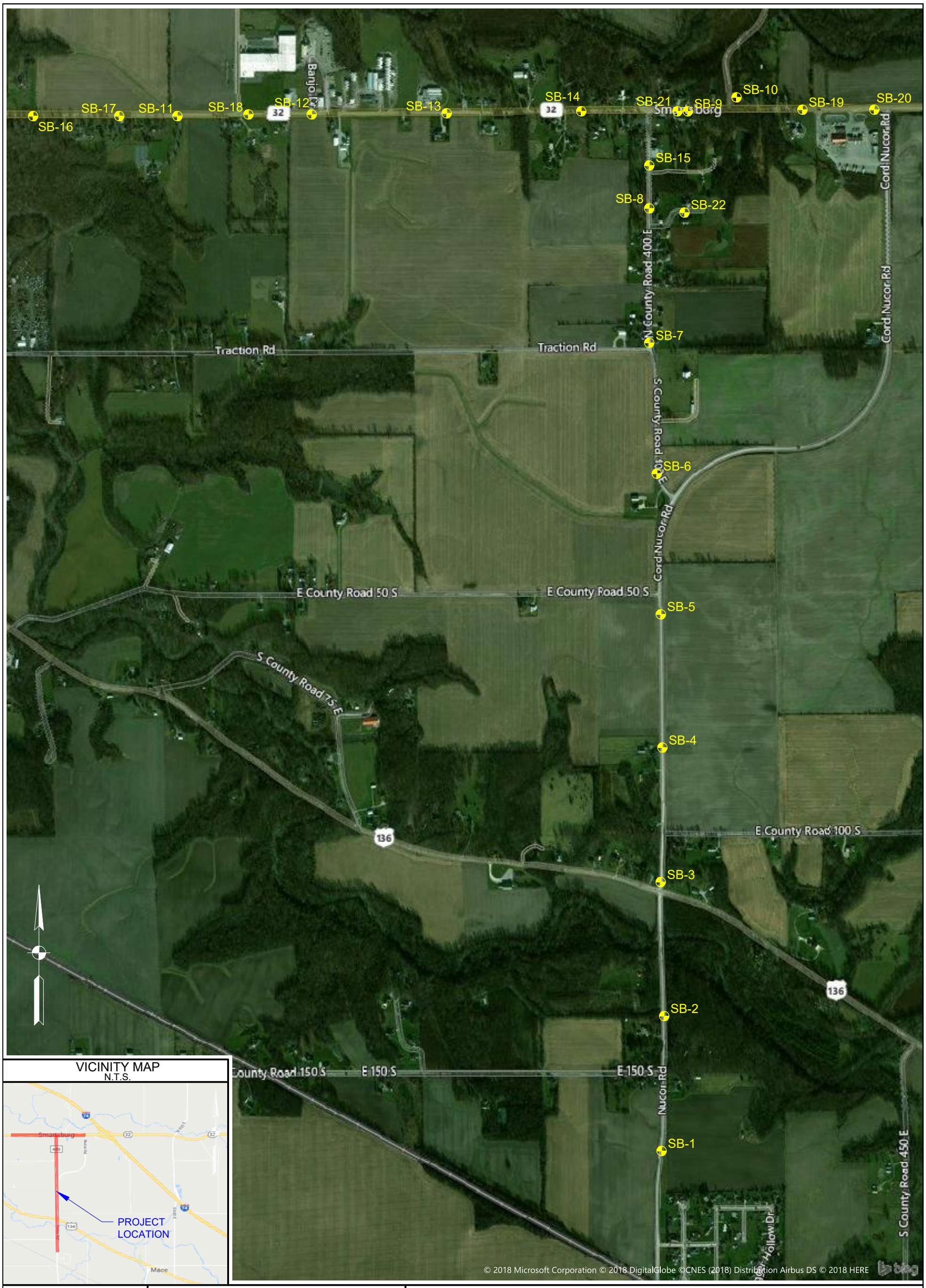
D. Soil Investigation and Sampling by Auger Borings
(ASTM* Designation: D 1452)

This method consists of augering a hole and removing representative soil samples from the auger flight or bucket at 5-ft intervals or with each change in the substrata. Relatively disturbed samples are obtained and its use is therefore limited to situations where it is satisfactory to determine approximate subsurface profile.

E. Diamond Core Drilling for Site Investigation
(ASTM* Designation: D 2113)

This method consists of advancing a hole in rock or other hard strata by rotating downward a single tube or double tube core barrel equipped with a cutting bit. Diamond, tungsten carbide, or other cutting agents may be used for the bit. Wash water is used to remove the cuttings. Normally, a 3-in. outside diameter by 2-in. inside diameter coring bit is used unless otherwise noted. The rock or hard material recovered within the core barrel is examined in the field and laboratory. Cores are stored in partitioned boxes and the length of recovered material is expressed as a percentage of the actual distance penetrated.

* American Society for Testing and Materials, Philadelphia, PA



VICINITY MAP
N.T.S.

LEGEND	NOTES
B-1 Test Boring Location and Designation	1. Base map developed using aerial imagery from © 2018 Microsoft Corporation © 2018 DigitalGlobe © CNES (2018) Distribution Airbus DS © 2018 HERE. 2. Vicinity map generated using imagery from google.com/maps. 3. Borings were located in the field by Earth Exploration, Inc. 4. Boring locations are approximate.

TEST BORING LOCATION PLAN

PROJECT:	SR 32 Wastewater Collection System
LOCATION:	Montgomery County, Indiana
CLIENT:	VS Engineering, Inc.
EEI PROJ. NO.:	CJ185238
SCALE:	1" = 1000'

PROJECT ENG:	TJH
APPROVED BY:	KPH
DRAWN BY:	JBF
DATE:	5/30/18
DRAWING NO.:	CJ185238.B1

EARTH EXPLORATION, INC. A Terracon COMPANY

UNIFIED SOIL CLASSIFICATION SYSTEM / GENERAL NOTES

FINE-GRAINED SOILS

CONSISTENCY	UNCONFINED STRENGTH (tsf)
Very Soft	<0.25
Soft	0.25 - 0.5
Medium	0.5 - 1.0
Stiff	1.0 - 2.0
Very Stiff	2.0 - 4.0
Hard	>4.0

COARSE-GRAINED SOILS

RELATIVE DENSITY	N-VALUE* (Blows/ft)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50+

RELATIVE PROPORTIONS

TERM	DEFINING RANGE BY % OF WEIGHT
Trace	0 - 5
Little	5 - 12
Some	12 - 35
And	35 - 50

ORGANIC CONTENT BY COMBUSTION METHOD

SOIL DESCRIPTION	LOI
Trace Organic Matter	0 - 5%
Little Organic Matter	5 - 12%
Organic Silt/Clay	12 - 35%
Sedimentary Peat	35 - 50%
Fibrous and Woody Peat	50%±

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

MAJOR DIVISIONS			SYMBOLS & DESCRIPTIONS	
COARSE-GRAINED SOILS More than 50% of material coarser than No. 200 sieve	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS Little or no fines	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES Appreciable amount of fines	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS More than 50% of coarse fraction passing No. 4 sieve	CLEAN SANDS Little or no fines	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES Appreciable amount of fines	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE-GRAINED SOILS More than 50% of material finer than No. 200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SAND OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

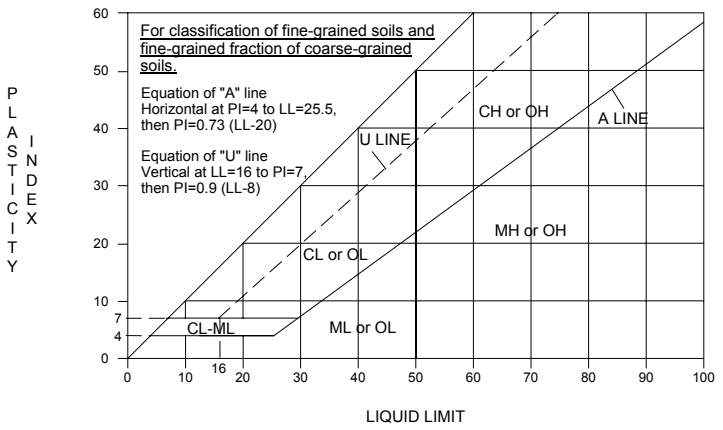
NOTE: DUAL SYMBOLS USED FOR BORDERLINE CLASSIFICATIONS

GRAIN SIZE TERMINOLOGY

SOIL FRACTION		PARTICLE SIZE	US STANDARD SIEVE SIZE
Boulders		Larger than 12-in.	Larger than 12-in.
Cobbles		3 to 12-in.	3 to 12-in.
Gravel	Coarse	3/4 to 3-in.	3/4 to 3-in.
	Fine	4.75 mm to 3/4-in.	#4 to 3/4-in.
Sand	Coarse	2.00 to 4.75 mm	#10 to #4
	Med	0.425 to 2.00 mm	#40 to #10
	Fine	0.075 to 0.425 mm	#200 to #40
Silt		0.005 to 0.075 mm	Smaller than #200
Clay		Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

PLASTICITY CHART



EXPLORATORY SAMPLING ABBREVIATIONS

AS	- Auger Sample	PID	- Photo-Ionization Detector
BF	- Backfilled Upon Completion	PMT	- Borehole Pressuremeter Test
BS	- Bag Sample	PT	- 3-in. O.D. Piston Sample
C	- Casing: Size 2½-in., NW; 4-in., HW	PTS	- Peat Sample
COA	- Clean-Out Auger	RB	- Rock Bit
CS	- Continuous Sampler	RC	- Rock Core
CW	- Clear Water	REC	- Recovery
DC	- Driven Casing	RQD	- Rock Quality Designation
DM	- Drilling Mud	RS	- Rock Sounding
FA	- Flight Auger	S	- Soil Sounding
FT	- Fish Tail	SS	- 2-in. O.D. Split-Spoon Sample
HA	- Hand Auger	ST	- Thin-Walled Tube Sample
HSA	- Hollow Stem Auger	VS	- Vane Shear Test
NW	- No Water Encountered	WPT	- Water Pressure Test

LABORATORY TEST ABBREVIATIONS

qp	- Hand Penetrometer Reading, tsf
qu	- Unconfined Compressive Strength, tsf
W	- Moisture Content, %
LL	- Liquid Limit, %
PL	- Plastic Limit, %
PI	- Plasticity Index, %
SL	- Shrinkage Limit, %
LOI	- Loss on Ignition, %
γ_d	- Dry Unit Weight, pcf
pH	- Hydrogen-Ion Concentration
P_{200}	- Percent Passing a No. 200 Sieve

*The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" O.D. split-spoon sampler. The sampler is driven with a 140 lb weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, LLC
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-01**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Sunny	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	60° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
SS-1		40	15		**GRANULAR SUBBASE**, (sand and gravel)							
					SP-SM, **POORLY GRADED SAND with SILT**, little gravel, medium dense, moist, brown							
SS-2		100	10									
				5								
SS-3		100	9		**SM**, **SILTY SAND**, trace gravel, loose, moist, brown, fine to medium grained							
SS-4		90	7									
				10								
SS-5		100	33		**CL-ML**, **SILTY CLAY**, some sand, trace gravel, very stiff, brown	3½			10.1			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	NW	NW	BF
To Cave-in		11	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **4/30/18** End **4/30/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-02**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Sunny	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	60° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1		85	29		**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			8.2			
SS-2		65	15	5	**SP-SM**, **POORLY GRADED SAND with SILT**, little gravel, medium dense, moist, brown, fine to medium grained							
SS-3		100	24									
SS-4		100	27	10	**SM**, **SILTY SAND**, trace gravel, medium dense, moist, brown, fine to medium grained							
SS-5		100	16		**CH**, **FAT CLAY**, little sand, trace gravel, very stiff, brown	2½			22.4			
SS-6		100	16	15	**CL**, **SANDY CLAY**, little gravel, hard, brown	>4½			14.0			
SS-7		95	50/.4									
SS-8		85	50/.5*	20	**WEATHERED SHALE**, soft, brown to gray below 19 ft							
SS-9		100	50/.3*									
SS-10		100	50/.3*									
					End of Boring at 23.8 ft							
					*Seating increment							

WATER LEVEL OBSERVATIONS

Depth ft	While Drilling	Upon Completion	After Drilling
To Water	NW	NW	BF
To Cave-in		23	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **4/30/18** End **4/30/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks: **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-03**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Sunny	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	65° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1	X	60	13		**GRANULAR SUBBASE**, (sand and gravel)							
					SP-SM, **POORLY GRADED SAND with SILT**, little gravel, loose, moist, brown, fine to medium grained							
SS-2	X	80	26	5	**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			11.8	20	13	7
SS-3	X	80	4		**CL**, **LEAN CLAY**, little sand, trace gravel, medium stiff, brown	½			---			
SS-4	X	5	11		**CL**, **SANDY CLAY**, little gravel, medium stiff, moist, brown, with cobble fragments	---			---			
SS-5	X	85	50/.4*	10								
SS-6	X	55	50/.3*									
SS-7	X	30	50/.1	15	**WEATHERED SHALE**, soft, brown to gray below 14 ft, with sandstone seam near 17 ft							
SS-8	X	85	50/.4*									
SS-9	X	85	50/.3*	20								
SS-10	X	100	50/.3*									
					End of Boring at 23.8 ft							
					*Seating increment							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	12	19	BF
To Cave-in		23½	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **4/30/18** End **4/30/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-04**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**65° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		50	31		**GRANULAR SUBBASE**, (sand and gravel)							
					SP-SM, **POORLY GRADED SAND with SILT**, little gravel, dense, moist, brown, fine to medium grained							
SS-2		45	12			3¾			22.3			
				5	**CL**, **SANDY CLAY**, little gravel, very stiff, brown							
SS-3		100	7			1			11.5			
SS-4		55	23		**CL-ML**, **SILTY CLAY**, some sand, little gravel, medium stiff to very stiff, brown	¾			12.1			
				10								
SS-5		100	23			2			10.0			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⧩ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**10½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **4/30/18** End **4/30/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-05**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**70° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1		80	15		**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			11.4			
SS-2		80	12			2½			23.8			
				5								
SS-3		100	6		**CL**, **LEAN CLAY**, little sand, little gravel, very stiff, brown	2			26.3	42	17	25
				▼								
SS-4		100	7			1½			8.8			
				10								
SS-5		100	22		**CL-ML**, **SILTY CLAY**, some sand, little gravel, medium stiff to stiff, brown	½			13.6			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**NW**	**8**	**BF**
To Cave-in		**11**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **4/30/18** End **4/30/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, LLC
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-06**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**65° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1		65	13		**CH**, **FAT CLAY**, little sand, little gravel, very stiff, brown	2			30.7			
SS-2		100	7	5	**CL**, **SANDY CLAY**, little gravel, stiff, brown	1½			23.3			
SS-3		90	13									
SS-4		40	7	10	**SM**, **SILTY SAND**, trace gravel, loose to medium dense, moist to wet below 10 ft, brown, fine to medium grained							
SS-5		100	18									
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**10**	**7½**	**BF**
To Cave-in		**9**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-07**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**70° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1		100	8		**CL**, **LEAN CLAY**, little sand, little gravel, stiff, brown	1½			19.7			
SS-2		80	10	5	**SP**, **POORLY GRADED SAND**, little gravel, loose, wet, brown, fine to medium grained							
SS-3		100	18		**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff to hard, gray	>4½			8.1			
SS-4		85	9	10		2½			10.6			
SS-5		100	18		**SM**, **SILTY SAND**, little gravel, medium dense, wet, gray and brown, fine to medium grained							
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	**4**	**2½**	**BF**
To Cave-in		**10**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-08**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**75° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1	X	90	6		**CL-ML**, **SILTY CLAY**, some sand, little gravel, stiff, brown, with fine to medium grained silty sand seam near 2 ft	1			10.6			
SS-2	X	100	8	5	**CL**, **LEAN CLAY**, little sand, little gravel, stiff, brown	1¼			26.3			
SS-3	X	100	9			2			14.8			
SS-4	X	100	6		**CL**, **SANDY CLAY**, little gravel, medium stiff to very stiff, brown	½			15.7			
SS-5	X	85	9	10		2			18.7			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**9½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-09**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Cloudy	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	75° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		40	13		**GRANULAR SUBBASE**, (sand and gravel)	½			15.1			
SS-2		55	20		**CL**, **SANDY CLAY**, little to some gravel below 5 ft, soft to medium stiff, brown	¼			10.9			
				5								
SS-3		80	8			¼			17.7			
SS-4		65	23			1¼			11.9			
				10	**CL-ML**, **SILTY CLAY**, some sand, little gravel, stiff to very stiff, brown							
SS-5		100	35			3			17.5			
SS-6		100	27		**CL**, **SANDY CLAY**, little gravel, medium stiff, brown	¾			13.9			
				15								
					End of Boring at 15 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	NW	NW	BF
To Cave-in		14	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/4/18** End **5/4/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-10**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**79° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1	X	100	34		**SP-SM**, **POORLY GRADED SAND with SILT**, some gravel, loose to medium dense, moist to wet below 5 ft							
SS-2	X	55	10	5 ▽								
SS-3	X	100	19		**SM**, **SILTY SAND**, some gravel, medium dense, wet, brown, with gravel seam near 11 ft, fine to medium grained							
SS-4	X	50	27	10 ▼								
SS-5	X	100	44		**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			11.2			
SS-6	X	100	22	15	**CL**, **SANDY CLAY**, little gravel, very stiff, brown	3			23.0			
SS-7	X	100	21		**SP**, **POORLY GRADED SAND**, little gravel, medium dense to very dense, wet, gray, fine to medium grained							
SS-8	X	85	80/0.8	20								
SS-9	X	100	54		**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff to hard, gray	2			12.3			
SS-10	X	95	85/0.7			>4½			6.9			
					End of Boring at 24.7 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	**5**	**8**	**BF**
To Cave-in		**16**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-11**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**80° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		55	6		**CL**, **SANDY CLAY**, little gravel, very stiff, brown	2			9.0			
SS-2		0	8	5	**CL**, **LEAN CLAY**, little sand, little gravel, stiff to medium stiff, brown	---			---			
SS-3		55	9			1			17.7			
SS-4		90	14	10		3			14.1			
SS-5		95	23		**CL**, **SANDY CLAY**, little gravel, medium stiff to hard, brown, with silty clay seams near 12 ft and 14 ft	4½			14.4			
SS-6		95	13	15		2			15.1			
SS-7		90	6			¾			14.3			
SS-8		90	9	20	**SM**, **SILTY SAND**, trace gravel, loose, wet, brown, fine to medium grained							
SS-9		95	45		**SP**, **POORLY GRADED SAND**, little gravel, very dense, wet, gray, fine to medium grained							
SS-10		85	36	25	**CL**, **SANDY CLAY**, little gravel, very stiff, gray	4			10.7			
					End of Boring at 25 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	▽ After Drilling
To Water	**9½**	**9**	**BF**
To Cave-in		**10½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
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Boring No. **SB-12**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Cloudy	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (crushed stone)							
SS-1		10	8		**CH**, **FAT CLAY**, little sand, little gravel, stiff, brown	1½			28.7			
SS-2		35	6	5		1			28.4			
SS-3		100	15		**CL**, **SANDY CLAY**, little gravel, very stiff to hard, brown	4½			13.3			
SS-4		85	19	10		3			13.3			
SS-5		100	19		**CL-ML**, **SILTY CLAY**, some sand, soft to hard, brown, with fine sand seams near 15 ft and 19½ ft	2¼			11.7			
SS-6		100	48	15		¼			11.9			
SS-7		90	36			>4½			11.8			
SS-8		80	27	20		3			8.7			
					End of Boring at 20 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	18	14	BF
To Cave-in		17	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/4/18** End **5/4/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks: **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-13**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**70° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1		45	10		**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff, brown, with asphalt fragments (fill)	2½			11.6			
SS-2		80	4		**CL**, **LEAN CLAY**, little sand, little gravel, soft, brown	¼			19.7			
				5								
SS-3		100	5			1¾			11.6			
SS-4		100	5		**CL-ML**, **SILTY CLAY**, some sand, little gravel, stiff, brown	1¼			13.3			
				10								
SS-5		60	5			1½			12.4			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**9½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/4/18** End **5/4/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-14**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Cloudy	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	70° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1	X	55	6			2½			11.7			
SS-2	X	35	4		**CL**, **LEAN CLAY**, little sand, little gravel, medium stiff to very stiff, brown, with fine sand seam near 4½ ft	½			19.0			
				5								
SS-3	X	100	4			1¼			28.1			
SS-4	X	90	8		**CL-ML**, **SILTY CLAY**, some sand, little gravel, stiff to hard, brown	>4½			11.8			
				10								
SS-5	X	100	9			1¼			13.1			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	NW	NW	BF
To Cave-in		12	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/4/18** End **5/4/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

Boring No. **SB-15**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**79° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
					GRANULAR SUBBASE, (crushed stone)							
SS-1	X	100	8		**CL-ML**, **SILTY CLAY**, some sand, little gravel, soft, moist, brown	¼			15.4			
SS-2	X	100	5		**CL**, **LEAN CLAY**, little sand, little gravel, very stiff, brown	2			20.4			
				5								
SS-3	X	100	7		**SM**, **SILTY SAND**, little gravel, loose, moist, brown, fine to medium grained							
SS-4	X	100	8		**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff, brown	2			10.9			
				10								
SS-5	X	100	10			4			11.3			
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**11½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
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Boring No. **SB-16**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Sunny	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	80° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		35	4			¾			12.7			
SS-2		70	3			½			13.8			
				5	**CL**, **SANDY CLAY**, little gravel, soft to medium stiff, brown, with silty sand seams near 4 ft and 7 ft							
SS-3		90	4			¼			17.1	23	13	10
SS-4		15	5	▽ ▼		---			---			
				10								
SS-5		35	14		**SP-SM**, **POORLY GRADED SAND with SILT**, little gravel, medium dense, wet, brown, with sandy clay seams, fine to medium grained							
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	9	9	BF
To Cave-in		10	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

EARTH EXPLORATION, Inc.

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

Boring No. **SB-17**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**80° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
SS-1		55	4		**CL-ML**, **SILTY CLAY**, some sand, some gravel, medium stiff, brown (fill)	½			30.5			
SS-2		65	6		**CL**, **LEAN CLAY**, little sand, little gravel, medium stiff to stiff, brown	2¼			20.4			
				5								
SS-3		100	6			1			12.2			
					CL-ML, **SILTY CLAY**, some sand, little gravel, medium stiff to stiff, brown							
SS-4		95	14			½			10.4			
				10								
SS-5		85	9		**SP-SM**, **POORLY GRADED SAND with SILT**, little gravel, loose, moist, brown, fine to medium grained							
					End of Boring at 12.5 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**13**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

EARTH EXPLORATION, LLC
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

Boring No. **SB-18**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**80° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		35	7		**CL-ML**, **SILTY CLAY**, some sand, some gravel, stiff, brown (fill)	3½			9.6			
SS-2		65	5	5	**CL**, **SANDY CLAY**, little gravel, stiff to very stiff, brown, with silty clay seams near 5 ft and 7 ft	1½			22.2			
SS-3		95	6			3½			13.6			
SS-4		100	5	10		2			13.3			
SS-5		100	4			3			11.9			
SS-6		20	23	▽15	**CL-ML**, **SILTY CLAY**, some sand, very stiff to hard, brown	>4½			13.3			
SS-7		45	19			---			---			
SS-8		100	20	20		---			---			
					End of Boring at 20 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**15**	**NW**	**BF**
To Cave-in		**18**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-19**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Sunny	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	80° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		65	5		**CL**, **SANDY CLAY**, little gravel, very stiff, brown	3¾			20.4			
SS-2		65	9	5	**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff, brown, with fine sand seam near 7 ft	2½			11.6			
SS-3		100	9			2			11.4			
SS-4		90	7	10	**CL**, **SANDY CLAY**, little gravel, stiff, brown	1¾			12.8			
SS-5		0	30			---			---			
SS-6		85	25	15 ▼	**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			7.3			
SS-7		85	16			3½			11.0			
SS-8		55	21	20	**CL**, **SANDY CLAY**, little gravel, very stiff to hard, brown	>4½			8.5			
					End of Boring at 20 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**NW**	**16**	**BF**
To Cave-in		**16½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-20**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**80° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
					ASPHALTIC CONCRETE							
SS-1		45	14		**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown (fill)	>4½			12.7			
					CL, **SANDY CLAY**, little gravel, very stiff to hard, brown							
SS-2		55	9	5		2			23.4			
SS-3		85	8		**CL**, **LEAN CLAY**, little sand, little gravel, soft to very stiff, brown	½			26.8			
SS-4		35	8	10		3			14.5			
					CL, **SANDY CLAY**, little gravel, very stiff, brown							
SS-5		95	7		**SM**, **SILTY SAND**, little gravel, loose, moist, brown, fine to medium grained	2			15.6			
SS-6		95	13	15	**CL-ML**, **SILTY CLAY**, some sand, little gravel, hard, brown	>4½			10.6			
SS-7		95	42	▼	**CL**, **SANDY CLAY**, little gravel, very stiff, brown to gray below 19 ft, with fine to medium sand seam near 17 ft	3½			10.6			
SS-8		95	9	▽ 20		2			9.8			
					End of Boring at 20 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⩛ After Drilling
To Water	**19½**	**17½**	**BF**
To Cave-in		**18**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/2/18** End **5/2/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

EARTH EXPLORATION, Inc.

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-21**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	Cloudy	Driller	B.J.
Struct. No.	---	Offset	---	Temp.	75° F	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (sand and gravel)							
SS-1	X	100	9		**CL**, **LEAN CLAY**, little sand, little gravel, stiff, brown	1½			25.0			
SS-2	X	45	4			½			11.9			
				5	**CL**, **SANDY CLAY**, little gravel, soft to medium stiff, brown							
SS-3	X	45	10			¼			11.8			
SS-4	X	100	11			3¼			11.1			
				10								
SS-5	X	100	19		**CL-ML**, **SILTY CLAY**, some sand, little gravel, medium stiff to hard, brown	>4½			11.1			
SS-6	X	45	31			¾			11.5			
				15	End of Boring at 15 ft							

WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⧩ After Drilling
To Water	NW	NW	BF
To Cave-in		14	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/4/18** End **5/4/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**

LOG OF TEST BORING

Project: **SR 32 Wastewater Collection System**
Location: **Montgomery Co., IN**
Client: **VS Engineering, Inc.**

EARTH EXPLORATION, Inc.
7770 West New York Street - Indianapolis, Indiana 46214
317-273-1690 / 317-273-2250 (Fax)

Boring No. **SB-22**
Elevation **---**
Datum **---**
EEI Proj. No. **CJ185238**
Sheet **1** of **1**

Project No.	---	Station	---	Weather	**Sunny**	Driller	**B.J.**
Struct. No.	---	Offset	---	Temp.	**70° F**	Inspector	---

SAMPLE No.	Type	Rec %	N Value	Depth ft	DESCRIPTION/CLASSIFICATION and REMARKS	q_p tsf	q_u tsf	γ_d pcf	W %	LL %	PL %	PI %
				0	**ASPHALTIC CONCRETE**							
					GRANULAR SUBBASE, (crushed stone)							
SS-1	X	100	4			1			20.4			
					CL, **LEAN CLAY**, little sand, little gravel, stiff, brown							
SS-2	X	90	6			1¾			20.1			
				5								
SS-3	X	100	12			3½			12.5			
SS-4	X	100	10		**CL-ML**, **SILTY CLAY**, some sand, little gravel, very stiff to hard, brown	4			9.3			
				10								
SS-5	X	100	19			>4½			10.2			
					End of Boring at 12.5 ft							

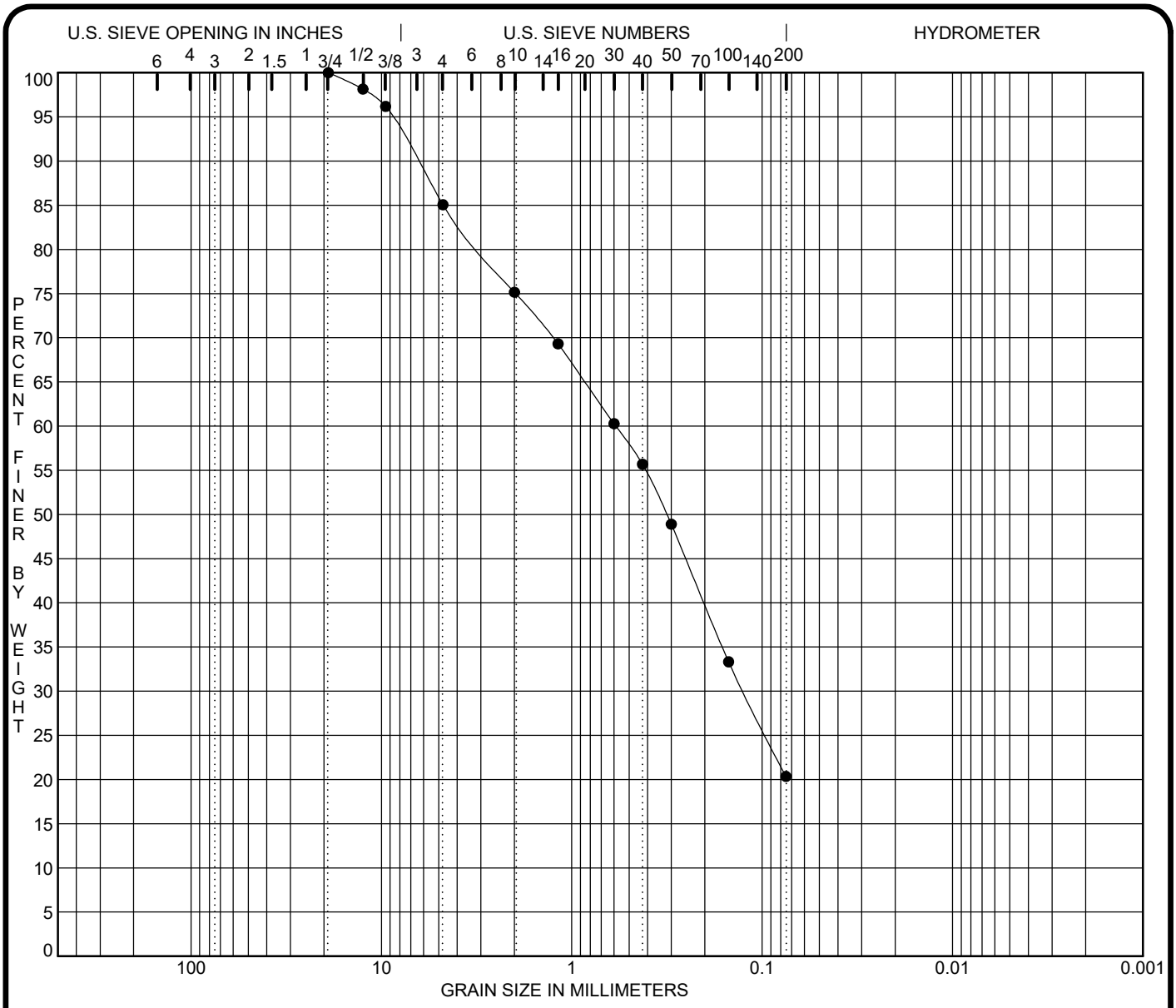
WATER LEVEL OBSERVATIONS

Depth ft	▽ While Drilling	▼ Upon Completion	⊽ After Drilling
To Water	**NW**	**NW**	**BF**
To Cave-in		**12½**	

The stratification lines represent the approximate boundary between soil/rock types and the transition may be gradual.

GENERAL NOTES

Start **5/1/18** End **5/1/18** Rig **CME 75**
Drilling Method **3¼" I.D. HSA** **Truck**
Remarks **Backfilled with auger cuttings and bentonite chip plug, and the roadway was restored with a pavement patch.**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample Identification	USCS Classification	MC%	LL	PL	PI	Cc	Cu
● SB-10 SS-4	SM, SILTY SAND		NP	NP	NP		

% Gravel (>4.75mm)	% Sand (4.75 to .075mm)	% Silt (.075 to .005 mm)	% Clay (<.005mm)
14.9	64.7		

Grain Size (mm)	% Passing	Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
64.0		**0.5**	57.9	**0.016**	
16.0	99.2	**0.25**	44.8	**0.008**	
4.0	83.1	**0.125**	29.9	**0.005**	
2.0	75.2	**0.075**	20.3	**0.002**	
1.0	67.1	**0.050**			

EARTH EXPLORATION INC

PROJECT SR 32 Wastewater Collection System
LOCATION Montgomery Co., IN
CLIENT VS Engineering, Inc. **CLIENT ID NO.**
EEI PROJECT NO. CJ185238 **DATE**

GRAIN SIZE DISTRIBUTION CURVE

Earth Exploration, Inc.
7770 West New York Street, Indianapolis, IN 46214
317-273-1690 / 317-273-2250 (Fax)

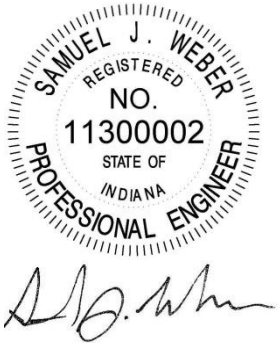
Technical Specifications

For

S.R. 32/Nucor Road Area Sanitary Sewer Collection System Montgomery County, Indiana

June 2018

VS ENGINEERING
4275 North High School Road • Indianapolis, Indiana 46254 • 317.293.3542
www.vsengineering.com



Technical Specifications
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All references to Indiana Department of Transportation Standard Specifications (INDOT SS) shall be directed to the 2018 Edition of the INDOT Specification Book.

SECTION 01000 – MEASUREMENTS AND PAYMENT

It is intended that payment for all work done under the Contract Documents for Unit Price Contract, including the furnishing of all construction staking, labor, tools, equipment, materials and the performing of all operations in connection with the construction of all work under the Unit Price Contract as described in the Contract Documents will be made under the following Pay Items and/or as detailed in the Special Provisions. Other work for which there is not a Pay Item will be considered incidental and shall be included in the Contract Unit Price for the various Pay Items and no additional compensation will be allowed. The number next to each category references the Item No. in the Unit Price Work table.

1-2 LOW PRESSURE SYSTEM, PVC SDR 21 or HDPE DR-11

Measurement: Measurement of Low Pressure System, PVC SDR 21 or HDPE DR-11 will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Low Pressure System, PVC SDR 21 or HDPE DR-11 shall be based on the unit price per linear foot as listed on the submitted Bid schedule for each size successfully installed. This price shall include all labor, materials and equipment for the installation of a PVC or HDPE low pressure sewer force main, including traffic control, clearing, grubbing, excavation, backfill, compaction and testing and daily maintenance including removing and restoring fences, removing and replacement of drives with in kind material, landscaping, and temporary services. PVC or HDPE pipe to be installed in accordance with INDOT standards and specifications.

3 AIR RELEASE VALVE FOR LOW PRESSURE SYSTEM

Measurement: Measurement of Air Release Valves for Low Pressure System shall be based on each assembly installed, complete in place, according to the specification and in the locations shown on the Engineer’s plans.

Payment: Payment of Air Release Valves for Low Pressure System shall be made at the unit price bid per valve installed. The unit price includes all labor, materials and equipment necessary to furnish and install valve, valve box, and all other work, not included under other items, necessary to complete the work as specified.

4, 6 SANITARY SEWER FORCE MAIN, PVC SDR 21 OR HDPE DR-11

Measurement: Measurement of Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11 will be in linear feet. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11 shall be based on the unit price per linear foot as listed on the submitted Bid schedule for each size successfully installed. This price shall include all labor, materials and equipment for the installation of a PVC or HDPE low pressure sewer force main, including traffic control, clearing, grubbing, excavation,

backfill, pavement removal and restoration, traffic markings, compaction and testing and daily maintenance including removing and restoring fences, removing and replacement of drives with in kind material, landscaping, and temporary services. PVC or HDPE pipe to be installed in accordance with INDOT standards and specifications.

5, 7 SANITARY SEWER FORCE MAIN, PVC SDR 21 OR HDPE DR-11, HDD

Measurement: Measurement of Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11 will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Sanitary Sewer Force Main, PVC SDR 21 or HDPE DR-11 will be in linear foot of pipe for the described diameter at the associated contract length including all bends, reducers and associated restraint. The unit price shall include all labor, materials and equipment for the installation of PVC or HDPE sewer force main including traffic control, clearing, grubbing, excavation, pipe restraint, polyethylene wrap, backfill, fittings, pavement removal and restoration, traffic markings, removing and replacement of drives with in kind material, compaction and testing and daily maintenance including restoring fences, landscaping and temporary services. Pipe is to be installed in accordance with INDOT specifications and standards.

8 8” Jack and Bore with 18” Casing

Measurement: Measurement of Gravity Sewer, PVC SDR 26 Casing Pipe, Jack and Bore will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Gravity Sewer, PVC SDR 26 Casing Pipe, Jack and Bore will be in unit price bid per linear foot of pipe Jacked and Bored pipe complete in place as indicated in plan sheets. This price shall include excavating and backfilling jacking and receiving pits, sheeting shoring bracing, jacking equipment, casing pipe, casing chocks and furnishing and installing carrier pipe, drainage, safety equipment and all materials and equipment for the installation of the pipe, including traffic control, clearing, backfill, compaction and testing, moving and replacing fences and mailboxes, welding, bedding, pavement removal and restoration, removing and replacement of drives with in kind material, and tree removal.

9,11 12” and 15” GRAVITY SEWER, PVC SDR 26, OPEN CUT

Measurement: Measurement of Gravity Sewer, PVC SDR 26 Open cut will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Gravity Sewer, PVC SDR 26 Open cut will be in linear feet of pipe as indicated in plan sheets. This price shall include excavating, drainage, safety equipment and all materials and equipment for the installation of the pipe, including traffic control, dewatering, clearing, backfill, grout, spacers, asphalt paving, removing and replacement of drives with in kind material, site grading, compaction and testing, moving and replacing fences and mailboxes, welding, bedding, pavement removal and restoration, and tree removal.

10 12" GRAVITY SEWER, PVC SDR 26, 24" CASING PIPE, JACK AND BORE

Measurement: Measurement of Gravity Sewer, PVC SDR 26 Casing Pipe, Jack and Bore will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment of Gravity Sewer, PVC SDR 26 Casing Pipe, Jack and Bore will be in unit price bid per linear foot of pipe Jacked and Bored pipe complete in place as indicated in plan sheets. This price shall include excavating and backfilling jacking and receiving pits, sheeting shoring bracing, jacking equipment, casing pipe, casing chocks and furnishing and installing carrier pipe, drainage, safety equipment and all materials and equipment for the installation of the pipe, including traffic control, clearing, backfill, compaction and testing, moving and replacing fences and mailboxes, welding, bedding, pavement removal and restoration, removing and replacement of drives with in kind material, and tree removal.

12 48" MANHOLE

Measurement: Measurement of 48" Manhole shall be by the vertical foot depth of the described manhole diameter installed measured in the vertical plane, complete in place.

Payment: Payment under this Item shall be based on unit price of each 48" Manhole installed. The unit price shall include all labor, materials and equipment for the installation of precast manhole, asphalt paving, driveways, tree removal, manhole base section, precast concrete rings, cone sections, dewatering, sealing manholes, concrete bench wall, flexible rubber seal, metal castings, storm drainage structures, granular backfill, watertight frame and cover, traffic control, clearing, grubbing, excavation, sewer pipe to manhole connections, required lining, compaction and testing and including restoring fences, landscaping, and temporary services. Manhole to be installed in accordance with the specifications and per associated standard details according to INDOT.

13 FORCE MAIN DISCHARGE CONNECTION

Measurement: Measurement of this Item shall be based on Each Unit. The quantity of force main discharge connection installed shall be measured horizontally along the centerline of the successfully installed discharge connection.

Payment: Payment under this Item shall be based on unit price of each Force Main discharge connection installed. The unit price shall include all labor, materials and equipment for the

installation of discharge connection, asphalt paving, driveways, tree removal, granular backfill, traffic control, clearing, grubbing, excavation, compaction and testing and including restoring fences, landscaping, and temporary services. Item to be installed in accordance with the specifications and per associated standard details according to INDOT.

14 72" WET WELL COATING

Measurement: Measurement of this Item shall be based on Each Unit.

Payment: Payment under this Item shall be based on unit price of each wet well coating, complete in place, for this item in accordance with the Plans, Specifications and Special Provisions. Payment for this item shall include the applications of specified coating over newly constructed wet well.

15 48" MANHOLE COATING, FORCE MAIN DISCHARGE MANHOLE

Measurement: Measurement of this Item shall be based on Each Unit of manhole coated as as specified in Section 33 39 13.

Payment: Payment under this Item shall be based on unit price of coating each wet well. The unit price shall include all labor, materials and equipment for the installation of precast manhole, including watertight frame and cover, traffic control, clearing, grubbing, excavation, required lining, backfill, compaction and testing, including restoring fences, landscaping, and temporary services.

16 FLUSHING STATION

Payment for installation of the terminal end flushing assembly shall be made at the Contract Lump Sum Price submitted. The Lump Sum Price for the terminal end flushing assembly installation shall be per the detail shown on the Plans and shall include excavation, HDPE pit and cover, all piping, joints and fittings, shut off ball valve, valve box and cover, all backfill, compaction testing, bracing or shoring, dewatering, protection of existing utilities, all labor, miscellaneous equipment and materials necessary to complete the Work.

Measurement: Measurement of this Item shall be based on the quantity of number of each flushing station installed.

Payment: Payment under this Item shall be based on unit price. The unit price shall include the installation of end-of-line flushing assembly at the upstream end of each sewer force main alignment, as directed by Engineer in plans. Flushing assembly shall be installed in accordance with Engineer's plans and manufacturer's standard drawings.

17 EAST LIFT STATION ELECTRICAL SERVICE

Measurement: Measurement of this Item shall be based on Lump Sum.

Payment: Payment under this Item shall be based on a Lump Sum. Payment shall include a new vented terminal box, new level sensor control circuit, maintenance of clearance from power conduit, a new 60 kw standby generator, and all electrical work done on and for the West Lift Station to be completed and running as intended by Engineer and include all labor, miscellaneous equipment and materials necessary to complete work. Contractor shall provide all stainless steel hardware for all equipment installed in wet well. This includes but is not limited to Kellem's cable grips, cable racks, mounting brackets, bolts and nuts.

18 EAST LIFT STATION

Measurement: Measurement of this Item shall be based on Lump Sum of the entirety of the lift station installed.

Payment: Payment under this Item shall be based on a Lump Sum. Payment shall include excavation, pit, cover, all piping, joints, fittings, backfill, testing, dewatering, site grading and compaction, clearing and grubbing, asphalt paving, tree removal, protection of all utilities, connection to proposed sewer, all labor, new valve vault, new sanitary wet well, miscellaneous equipment and materials necessary to complete work. The quantity of fence removed and reset shall be the number of linear feet as measured horizontally along the centerline of the successfully installed fence of wooden material as shown and specified in lift station site plan sheets. The cost of all equipment, labor, removal and replacement of drives with in kind material, and miscellaneous materials (including all hardware, fasteners and paint necessary) related to the resetting of the fence will be included in the cost of the pay item. The removal and reinstallation of the street/stop signs shall be measured per each sign removed and reinstalled in accordance with INDOT details and standards.

19 WEST LIFT STATION ELECTRICAL SERVICE

Measurement: Measurement of this Item shall be based on Lump Sum.

Payment: Payment under this Item shall be based on a Lump Sum. Payment shall include a new vented terminal box, new level sensor control circuit, maintenance of clearance from power conduit, a new 60 kw standby generator, and all electrical work done on and for the West Lift Station to be completed and running as intended by Engineer and include all labor, miscellaneous equipment and materials necessary to complete work. Contractor shall provide all stainless steel hardware for all equipment installed in wet well. This includes but is not limited to Kellem's cable grips, cable racks, mounting brackets, bolts and nuts.

20 WEST LIFT STATION

Measurement: Measurement of this Item shall be based on Lump Sum of the entirety of the lift station installed.

Payment: Payment under this Item shall be based on a Lump Sum. Payment shall include excavation, pit, cover, all piping, joints, fittings, backfill, testing, clearing and grubbing, tree removal, asphalt paving, dewatering, protection of all utilities, connection to proposed sewer, all labor, miscellaneous equipment and materials necessary to complete work. The quantity of fence

removed and reset shall be the number of linear feet as measured horizontally along the centerline of the successfully installed fence of wooden material as shown and specified in lift station site plan sheets. Fence removal and reset will be included in the lump sum cost of the lift station. The cost of all equipment, site grading and compaction, labor, and materials (including all hardware, fasteners and paint necessary) related to the resetting of the fence will be included in the cost of the pay item. The removal and reinstallation of the street/stop signs shall be measured per each sign removed and reinstalled in accordance with INDOT details and standards.

21 42" CONCRETE CUVERT REMOVAL AND REPLACEMENT

Measurement: Measurement of 42" concrete culvert removal and replacement shall be in linear feet and as shown in plans. The quantity of culvert installed will be in linear feet of described culvert diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of 42" concrete culvert installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment under this Item shall be based on a Unit Price of linear feet. Payment shall include excavation, pit, cover, all piping, joints, fittings, bedding, backfill, patching, testing, dewatering, site grading and compaction, protection of all utilities, all labor, miscellaneous equipment and materials necessary to complete work.

22 CONCRETE END SECTIONS

Measurement: Measurement of end sections will be in each end section unit installed, complete in place. The quantity of end section installed shall be the number of end sections correctly installed, backfilled, and tested successfully.

Payment: Payment under this Item shall be based on a unit price of each end section. Payment shall include excavation, pit, cover, all piping, joints, fittings, bedding, backfill, patching, testing, clearing and grubbing, tree removal, dewatering, site grading and compaction, protection of all utilities, all labor, miscellaneous equipment and materials necessary to complete work.

23 6" LATERAL CONNECTION, OPENCUT

Exact location of each lateral shall be determined by the property owner. CONTRACTOR shall provide owner with the means to stake their lateral and a written form to include a site plan and indication of lateral. This form needs to be documented of timing when property owner receives form, with a property owner's signature lien and statement saying they must return within five (5) days or we will design plans to install the lateral. If the property owner has not staked their lateral location within five (5) working days, the CONTRACTOR shall use the lateral location as shown on the plans or as directed by ENGINEER.

Measurement: Measurement of 6" lateral connections will be in linear feet and as shown in plans. The quantity of pipe installed will be in linear feet of described pipe diameter installed through all

fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment under this Item shall be based on a Unit Price of linear feet. Payment shall include excavation, pit, cover, all piping, joints, fittings, backfill, testing, dewatering, site grading and compaction, protection of all utilities, all labor, miscellaneous equipment and materials necessary to complete work.

24 1.25" LATERAL CONNECTION

Exact location of each lateral shall be determined by the property owner. CONTRACTOR shall provide owner with the means to stake their lateral and a written form to include a site plan and indication of lateral. This form needs to be documented of timing when property owner receives form, with a property owner's signature lien and statement saying they must return within five (5) days or we will design plans to install the lateral. If the property owner has not staked their lateral location within five (5) working days, the CONTRACTOR shall use the lateral location as shown on the plans or as directed by ENGINEER.

Measurement: Measurement of 1.25" lateral connections will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment under this Item shall be based on a Unit Price of linear feet.

25 1.25" LATERAL CONNECTION, HDD

Exact location of each lateral shall be determined by the property owner. CONTRACTOR shall provide owner with the means to stake their lateral and a written form to include a site plan and indication of lateral. This form needs to be documented of timing when property owner receives form, with a property owner's signature lien and statement saying they must return within five (5) days or we will design plans to install the lateral. If the property owner has not staked their lateral location within five (5) working days, the CONTRACTOR shall use the lateral location as shown on the plans or as directed by ENGINEER.

Measurement: Measurement of 1.25" lateral connections will be in linear feet of described pipe diameter installed through all fittings, valves measured in horizontal plane only, complete in place. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from the outside wall of structure to outside wall of structure, as measured along the centerline of the successfully installed pipe.

Payment: Payment under this Item shall be based on a unit price of linear feet.

26 GRINDER PUMP STATION, INSTALLATION, CONTROLS, ELECTRICAL, COMPLETE IN PLACE

Measurement: Measurement under this Item shall be based on each grinder pump installed complete in place in accordance with the specifications and in the locations shown on the Engineer's plans.

Payment: Payment under this Item shall be based on a unit price per complete installation including associated connection of flushing station at right of way line; connection includes installing a wet tapping sleeve or tapping saddles as required for connection to the active main The unit price includes all labor, materials and equipment necessary to install the grinder pump including excavation backfill and restoration and all other work, not included under other items, necessary to complete work as specified. Connection items to be installed in accordance with the specifications and per associated standard details by INDOT.

27 DECOMISSION SEPTIC TANKS

Measurement: Measurement of this Item shall be based on number of units of septic tanks as indicated in Engineer's Plans.

Payment: Payment under this Item shall be based on unit price. These items shall include finish grading, soil preparation, top soil, seeding, mulch, fertilizer, and water.

28-29 AIR RELEASE VALVES & STRUCTURES FOR 4" FORCEMAIN & 6" FORCEMAIN

Measurement: Measurement for this Item shall be based on each unit installed as shown in plans from Engineer.

Payment: Payment under this Item shall be based on unit price. Payment for air release valves and pits will be based upon the Contract Unit Price for each valve size, type and structure size and shall include the excavation, bedding, valve, manhole, casting, backfill, and necessary piping from the main and appurtenances as detailed on the plans and INDOT Standard Construction Details.

31 EROSION CONTROL & TEMPORARY SEEDING
The work shall consist of all work necessary to provide erosion and sediment control measures in accordance with Section 01 57 13 of the Contract Documents and as called out on the plans and Special Provisions.

Measurement: Erosion Control and Temporary Seeding is based on a lump sum measurement.

Payment: Payment for Erosion Control and Temporary Seeding shall be on a lump sum price and shall be paid monthly based upon a percentage of construction completed at each incremental billing period. Payment for item shall include the excavation of unsuitable material and shall include all cost associated with excavation below bottom elevation of structure bedding, or as directed by Engineer, temporary sheeting, shoring, disposal of excavated material, dewatering,

and erosion control. Common excavation, excavation of unsuitable material, and additional special backfill for unsuitable material will be included in the erosion control and temporary seeding line item.

32 MOBILIZATION AND DEMOBILIZATION

The work shall consist of all work necessary for the movement of personnel and equipment to and from the project site and for the establishment and removal of all temporary facilities necessary for the performance of the work, insurance and bonding requirements, and **pre-construction audio/video survey** (and photos as required).

Measurement: the pay quantity for the mobilization portion of the work will be limited to 60 percent of the total contract bid amount for this Work Item, which will be included in the first partial payment estimate. The balance of the bid price shall be considered as demobilization and will be paid for when all work is completed on the job and final clean-up is completed. No additional payment will be made for demobilization and remobilization, initiated by the contractor, due to shutdowns, suspensions of the Work, or for other mobilization activities.

Payment: Payment under this Item shall be based on lump sum of 15 percent of total project cost in conjunction with Clearing ROW, MOT, and Construction Engineering.

32 CLEARING RIGHT OF WAY

It shall be the responsibility of the Contractor to visit the site prior to the submittal of bids in order to become familiar with the scope of work. Disposal of all materials encountered shall be off site, shall be the responsibility of the Contractor and shall be consistent with all applicable Local, State, and Federal rules, regulations, and guidelines.

Measurement: Measurement under this Item shall be based on unit price.

Payment: Payment under this Item shall be based on lump sum of 15 percent of total project cost in conjunction with Mob/Demob, MOT, and Construction Engineering. Payment for Clearing Right-of-Way shall be a Lump Sum item and shall include the removal and proper disposal of all obstructions within the limits of the construction that are not specifically covered as pay items of the Contract. These obstructions shall include but are not limited to curbs and sidewalks, walls, fallen trees, invasive plant species, structures, fence, clearing and grubbing, tree removal, headwalls, pavement, metal, rubbish, concrete rubble, boulders, building materials, iron boxes, metal pipes, metal barrels, and any other obstructions encountered, and work shall be in accordance with Section 201 and Section 202 of the Indiana Department of Transportation's Standard Specifications. Payment for Clearing Right-of-Way shall be paid monthly based upon a percentage of the construction completed at each incremental billing period.

32 CONSTRUCTION ENGINEERING

The work shall consist of all work necessary to provide construction engineering in accordance with Section 105.08 of the Contract Documents and as called out on the plans. Payment for construction engineering shall be a Lump Sum Price and shall be paid monthly based upon a percentage of construction completed at each incremental billing period.

Measurement: Measurement of Construction Engineering shall be based on lump sum.

Payment: Payment for Construction Engineering shall be based on lump sum of 15 percent of total project cost in conjunction with Mob/Demob, Clearing ROW, and Maintenance of Traffic.

32 MAINTENANCE OF TRAFFIC

This work shall consist of furnishing, placing and maintaining signs, barricades, temporary pavement markings, temporary bituminous dividers, fencing and other traffic control devices and construction and maintenance operations in accordance with the applicable Indiana Manual Uniform Traffic Control Devices (MUTCD) requirements and in reasonably close conformance with the Plans or as directed.

Measurement: The pay quantity for this item shall be the percentage of Work completed at the time of billing (i.e., 10 percent of the lump sum amount for Maintenance and Protection of Traffic will be earned at 10 percent of earned Contract amount.)

Payment: Payment for Maintenance and Protection of Traffic shall be lump sum of 15 percent of total project cost in conjunction with Mob/Demob, Clearing ROW, and Construction Engineering.

SECTION 01 11 21

MISCELLANEOUS WORK ITEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide and maintain methods, equipment, and temporary construction as required to perform the items outlined in this Section.

1.2 MOBILIZATION AND DEMOBILIZATION

A. This item shall include all costs to complete all Work necessary for, but not limited to, furnishing bonds, acquiring insurance, acquiring permits, preparing schedules, delivering submittals, construction staking, performance of construction preparatory operations, coordination and administration, notifications of other utilities, agencies or individuals associated with the Work, all supervision, labor, equipment and materials necessary for the movement of personnel, equipment, and materials to and from the project Site, the establishment of all other facilities necessary to the performance of Work and testing where not otherwise specified.

B. This price shall also include the cost of maintaining secure storage and work areas, including the security of personnel, open trenches, equipment, and materials.

1.3 REMOVE & RESET FENCING

A. This item shall include all cost associated with the removal and resetting of the fence as required to complete the Work, as indicated on the plans, and at the direction of the Engineer.

B. All fencing material to be reset must be removed without breaking, bending, or damage to any part of the fence.

C. If fence posts are required to be removed and reset, reinstall using the same method as originally installed.

D. If fence is damaged beyond repair during removal, the Contractor shall furnish and install new fencing of the same type and size, to the satisfaction of the Owner, and at no additional cost to the Owner.

1.4 REMOVE AND REINSTALL STOP/STREET SIGNS

A. The Contractor shall be responsible for determining if the temporary removal or relocation of street and/or traffic signs is necessary.

B. Contractor shall be responsible for coordinating this work with the Montgomery County Highway Department and INDOT, as applicable and shall receive written approval prior to any sign removal and/or relocation.

C. Sign relocation will be as directed by the Montgomery County Highway Department and INDOT.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.13

PRE-CONSTRUCTION MEETINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. A pre-construction meeting will be held for the Project.
   2. Contractor shall attend the meeting prepared to discuss all items on the agenda.
   3. Engineer will distribute an agenda, preside at meeting, and prepare and distribute minutes to all participants and others as requested.

B. Purpose of meeting is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by Contractor, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.

C. Date, Time and Location: Meeting will be held after execution of the Contract and before Work starts at the Site. Engineer will establish the date, time, and location of meeting and notify the interested and involved parties.

D. Prior to the meeting, submit the following preliminary schedules in accordance with the General Conditions:
   1. Progress Schedule.
   2. Schedule of Submittals.
   3. Schedule of Values.

E. Contractor shall provide information required and contribute appropriate items for discussion. Contractor shall bring to the meeting the following, with sufficient number of copies for each attendee:
   1. Preliminary Progress Schedule, as submitted to Engineer.
   2. Preliminary Schedule of Submittals, as submitted to Engineer.
   3. Preliminary Schedule of Values, as submitted to Engineer.
   4. List of Subcontractors.
   5. List of emergency contact information, in accordance with Article 1.5 of this Section.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 REQUIRED ATTENDANCE

A. Representatives of each entity attending the meeting shall be authorized to act on that entity's behalf.

B. Contractor Attendance: Meeting shall be attended by Contractor's project manager and site superintendent, project managers for major Subcontractors, and representatives of major equipment Suppliers as Contractor deems appropriate.

C. Other attendees will be representatives of:
   1. Owner.
   2. Engineer.
   3. Authorities having jurisdiction over the Work, if available.
   4. Utility owners, as applicable.
   5. Others as requested by Owner, Contractor, or Engineer.

1.4 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revisions to this agenda, if any, will be furnished to Contractor prior to the meeting.
   1. Procedural and Administrative:
      a. Personnel and Teams:
         1) Designation of roles and personnel.
         2) Limitations of authority of personnel, including personnel who will sign Contract modifications and make binding decisions.
         3) Lists of proposed Subcontractors and manufacturers (where applicable).
         4) Authorities having jurisdiction.
      b. Procedures for communications and correspondence.
      c. Copies of the Contract Documents and availability.
      d. Subcontractors.
      e. The Work and Scheduling:
         1) Scope of the Work.
         2) Contract Times, including Milestones (if any).
         3) Phasing and sequencing.
         4) Preliminary Progress Schedule.
         5) Critical path activities.
      f. Safety:
         1) Responsibility for safety.
         2) Designation of Contractor's safety representative.
         3) Emergency procedures and accident reporting.
         4) Emergency contact information.
         5) Confined space entry procedures.
         6) Impact of Project on public safety.
      g. Permits.
      h. Review of insurance requirements and insurance claims.
      i. Coordination:
         1) Project coordination, and coordination among Contractors.
         2) Coordination with Owner's operations.
         3) Progress meetings.
      j. Products and Submittals:
         1) Preliminary Schedule of Submittals.
         2) Shop Drawings, Samples, and other submittals.
         3) Product options, "or equals", and substitutions.

4) Construction photographic documentation.

k. Contract Modification Procedures
   1) Requests for Interpretation.
   2) Clarification notices.
   3) Field Orders.
   4) Requests for Quote.
   5) Change Order proposals.
   6) Work Change Directives.
   7) Change Orders.
   8) Procedure for filing Claims.

l. Payment:
   1) Owner's Project financing and funding, as applicable.
   2) Owner's tax-exempt status.
   3) Preliminary Schedule of Values, and procedures for measuring for payment.
   4) Retainage.
   5) Progress payment procedures.
   6) Prevailing wage rates and payrolls.

m. Testing and inspections, including notification requirements.

n. Disposal of demolition materials.

o. Record documents.

p. Preliminary Discussion of Contract closeout:
   1) Procedures for Substantial Completion.
   2) Contract closeout requirements.
   3) Correction period.
   4) Duration of bonds and insurance.

2. Site Mobilization (if not covered in a separate meeting):
   a. Working hours and overtime.
   b. Field offices, trailers, and staging areas.
   c. Temporary facilities.
   d. Temporary utilities and limitations on utility consumption (where applicable).
   e. Utility company coordination (if not done as a separate meeting).
   f. Access to Site, access roads, and parking for construction vehicles.
   g. Maintenance and protection of traffic.
   h. Use of premises.
   i. Protection of existing property.
   j. Security.
   k. Temporary controls, such as sediment and erosion control, noise control, dust control, storm water control, and other such measures.
   l. Site barriers and temporary fencing.
   m. Storage of materials and equipment.
   n. Reference points and benchmarks; surveys and layouts.
   o. Site maintenance during the Project.
   p. Cleaning and removal of trash and debris.
   q. Restoration.
3. General discussion and questions.
4. Next meeting.
5. Site visit, if required.

1.5 EMERGENCY CONTACT INFORMATION

A. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list as soon as possible and at the next progress meeting.

B. Contractor's list of emergency contact information shall include:
   1. Contractor's project manager's office, field office, and cellular telephone numbers.
   2. Contractor's site superintendent's office, field office, and cellular telephone numbers.
   3. Contractor's foreman's field office and cellular telephone numbers.
   4. Major Subcontractors' and Suppliers' office, cellular, and home telephone numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:
   1. Owner's office and cellular telephone numbers.
   2. Owner's central 24-hour emergency telephone number.
   3. Engineer's project manager's office and cellular telephone numbers.
   4. Resident Project Representative's office, field office and cellular telephone numbers.
   5. Utility companies' 24-hour contact telephone number(s), including gas, water, sewer, oil, telephone, cable television/telecommunications, and other companies or concerns having utilities in the vicinity of the Work.
   6. Highway and street owners' 24-hour telephone number(s).
   7. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.
   8. Other involved entities as applicable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 31 19.23

PROGRESS MEETINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Progress meetings may be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.
   2. Engineer will preside at progress meetings and will prepare and distribute agenda and minutes of progress meetings to all meeting participants and others as requested.

B. Date and Time:
   1. As required by the Resident Project Representative.

C. Place: Contractor's field office at the Site or other location mutually agreed upon by Owner, Engineer, and Contractor.

D. Handouts: Contractor shall bring to each progress meeting a minimum of 10 copies of each of the following:
   1. List of Work accomplished since the previous progress meeting.
   2. Up-to-date Progress Schedule.
   3. Up-to-date Schedule of Submittals.
   4. Detailed "look-ahead" schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.
   5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 REQUIRED ATTENDANCE

A. Representatives present for each entity shall be authorized to act on that entity's behalf.

B. Required Attendees:
   1. Contractor:
      a. Project manager.
      b. Site superintendent.
      c. Safety representative.
      d. When needed for the discussion of a particular agenda item, representatives of subcontractors and suppliers shall attend meetings.

2. Engineer:
    a. Project manager or designated representative.
    b. Resident Project Representative (if any).
    c. Others as required by Engineer.
3. Owner's representative(s), as required.
4. Testing and inspection agencies, as required.
5. Others, as appropriate.

1.4 AGENDA

A. Preliminary Agenda: Be prepared to discuss in detail the topics listed below. Revised agenda, if any, will be furnished to Contractor prior to first progress meeting. Progress meeting agenda may be modified by Engineer during the Project as required.
    1. Review, comment, and amendment (if required) of minutes of previous progress meeting.
    2. Review of progress since the previous progress meeting.
    3. Planned progress through next progress meeting.
    4. Review of Progress Schedule
        a. Contract Times, including milestones (if any)
        b. Critical path.
        c. Schedules for fabrication and delivery of materials and equipment.
        d. Corrective measures, if required.
    5. Submittals:
        a. Review of status of critical submittals.
        b. Review revisions to schedule of submittals.
    6. Contract Modifications
        a. Requests for Interpretation.
        b. Clarification notices.
        c. Field Orders.
        d. Requests for Quote.
        e. Change Order proposals.
        f. Work Change Directives.
        g. Change Orders.
        h. Claims.
    7. Applications for progress payments.
    8. Problems, conflicts, and observations.
    9. Quality standards, testing, and inspections.
    10. Coordination between parties.
    11. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.
    12. Safety.
    13. Permits.
    14. Construction photographic documentation.
    15. Record documents status.
    16. Punch list status, as applicable.
    17. Other business.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Prepare and submit Progress Schedules in accordance with the General Conditions and this section, unless otherwise accepted by Engineer.
   2. Maintain and update Progress Schedules. Submit updated Progress Schedules as specified in this section unless otherwise directed by Engineer.
   3. Engineer's acceptance of the Progress Schedule, and comments or opinions concerning the activities in the Progress Schedule shall not control Contractor's independent judgment relative to means, methods, techniques, sequences, and procedures of construction. Contractor is solely responsible for complying with the Contract completion requirements.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Progress Schedules:
      a. Submit five copies of preliminary Progress Schedule in accordance with Paragraph 2.05 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures.
      b. After making revisions in accordance with Engineer's comments on the preliminary Progress Schedule, submit five copies of Progress Schedule in accordance with Paragraph 2.07 of the General Conditions. Submit in accordance with Section 01 33 00, Submittal Procedures.
      c. Submit updated Progress Schedule at each progress meeting, or on a monthly basis if progress meetings are not held. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect. For monthly Progress Schedule submittals, bring to progress meeting the number of copies of the updated Progress Schedule specified in Section 01 31 19.23, Progress Meetings.
      d. Submit each Progress Schedule submittal with a letter of transmittal complying with requirements of Section 01 33 00, Submittal Procedures, and specifically indicating the following:
         1) Listing of activities and dates that have changed since the previous Progress Schedule submittal.
         2) Discussion of problems causing delays, anticipated duration of delays, and proposed countermeasures.

2. Recovery Schedules: Submit in accordance with this section.

1.4 PROGRESS SCHEDULE FORMAT AND CONTENT

A. Format:
   1. Type:
      a. Horizontal bar chart or Gantt chart.
   2. Sheet Size: 22 inches by 34 inches, unless otherwise accepted by Engineer.
   3. Time Scale: Indicate first date of each work week.
   4. Organization:
      a. Indicate on the separate Schedule of Submittals dates for submitting and reviewing Shop Drawings, Samples, and other submittals.
      b. Group the deliveries of materials and equipment into a separate sub-schedule that is part of the Progress Schedule.
      c. Group construction into a separate sub-schedule (that is part of the Progress Schedule) by activity.
      d. Group critical activities that dictate the rate of progress (the "critical path") into a separate sub-schedule that is part of the Progress Schedule. Clearly indicate the critical path on the Progress Schedule.
      e. Organize each sub-schedule by specification section number.
   5. Activity Designations: Indicate title and related specification section number.

B. Content: Progress Schedules shall indicate the following:
   1. Dates for shop-testing.
   2. Delivery dates for materials and equipment to be incorporated into the Work.
   3. Dates for beginning and completing each phase of the Work by activity and by trade.
   4. Dates for start-up and check-out, field-testing, and instruction of Owner's personnel.
   5. Dates corresponding to the Contract requirements, and planned completion date associated with each milestone (if any), Substantial Completion, and readiness for final payment.

C. Coordinate the Progress Schedule with the Schedule of Submittals.

1.5 RECOVERY SCHEDULES

A. Recovery Schedules, General:
   1. When updated Progress Schedule indicates that the ability to comply with the Contract requirements falls seven or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract requirements, Contractor shall prepare and submit a Progress Schedule demonstrating Contractor's plan to accelerate the Work to achieve compliance with the Contract requirements ("recovery schedule") for Engineer's acceptance.
   2. Submit recovery schedule within seven days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:
   1. At no additional cost to Owner, do one or more of the following: furnish additional labor, provide additional construction equipment, provide suitable materials, employ additional

Work shifts, expedite procurement of materials and equipment to be incorporated into the Work, and other measures necessary to complete the Work within the Contract requirements.

2. Upon acceptance of recovery schedule by Engineer, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action:

1. Contractor's refusal, failure, or neglect to take appropriate recovery action, or to submit a recovery schedule, shall constitute reasonable evidence that Contractor is not prosecuting the Work, or separable part thereof, with the diligence that will provide completion within the Contract requirements. Such lack of action shall constitute sufficient basis for Owner to exercise remedies available to Owner under the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Shop Drawing procedures shall conform to requirements as described in this Section.

B. The ***Required Submittal Listing*** for this Project is indicated in Attachment 1 herein.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item. If additional Shop Drawing which are not noted in Attachment 1 are required, they will be prepared and submitted at no additional cost to the Owner.

1.3 PROCEDURE

A. Submit Shop Drawings in accordance with Paragraph ***1.4 –Project Electronic Data Protocol***. Refer to ***Required Submittal Listing*** noted above for Project Shop Drawing. Note that the Owner reserves the right to amend the list as Project needs dictate.

B. A letter of transmittal shall accompany each submittal. A separate transmittal letter shall accompany the data submitted for each submittal item.

C. At the beginning of each letter of transmittal provide a reference heading including the following information:
   1. Owner's Name _____
   2. Project Name _____
   3. Owner’s Work Order No. (as applicable) _____
   4. Section No. _____
   5. Submittal No.(see section 1.3G) _____

D. If a Shop Drawing deviates from the requirements of the Contract Documents, Contractor shall specifically note each variation in his letter of transmittal.

E. All Shop Drawings submitted for approval shall have a title block with complete identifying information satisfactory to Engineer.

F. All Shop Drawings submitted shall bear the stamp of approval and signature of Contractor as evidence that they have been reviewed by Contractor. Submittals without this stamp of approval will not be reviewed by Engineer and will be returned to Contractor. Contractor's stamp shall contain the following minimum information:

Project Name: _____

Contractor's Name: _____

Date: _____

----------Reference----------

Item: _____

Specifications Section: _____

Page No.: _____

Para. No.: _____

Drawing No.:_____ of _____

Location: _____

Submittal No.: _____

Approved By: _____

G. Submittals shall be numbered in accordance with the project submittal numbering sequence. This sequence will be provided to the Contractor and will generally follow the form of: (Work Order No., as applicable)-(Section No.)-(Paragraph No.)-(Item No.)-(Extension APC/ECO). An item number will be assigned to each submittal, within each section; starting with No. 0001 and thence numbered consecutively. Resubmittals shall be identified by the original submittal number followed by a dash and “R1” for the first resubmittal, “R2" for the second resubmittal, etc.

H. Contractor shall comply with the data formats, transmission methods, etc. as directed by Engineer. Contractor shall initially submit to Engineer a minimum of 7 copies of all submittals that are on 11-inch by 17-inch or smaller sheets, and 2 prints made from original, for all submittals on sheets larger than 11-inch by 17-inch. One copy of each submittal shall be stamped "Preliminary - Not For Construction."

I. After Engineer completes his review, Shop Drawings will be marked with one of the following notations:
   1. Approved (APP)
   2. Approved as Noted (AAN)
   3. No Action Required (NAR)
   4. Revise and Resubmit (R&R)
   5. Rejected (REJ)
   6. Hold

J. If a submittal is acceptable, it will be returned "Approved" or "Approved as Noted".

K. Upon a submittal being returned "Approved" or "Approved as Noted", Contractor may order, ship or fabricate the materials included on the submittal, provided it is in accordance with the corrections indicated.

L. If a submittal has been submitted, but does not require approval, it will be returned “No Action Required”. This indicates the receipt of the submittal is acknowledged and no further submittal action is required from any party.

M. If a submittal is unacceptable, it will be returned with one of the following notations:
   1. "Revise and Resubmit"
   2. "Rejected"

N. Upon notification of a submittal returned "Revise and Resubmit", Contractor shall make the corrections indicated and repeat the initial approval procedure. The "Rejected" notation is used to indicate material or equipment that is not acceptable. Upon notification of a submittal so marked, Contractor shall repeat the initial approval procedure utilizing acceptable material or equipment.

O. Incomplete submittals, which could be remedied by the Contractor’s submission of additional information, may be held without disposition. The Contractor will receive a Submittal Hold Notice, detailing generally the required additional information. If the requested information is not received by the date indicated on the Submittal Hold Notice, the submittal shall be marked “Rejected” and Contractor will be notified.

P. Any related Work performed or equipment installed without an "Approved" or "Approved as Noted" Shop Drawing will be at the sole responsibility of the Contractor.

Q. Shop Drawings shall be submitted well in advance of the need for the material or equipment for construction and with ample allowance for the time required to make delivery of material or equipment after data covering such is approved. Contractor shall assume the risk for all materials or equipment which are fabricated or delivered prior to the approval of Shop Drawings. Materials or equipment will not be included in periodic progress payments until approval thereof has been obtained in the specified manner.

R. Engineer will review and process all submittals promptly, but a reasonable time should be allowed for this, for the Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to Contractor.

S. It is Contractor's responsibility to review submittals made by his Suppliers and Subcontractors before transmitting them to Engineer to assure proper coordination of the Work and to determine that each submittal is in accordance with his desires and that there is sufficient information about materials and equipment for Engineer to determine compliance with the Contract Documents. Incomplete or inadequate submittals will be returned for revision without review.

T. Contractor shall furnish required submittals with complete information and accuracy in order to achieve required approval of an item within three submittals. All costs to Engineer involved with subsequent submittals of Shop Drawings, Samples or other items requiring approval, will

be backcharged to Contractor, at the rate of 3.0 times direct technical labor cost, by deducting such costs from payments due Contractor for Work completed. In the event that Contractor requests a substitution for a previously approved item, all of Engineer's costs in the reviewing and approval of the substitution will be backcharged to Contractor unless the need for such substitution is beyond the control of Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

EXHIBIT 01 33 00-1
PROJECT ELECTRONIC DATA PROTOCOL TABLE

		Data Format					Transmitting Party			Transmission Method				Receiving Party			
Section	Electronic Data	DWG	EM	PDF	HC	W	C	E	O	EM	EMA	Mail	PMIS	C	E	O	Notes
3.01.A	**Project Communications**																
	General Communications & Correspondence		X	X	X (3)		X	X	X	X	X	X (3)		X	X	X	
	Meeting Notices and Agendas		X	X	X (3)	X		X			X	X (3)		X		X	
	Meeting Minutes			X	X (3)			X			X	X (3)		X		X	
3.01.B	**Contractor's Submittals to Owner**																
	Shop Drawings			X	X (3)		X				X	X (3)	X			X	1, 2
	Product Data			X	X (3)		X				X	X (3)	X			X	1, 2
	Informational and Closeout Submittals			X	X (3)		X				X	X (3)	X			X	1, 2
3.01.C	**Engineer's Return of Reviewed Submittals to Owner**																
	Shop Drawings			X				X					X			X	2
	Product Data			X				X					X			X	2
	Informational and Closeout Submittals			X				X					X			X	2
3.01.D	**Modifications**																
	Requests for Interpretation (RFI)			X			X	X					X			X	1
	Engineer's Interpretations (RFI Responses)			X				X					X			X	2
	Clarifications to Engineer			X					X				X		X		
	Field Orders			X	X				X		X	X		X			
	Proposal Requests			X	X		X	X	X		X	X				X	2
	Change Order Proposals			X	X		X				X	X				X	2
	Change Order Proposals - Response			X	X				X		X	X		X			
	Work Change Directive (for Contractor's Signature)			X	X				X		X	X		X			
	Change Order (for Contractor's Signature)				X				X		X	X		X			
3.01.E	**Applications for Payment**			X	X		X				X	X				X	2
3.01.F	**Notices and Claims to Contractor**			X	X				X		X	X		X			
	Notices and Claims to Owner			X	X		X				X	X				X	2
3.01.G	**Closeout Documents**																
	Record Documents (Red Lined Drawings)			X	X		X				X	X				X	2
	Punch List			X	X				X		X	X		X			
	Contract Closeout Documents			X	X		X				X	X				X	2

KEY

Data Format	
DWG	.dwg, AutoCAD 2007 drawing
EM	.htm, .txt, .rtf, E-mail text
PDF	.pdf portable document format
HC	Hard Copy
W	.doc, microsoft word 97-2003

Transmitting Party	
C	Contractor
E	Engineer
O	Owner

Transmission Method	
EM	Via e-mail
EMA	As an attachment to an e-mail
PMIS	Program Management Information System website
Mail	Via United States Postal Office

Receiving Party	
C	Contractor
E	Engineer
O	Owner

Notes

1. **Modifications by Engineer to Contractor's submittals and requests for interpretations are limited to printing out, marking-up, and adding comment sheets.**
2. **Review by OWNER prior to OWNER distribution to appropriate parties**
3. **Primary data format is electronic (PDF), and Secondary is hard copy (with Owner appoval)**

SECTION 01 52 03

COMMON CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall provide all temporary utilities required for the Project.
   1. Make all arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
   2. Pay all utility service costs, including cost of electricity, water, fuel, and other utility services required for the Work.
   3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
   4. Should Owner occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately between Owner and Contractor as mutually agreed to by the parties.
   5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
   6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
   7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:
   1. Sanitary facilities.
   2. First-aid facilities.
   3. Temporary Site and Other Roads
   4. Parking
   5. Security
   6. Contractor’s Staging and Work Area
   7. Contractor’s Field Offices and Buildings

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Sanitary Facilities.
   1. Provide suitably-enclosed chemical or self-contained toilets for Contractor’s employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner.
   2. Maintain in sanitary condition and properly supply with toilet paper.

3. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site.
4. Provide suitable temporary washing facilities for employees and visitors.
5. Provide temporary sanitary facilities for Engineer's field office. Coordinate with Owner for tie in with existing drain.

B. First-aid Facilities.
   1. Provide temporary first-aid stations at or immediately adjacent to the Site's major Work areas, and inside Contractor's temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.
   2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19.13, Pre-Construction Meeting.

C. Temporary Site and Other Roads
   1. Construct and maintain temporary roadways and parking in snow free, ice free, drivable condition.
   2. Maintain existing roads that are open to traffic and used during construction free from accumulation of dirt, mud and construction debris. Roads shall be considered "maintained" when material has been removed by a sweeper. Conduct magnetic sweeps of all temporary and existing roadways and parking as needed upon request of Engineer or Owner.
   3. Contractor shall repair or replace existing roads to original or better condition prior to final completion. Survey and video record condition of existing roads prior to construction as part of pre-construction video; see Section 01 71 16.13 Video Documentation of Conditions.

D. Parking
   1. Staging area and designated areas within construction limits may be used for parking of construction personnel's private vehicles and Contractor's lightweight vehicles.
   2. Do not allow heavy vehicles or construction equipment in parking areas.
   3. Make arrangements for additional parking off Site as required.
   4. Provide separate temporary parking to accommodate three vehicles.

E. Security
   1. Owner will not provide security.
   2. Contractor is responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect Contractor's and Owner's interest.

F. Contractor's Staging and Work Area
   1. Contractor's Staging.
      a. Construct and maintain staging area at location showing on Drawings and at other locations obtained by the Contractor as required to complete the Work.
      b. Provide video survey of all Owner's properties outside of new structure areas proposed by Contractor to be used for staging, storage, or Work areas as part of preconstruction video; see Section 01 71 16.13 Video Documentation of Conditions..

c. Provide a minimum 6 inches crushed stone surface where equipment and office trailers and other vehicular traffic is anticipated. Material lay down areas do not need to be surfaces with stone.

2. Contractor's Work Area
   a. Limit operations and storage of equipment and materials on OWNERS property to areas shown on Drawings and as determined by Engineer.
   b. Except as provided herein, no sidewalk, private property, railroad or public right-of-way, or other area adjacent to Site shall be used for storage of Contractor's equipment and materials unless prior written approval is obtained from the Owner and legal owner of the respective locations.
   c. Contractor shall maintain staging areas during construction in a manner that will not obstruct operations on any existing public right of way open to traffic, railroad tracks, or OWNERS areas. Work shall proceed in an orderly manner; maintain construction Site and staging area free of debris and unnecessary equipment or materials.
   d. Site used for staging, storage and Work areas shall be restored to existing conditions at the end of the Project unless shown otherwise in the Drawings.

G. Contractor's Field offices and Buildings
   1. If required by Contractor, erect where designated by Engineer, and maintain temporary field office and tool and storage buildings for Contractor use.
   2. Buildings shall be neat and well-constructed, surfaced with plywood, siding, masonite, or other similar material, well painted and void of advertisements.

1.4 USE OF OWNER'S SYSTEM

A. Use of Permanent Utility Systems Provided Under the Project:
   1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
      a. Obtain Owner's written permission to use permanent systems.
      b. Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.
      c. Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
   2. Do not use the following permanent facilities:
      a. Telephone and communication facilities.
      b. Sanitary facilities.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary systems may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
   1. Locate temporary systems for proper function and service.
   2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.
   3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until Work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

C. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

3.4 OWNERS USE

A. Upon acceptance of Work, or portion of Work defined and certified as Substantially Complete by Engineer, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation.

+ + END OF SECTION + +

SECTION 01 52 05

DETAILED CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall provide all temporary utilities required for the Project.
   1. Make all arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.
   2. Pay all utility service costs, including cost of electricity, water, fuel, and other utility services required for the Work.
   3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion and removal of temporary field offices and sheds.
   4. Should Owner occupy part of the Project prior to Substantial Completion of the entire Work, cost of utilities consumed via temporary utilities serving the portion occupied by Owner will be shared proportionately between Owner and Contractor as mutually agreed to by the parties.
   5. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.
   6. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.
   7. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:
   1. Electricity
   2. Lighting.
   3. Telephone and communications.
   4. Heating, ventilating, and temporary enclosures.
   5. Water.
   6. Sanitary facilities.
   7. First-aid facilities.
   8. Fire protection.
   9. Temporary Site and Other Roads
   10. Parking
   11. Security
   12. Contractor’s Staging and Work Area
   13. Contractor’s Field Offices and Buildings
   14. Engineer’s Field Offices and Buildings

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate work item.

1.3 REQUIREMENTS FOR TEMPORARY UTILITIES AND TEMPORARY FACILITIES

A. Electrical:
   1. Temporary electricity is not available and may not be obtained from Owner's electrical system.
   2. Arrange with local utility for temporary electrical service.
   3. Pay for installation of temporary electrical service including poles, transformers, and metering.
   4. Register temporary meter in Contractor's name.
   5. Pay for electricity consumed for construction purposes until Final Completion or until occupancy by Owner.
   6. Provide, maintain, and remove temporary electric service facilities.
   7. Provide temporary electric systems and components in conformance with requirements of National Electric Code and local authorities.
   8. Facilities exposed to weather shall be weatherproof type.
   9. Enclosures shall be locked to prevent unauthorized access.
   10. Provide wiring, switches, sockets, and similar equipment required for temporary lighting and power tools.
   11. Provide electric service to temporary offices.

B. Lighting.
   1. Temporary lighting shall be sufficient to enable Contractor and Subcontractors to complete Work and enable Engineer to observe Work. Illumination shall meet or exceed all federal, state and local code requirements.

C. Telephone and Communications.
   1. Provide temporary telephone and communications required for Contractor's operations at the Site and for summoning emergency medical assistance.

D. Heating, Ventilating, and Enclosures.
   1. Provide sufficient temporary heating, ventilating, and enclosures to ensure safe working conditions and prevent damage to existing facilities and the Work.
   2. Except where otherwise specified, temporary heating shall maintain temperature of the area served between 50 degrees F and maximum design temperature of building or facility and its contents.
   3. Maintain temperature of areas occupied by Owner's personnel or electronic equipment, including offices, lunch rooms, locker rooms, toilet rooms, and rooms containing computers, microprocessors, and control equipment, between 65 degrees F and 80 degrees F with relative humidity less than 75 percent.
   4. Required temperature range for storage areas and certain elements of the Work, including preparation of materials and surfaces, installation or application, and curing as applicable, shall be in accordance with the Contract Documents for the associated Work and the Supplier's recommended temperature range for storage, application, or installation, as appropriate.

5. Provide temporary ventilation sufficient to prevent accumulation in construction areas and areas occupied by Owner of hazardous and nuisance levels or concentrations of dust and particulates, mist, fumes or vapors, odors, and gases, associated with construction.
6. Provide temporary enclosures and partitions required to maintain required temperature and humidity.
7. Repair or replace materials damaged because of lack of heat.
8. Heat shall be warm air from oil or gas-fired portable heaters suitable ventilated to the outside.
9. Open salamander type heaters are not permitted.

E. Water.
1. Provide temporary water facilities including piping, valves, meters if not provided by owner of existing waterline, backflow preventers, pressure regulators, and other appurtenances. Provide freeze-protection as required.
2. Provide water for temporary sanitary facilities, field offices, Site maintenance and cleaning and, when applicable, disinfecting and testing of systems.
3. Continuously maintain adequate water flow and pressure for all purposes during the Project, until removal of temporary water system.

F. Sanitary Facilities.
1. Provide suitably-enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner.
2. Maintain in sanitary condition and properly supply with toilet paper.
3. Provide supply of potable drinking water and related facilities and consumables for all personnel using the Site.
4. Provide suitable temporary washing facilities for employees and visitors.
5. Provide temporary sanitary facilities for Engineer's field office. Coordinate with Owner for tie in with existing drain.

G. First-aid Facilities.
1. Provide temporary first-aid stations at or immediately adjacent to the Site's major Work areas, and inside Contractor's temporary field office. Locations of first-aid stations shall be determined by Contractor's safety representative.
2. Provide list of emergency telephone numbers at each hardwired telephone at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19.13, Pre-Construction Meeting.

H. Fire Protection.
1. Provide temporary fire protection, including portable fire extinguishers rated not less than 2A or 5B in accordance with NFPA 10, Portable Fire Extinguishers, for each temporary building and for every 3,000 square feet of floor area under construction.
2. Comply with NFPA 241, Safeguarding Building Construction, Alternation, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

I. Temporary Site and Other Roads
1. Construct and maintain temporary roadways and parking in snow free, ice free, drivable condition.

2. Maintain existing roads used during construction free from accumulation of dirt, mud and construction debris. Roads shall be considered "maintained" when material has been removed by a sweeper. Conduct magnetic sweeps of all temporary and existing roadways and parking as needed upon request of Engineer or Owner.
3. Contractor shall repair or replace existing roads to original or better condition prior to final completion. Survey and video record condition of existing roads prior to construction as part of pre-construction video.

J. Parking
1. Staging area and designated areas within construction limits may be used for parking of construction personnel's private vehicles and Contractor's lightweight vehicles.
2. Do not allow heavy vehicles or construction equipment in parking areas.
3. Make arrangements for additional parking off Site as required.
4. Provide separate temporary parking at Engineer's field office to accommodate three vehicles.

K. Security
1. Owner will not provide security.
2. Contractor is responsible for loss or injury to persons or property where Work is involved, and shall provide security and take precautionary measures to protect Contractor's and Owner's interest.

L. Contractor's Staging and Work Area
1. Contractor's Staging
   a. Construct and maintain staging area at location showing on Drawings and at other locations obtained by the Contractor as required to complete the Work.
   b. Provide video survey of all Owner's properties outside of new structure areas proposed by Contractor to be used for staging, storage, or Work areas as part of preconstruction video.
   c. Provide a minimum 6 inches crushed stone surface where equipment and office trailers and other vehicular traffic is anticipated. Material lay down areas do not need to be surfaces with stone.
2. Work Area
   a. Limit operations and storage of equipment and materials on Owner's property to areas shown on Drawings and as determined by Engineer.
   b. Except as provided herein, no sidewalk, private property, railroad or public right-of-way, or other area adjacent to Site shall be used for storage of Contractor's equipment and materials unless prior written approval is obtained from the Owner and legal owner of the respective locations.
   c. Contractor shall maintain staging areas during construction in a manner that will not obstruct operations on any existing public right of way, railroad tracks, or Owner's areas. Work shall proceed in an orderly manner; maintain construction Site and staging area free of debris and unnecessary equipment or materials.
   d. Site used for staging, storage and Work areas shall be restored to existing conditions at the end of the Project unless shown otherwise in the Drawings.

M. Contractor's Field offices and Buildings

1. If required by Contractor, erect where designated by Engineer, and maintain temporary field office and tool and storage buildings for Contractor use.
2. Buildings shall be neat and well constructed, surfaced with plywood, siding, Masonite, or other similar material, well painted and void of advertisements.

N. Engineer's Field Office
1. Provide field office with minimum floor area of 550 sq. ft, with three separate offices, bathroom and interior partitions as designated by Engineer. Provide exterior covered entrance with handrail and steps. Provide weather tight enclosures connecting field trailers together as one facility or provide combined modular units to equal required square footage and facilities.
2. Field office shall be new or like new mobile or modular structure.
3. Include following utilities, equipment and furniture:
    a. Heat and air condition, capable of maintaining 70°F during all winter and summer temperatures.
    b. Electrical power and lights.
    c. Potable water and sanitary hookup.
    d. Secure lockable doors and barred windows.
    e. Potable bottled water, chiller, and heater with fresh bottle service for the duration of Project.
    f. New or like new office furniture and fixtures as required by the Engineer.
        1) Desk, book cases, chairs, folding tables, etc.
        2) First aid and blood-borne pathogens kit.
        3) Adequate fire extinguishers and smoke alarms for field office space.
4. Maintain utility systems, office equipment, and field office weekly. Provide field office, bathroom, and kitchen cleaning weekly. Provide expendable supplies for office equipment and bathroom requirements until Final completion.

1.4 USE OF OWNER'S SYSTEM

A. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.

B. Use of Permanent Utility Systems Provided Under the Project:
1. Permanent electrical, lighting, water, heating, ventilating, and fire protection systems and first-aid facilities may be used to provide temporary utilities and temporary facilities if the following are met:
    a. Obtain Owner's written permission to use permanent systems.
    b. Permanent systems to be used for temporary utilities or temporary facilities shall have achieved Substantial Completion, including complete functionality of all controls.
    c. Contractor shall pay all costs while using permanent system, including operation, maintenance, replacement of consumables, and provide replacement parts.
2. Do not use the following permanent facilities:
    a. Telephone and communication facilities.
    b. Sanitary facilities.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for temporary systems may be new or used, but shall be adequate for purposes intended and shall not create unsafe conditions, and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:
   1. Locate temporary systems for proper function and service.
   2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and Work of utility companies.
   3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.2 USE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:
   1. Enforce compliance with Laws and Regulations.
   2. Enforce safe practices.
   3. Prevent abuse of services.
   4. Prevent nuisances and hazards caused by temporary systems and their use.
   5. Prevent damage to finishes.
   6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until Work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

3.3 REMOVAL

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site

to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

B. Where temporary utilities are disconnected from existing utility, provide suitable, watertight or gastight (as applicable) cap or blind flange, as applicable, on service line, in accordance with requirements of utility owner.

C. When permanent utilities and systems that were used for temporary utilities, upon Substantial Completion replace all consumables such as filters and light bulbs and parts used during the Work.

3.4 OWNERS USE

A. Upon acceptance of Work, or portion of Work defined and certified as Substantially Complete by Engineer, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation.

+ + END OF SECTION + +

SECTION 01 55 26

MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall keep all streets and traffic ways open for passage of traffic and pedestrians during the Work, unless otherwise approved by owner of the street, traffic way, or right-of-way, as applicable. Construction traffic shall access the Site only via previously approved entrance(s) or as noted on the Drawings.

B. When required to cross, obstruct or temporarily close a street or traffic way, provide and maintain suitable bridges, detours or other approved temporary expedient for the accommodation of traffic. Closings shall be for shortest time practical, and passage shall be restored immediately after completion of backfill and temporary paving or bridging. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

C. Submit a Barricade Permit with the Montgomery County Highway Department and INDOT, as applicable. Contractor shall notify and coordinate with the fire department, police department, and other emergency services prior to the implementation of the proposed construction operations. Emergency traffic must have access to the Project area at all times.

D. Give reasonable notice to owners or tenants of private property who may be affected by construction operations. Give minimum seventy-two (72) hours notice.

E. Provide signs, signals, barricades, flares, lights and other equipment, service, and personnel required to regulate and protect all traffic and warn of hazards. Such Work shall conform to requirements of Owner and authority having jurisdiction at the Site. Remove temporary equipment and facilities when no longer required, and restore grounds to original or to specified conditions, as applicable.

F. The Contractor shall provide the Engineer with a ***Maintenance of Traffic Plan*** for approval thirty (30) days prior to the closure of any streets. After the Maintenance of Traffic Plan is approved, any additional revisions required to the plan shall be approved by the Montgomery County Highway Department and INDOT, as applicable, with at least 72 hours notice.

1.2 MEASUREMENT AND PAYMENT

A. Traffic Control
   1. Work Item Number and Title

      01 55 26-A Maintenance and Protection of Traffic
   2. Payment for Maintenance and Protection of Traffic shall be on a lump sum basis.

3. The pay quantity for this item shall be the percentage of Work completed at the time of billing (i.e., 10 percent of the lump sum amount for Maintenance and Protection of Traffic will be earned at 10 percent of earned Contract amount).

1.3 TRAFFIC SIGNALS AND SIGNS

A. Provide and operate traffic control and directional signals required to direct and maintain an orderly flow of traffic in all areas under Contractor's control, and areas affected by Contractor's operations.

B. All signs, barricades, and lights shall be in good condition and conform to Indiana Manual on Uniform Traffic Control Devices and Section 801 of the Indiana Department of Transportation (INDOT) Standard Specifications (Latest Edition).

C. The Contractor shall be responsible for determining if the temporary removal or relocation of street and/or traffic signs is necessary. Should such Work take place, the Contractor shall be responsible for calling the Montgomery County Highway Department at 765/364-6446. The Contractor shall be responsible for any and all sign removal and/or relocation.

D. At a minimum provide traffic control and directional signs, mounted on barricades or standard posts at the following locations (all in conformance with the approved ***Maintenance of Traffic Plan***):
   1. Each change of direction of a roadway and at each crossroad.
   2. Detours and hazardous areas.
   3. Parking areas.

1.4 FLAGMEN

A. Provide qualified and suitably equipped flagmen when construction operations encroach on traffic lanes, as required for regulation of traffic and in accordance with requirements of the authority having jurisdiction.

1.5 PARKING CONTROL

A. Control all Contractor-related vehicular parking within limits of the Work to preclude interfering with: public traffic or parking, access by emergency vehicles, Owner's operations, and construction operations. Provide temporary parking facilities for the public, as required because of construction or operations.

B. Monitor parking of all construction and private vehicles at the Site:
   1. Maintain free vehicular access to and through parking areas.
   2. Prohibit parking on or adjacent to access roads, and in non-designated areas.
   3. Construction vehicles must possess current vehicle registration.
   4. Private vehicles shall park only in designated areas.

1.6 HAUL ROUTES

A. Consult with authorities having jurisdiction to establish thoroughfares that will be used as haul routes and Site access.

B. Confine construction traffic to designated haul routes.

C. Provide traffic control at critical areas of haul routes to expedite traffic flow, and to minimize interference with normal traffic.

1.7 STREET SWEEPING

A. All open streets upon which construction activities have occurred shall be broom cleaned at the end of each workday. These construction activities include, but are not limited to, deliveries, hauling, and equipment transport. Large pieces of debris shall be removed immediately.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 57 00

TEMPORARY CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control environmental conditions at the Site and adjacent areas.
   2. Maintain controls until no longer required.
   3. Upon completion of the Work, remove temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition.

1.2 MEASUREMENT AND PAYMENT

A. Temporary Controls:
   1. All items listed in this specification are to be included in overall Project cost and not bid as a separate Work item.

1.3 NOISE CONTROL

A. Noise Control – General:
   1. Contractor’s vehicles and equipment shall minimize noise to greatest degree practicable. Air compressors shall be equipped with silencers and the exhaust of all gasoline and/or diesel motors and other power equipment shall be provided with mufflers.
   2. Noise levels shall conform to Laws and Regulations, including OSHA requirements and local ordinances.
   3. Noise levels shall not interfere with the work of Owner or others. No Work shall be performed within residential areas before 7:00 am or after 8:00 pm.

1.4 DUST CONTROL

A. Control objectionable dust caused by Contractor's operation of vehicles and equipment, clearing, or other actions. To minimize airborne dust, apply water or use other methods subject to acceptance of Engineer and approval of authorities having jurisdiction.

B. The Contractor shall maintain a mechanical broom on Site at all times. All open streets upon which construction activities have occurred shall be broom clean at the end of the workday or as directed. These construction activities include, but are not limited to deliveries, hauling, and equipment transport.

C. The Contractor shall maintain filled surfaces which are subject to vehicular traffic in a dust-free condition by the use of approved treatment by the Engineer until final paving or other final treatment of surface is accomplished.

D. Dust control operations shall be performed by the Contractor at the time ordered by the Owner, but failure of the Owner to issue such order will not relieve the Contractor of this responsibility. The cost of dust treatment is considered as incidental and shall not be grounds for extra payment.

1.5 PEST AND RODENT CONTROL

A. Pest and Rodent Control – General:
   1. Provide rodent and pest control as required to prevent infestation of the Site and storage areas.
   2. Employ methods and use materials that do not adversely affect conditions at the Site or on adjoining properties.

1.6 POLLUTION CONTROL

A. Pollution Control – General:
   1. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere caused by discharge of noxious substances from construction operations.
   2. Equipment used during construction shall conform to federal, state, and Local Laws and Regulations.

B. Spills and Contamination:
   1. Provide equipment and personnel to perform emergency measures required to contain spillages, and to remove contaminated soils or liquids.
   2. Excavate contaminated earth and dispose of off-Site, and replace with suitable compacted fill and topsoil.

C. Protection of Surface Waters: Implement special measures to prevent harmful substances from entering surface waters. Prevent disposal of wastes, effluents, chemicals, or other such substances in or adjacent to surface waters and open drainage routes, in sanitary sewers, or in storm sewers.

D. Atmospheric Pollutants:
   1. Provide systems for controlling atmospheric pollutants related to the Work.
   2. Prevent toxic concentrations of chemicals.
   3. Prevent harmful dispersal of pollutants into atmosphere.

E. Solid Waste:
   1. Provide systems for controlling and managing solid waste related to the Work.
   2. Prevent solid waste from becoming airborne, and from discharging to surface waters and drainage routes.
   3. Properly handle and dispose of solid waste. All debris resulting from construction operations; i.e. packaging, waste material, damaged equipment, etc. shall be trucked from the construction Site by the Contractor and disposed of in accordance with Federal, State, and City rules and regulations. Consult with City and local authorities to establish thoroughfares that can be used as haul routes. Confine construction traffic to designated haul routes. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed from public right-of-ways.

1.7 TEMPORARY FENCING FOR EXCAVATIONS

A. Furnish and install a temporary fence surrounding excavations and work area. Fence shall have openings only at vehicular, equipment and worker access points.

B. The fence shall be an orange safety fence type enclosure, 48 inches high. Fence shall be constructed of high density polyethylene with oval openings. The mesh openings shall be 1 ¾ inches by 1 ¾ inches. Posts shall be made of steel, either U, Y, T or channel section, and shall have corrugations, knobs, notches or studs. Posts shall be anchored 2 feet into the ground. Posts shall have holes every two inches that the fencing shall be attached by zip lock ties. Posts shall be placed no further than ten feet apart.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 INSTALLATION AND MAINTENANCE- TEMPORARY CONTROLS

A. Temporary control measures shall be implemented and maintained to meet requirements under this section.

3.2 TESTING

A. All materials provided under this Specification shall meet the requirements of the applicable sections of the Indiana Department of Transportation Standards Specifications (INDOTSS), latest edition.

+ + END OF SECTION + +

SECTION 01 57 13

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide and maintain methods, equipment, and temporary construction as required to control conditions at the Site and adjacent areas.
2. Contractor shall maintain all controls until Contractor warranty period is complete, or until controls are no longer needed, whichever is earlier. Upon completion of the Work, remove unneeded temporary controls and restore Site to specified condition; if condition is not specified, restore Site to pre-construction condition. Remaining controls shall be removed after site is entirely stabilized with vegetative cover.
3. Contractor shall provide all labor, materials, equipment and services required to provide all permanent erosion control measures as required.

B. Related Sections:
1. Section 31 05 19, Geosynthetics for Earthwork.
2. Section 32 05 19.19, Geogrids for Exterior Improvements.

1.2 QUALITY ASSURANCE

A. Comply with applicable provision and recommendations of the following:
1. Erosion Control methods and procedures shall comply with 327 IAC 15-5. Any inconsistencies with 327 IAC 15-5 will not apply except if inconsistency has been approved by IDEM or the IDNR Division of Soil Conservation.
2. Indiana Storm Water Quality Manual, formerly the Indiana Handbook for Erosion Control in Developing Areas. Copies are available from Indiana State Department of Agriculture, Division of Soil Conservation 402 W. Washington Street, #W265, Indianapolis, IN 46204, or downloaded at http://www.in.gov/idem/4899.htm.
3. Indiana Department of Transportation (INDOT) Standard Specifications, current edition.

1.3 SUBMITTALS

A. Erosion Control Plan:
1. Plan for construction staging and maintenance of the Site relative to erosion and sediment controls. Indicate on a Site plan approximate areas of planned disturbance of soils and soil cover over time during the Project. For areas not indicated in the Contract Documents as being disturbed and that Contractor proposes to disturb, Erosion Control Plan shall include proposed erosion and sediment control measures for the additional area.
2. Location and details of temporary concrete washout areas.

B. Product Data, Manufacturer Installation and Maintenance Instructions:

1. Submit manufacturer product data, installation instructions and maintenance instructions for all erosion control products included in this specification.

C. Erosion Control Inspection Log
   1. Contractor shall submit a copy of all erosion control inspection logs, completed in accordance with Section 3.2, with each monthly pay application.
   2. Pay application will not be approved without the submittal of the erosion control inspection log.

1.4 MEASUREMENT AND PAYMENT

A. Erosion and Sedimentation Control: (Unit Price)
   1. Work Item Title and Number

      01 57 13-A Temporary Erosion and Sedimentation Control

   2. Payment for Erosion and Sedimentation Control shall be on a lump sum basis per , as indicated in the Bid Schedule.
   3. The payment quantity shall be based on the units actually installed, and removed upon completion, to complete the erosion control plan requirements.

1.5 STORMWATER RUNOFF

A. Stormwater Control – General:
   1. Provide methods to control stormwater runoff (surface drainage) and water from excavations and structures to prevent damage to the Work, the Site, and adjoining properties.
   2. Control fill, grading, and ditching to direct water away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff courses to prevent erosion, damage, or nuisance.

B. Equipment and Facilities for Stormwater Control: Provide, operate, and maintain equipment and facilities of adequate size to control storm water runoff.

C. The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all stormwater runoff entering the excavations or other parts of the Work and shall keep said excavations dry until the structures to be built or pipelines to be placed therein are completed. No stormwater shall be allowed to rise over or come in contact with masonry until the concrete and mortar have attained a satisfactory set, except in cases where the concrete has been tremied into place with the approval of the Engineer. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation free of stormwater.

D. Discharge and Disposal: Dispose of stormwater in manner to prevent flooding, erosion, and other damage to any and all parts of the Site and adjoining areas, and that conforms to Laws and Regulations.
   1. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the water downstream of the

point of discharge, shall not be directly discharged. Such waters shall be diverted through a settling basin, filter or other approved method, before being discharged.

2. Contractor will be held responsible for the condition of any pipe, conduit or channel used for drainage purposes and all such pipes, conduits or channels shall be left clean and free of sediment.

1.6 EROSION CONTROL

A. Erosion Control – General:

1. Plan and execute construction and earthwork by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas, to prevent erosion and sedimentation.
2. Hold to a minimum the areas of bare soil exposed at one time.
3. Provide temporary control measures such as berms, dikes, and drains.
4. Construct fills and waste areas by selective placement to reduce surface silts or clays that will erode.
5. Periodically inspect earthwork to detect evidence of the start of erosion; apply corrective measures as required to control erosion. Continue inspections and corrective measures until permanent vegetation has been established.
6. The Contractor shall maintain drainage flow at all times through any ditches disturbed during construction. The Contractor shall minimize disturbance and sedimentation due to excavation in ditches and shall restore the ditches to their original condition and performance.
7. Periodically inspect impacted ditches and streams to detect evidence of the start of erosion; apply corrective measures as required to control erosion. Continue inspections and corrective measures until permanent erosion control and vegetation have been established.

B. Erosion Control Permit (SWPPP):

1. Contractor shall comply with the 327 IAC 15-5 “Stormwater Run-Off Associated with Construction Activity” permit, as provided by the Owner and as shown or specified in the construction documents.
2. Contractor shall follow the Indiana Storm Water Quality Manual.
3. Contractor shall submit proof of approved erosion control plans for excavated materials disposal site.
4. Contractor shall install and maintain erosion control around stockpiles of granular material using gravel filled bags.
5. Contractor shall install and maintain erosion control around existing and newly constructed inlets downstream from construction activity.
6. Contractor shall furnish, install, and maintain erosion control measures such as silt fences and temporary seeding and sodding on all disturbed areas.
7. Contractor to minimize granular deposits on the street surfaces and sidewalks, open to traffic. Excess material shall be removed at end of workday by approved methods. (i.e. street sweeper, brooming). Contractor shall not remove material by flushing street with water.
8. Contractor shall post a copy of the Notice of Intent letter on project board at the Site entrance or other approved highly visible location on Site.

9. Contractor shall provide a trained individual (CESSWI or INDOT Level 1 certified) to oversee the installation and maintenance of erosion and sedimentation control.
10. Contractor to inspect, repair, and maintain erosion and sedimentation control a minimum of once each week or by the end of the next business day after a storm event greater than 0.5" of rainfall in 24 hours. A trained individual shall prepare a written evaluation of each inspection, repair, and maintenance performed. The evaluation must include: the name of the individual performing the evaluation; the date of the evaluation; problems identified at the project site; and details of corrective actions recommended and completed.
11. Corrective actions required, as a result of an inspection or control measure failure shall be scheduled within 24 hours of inspection or failure.
12. Contractor shall make the Construction Drawings and inspection reports available upon request.
13. Contractor to record any revisions to the Storm Water Pollution Prevention Plan.
14. Areas to be left inactive for 8 days or more to be treated with temporary or permanent seeding or sodding.
15. If provisions of these specifications conflict with provisions of the Standard Specifications the provisions of this specification will govern.

1.7 MAINTENANCE

A. Contractor shall maintain erosion controls during Contractor warranty period or until a Notice of Termination of the Rule 5 permit has been issued. Contractor is to maintain responsibility for required inspections, and restoration to original design condition as required.

PART 2 PRODUCTS

2.1 GENERAL-EROSION AND CONTROL

A. All erosion control products shall be in accordance with the Indiana Department of Transportation Standards Specifications (INDOTSS).

B. All materials provided under this Specification shall meet the requirements of the applicable sections of the Indiana Department of Transportation Standards Specifications (INDOTSS), latest edition or Indiana Storm Water Quality Handbook.

2.2 SITE PREPARATION

A. Temporary Construction Entrance
   1. Construction of temporary construction entrances shall conform to the details provided in the Contract Documents.
   2. Manufactures: The following geosynthetic material will be accepted:
      a. Mirafi HP270
      b. Or equal
   3. A woven geotextile fabric shall be installed for separation of subbase and base aggregate materials. Refer to Section 31 05 19-Geosynthetics for Earthwork for geotextile fabric requirements. :

4. Base aggregate material shall consist of INDOT #8 aggregate and capped with INDOT #8 aggregate. Thickness of each aggregate layer shall conform to the dimensions indicated on the Drawings.
5. Prior to installation, all vegetation shall be removed from foundation area.
6. Foundation area shall be graded for positive drainage.
7. Where possible, divert all stormwater runoff and drainage from the temporary construction entrance to a sediment trap or basin.

B. Temporary Perimeter Protection - Silt Fence
1. Construction of sediment barriers shall conform to the details provided in the Contract Documents.
2. Sediment barriers shall be designed and used in situations in which only sheet or overland flows are expected.
   Provide woven geotextile fabrics for use in sediment barriers. Refer to Section 31 05 19-Geosynthetics for Earthwork for geotextile fabric requirements.
3. Sediment barriers shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.
4. Sediment barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
5. Should the sediment barrier decompose or become ineffective prior to the upslope area being permanently stabilized, the barrier shall be replaced promptly.
6. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
7. Any sediment deposits remaining, in place, after the barrier has been removed shall be dressed to conform to the existing grade, prepared, and seeded.

C. Temporary Perimeter Protection - Filter Sock
1. Manufactures: The following proprietary sediment control devices will be accepted for use as perimeter protection:
   a. Filtrexx Sediment Control
   b. Or equal
2. Construction of sediment barriers shall conform to the details provided in the contract documents.
3. Sediment barriers shall be used and installed as recommended by the manufacturer. Filtrexx Sediment Control Soxx for use in sediment barriers shall conform to the following table:

Filtrexx Sediment Control					
Filtrexx Soxx Material					
Material Type	3mil HDPE	5mil HDPE	5mil HDPE	Multi-Filament Polypropylene (MFPP)	Multi-Filament Polypropylene Safety Soxx
Material Characteristics	Photodegradable	Photodegradable	Biodegradable	Photodegradable	Photodegradable
Design Diameters (inch)	5 8 12	5 8 12	8 12 18	8 12 18	8 12 18

	18	18 24 32	24 32	24 32	24 32
Mesh Opening (inch)	⅜	⅜	⅜	⅜	⅛
Tensile Strength (psi)	ND	26	26	44	202
% Original Strength form Ultraviolet Exposure (ASTM G-155)	23% at 1,000 hr	23% at 1,000 hr	ND	100% at 1,000 hr	100% at 1,000 hr
Functional Longevity/Project Duration	6 mo–2 yr	9 mo–3 yr	6 –12 months	1 –4 year	2 –5 year

4. Filtrexx Sediment Control Soxx shall contain a coarse composted material that is a Certified Filtrexx Filter Media.
5. Sediment barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
6. Sediment deposits should be removed after each storm event. They must be removed when deposits reach approximately one-half the height of the barrier.
7. Any sediment deposits remaining, in place, after the barrier has been removed shall be dressed to conform to the existing grade, prepared, and seeded.
8. Filtrexx Sediment Control, including Filtrexx Filter Media, shall be properly disposed of offsite.

2.3 CONCRETE WASHOUT AREA

A. General
1. A concrete washout location shall be designated and a system shall be implemented to reduce the discharge of pollutants associated with concrete washout waste.
2. Construction/Installation of a concrete washout system shall be complete prior to concrete delivery.
3. Do not wash out concrete trucks or equipment into storm drains, wetlands, streams, rivers, creeks, ditches, or streets.
4. Signage shall be installed to designate location of concrete washout system.
5. Concrete washout system shall conform to the details on the Drawings.
6. Washout system shall utilize a pit or bermed area designed and maintained at a capacity to contain all liquid and concrete waste generated by washout operations, between scheduled cleanout periods.
7. Pit shall be lined with ten millimeter polyethylene lining to control seepage.
8. Place flags, safety fencing, or equivalent to provide a barrier to construction equipment and other traffic.
9. Inspect the overall washout system daily for leaks, spills, tracking of soil by equipment, lining failure, and hardened concrete.
10. Once concrete wastes have hardened, remove and dispose off-site.

11. Excess concrete shall be removed when the washout system reaches 50 percent of the design capacity.
12. Replace the plastic liner after each cleaning of the concrete washout system.
13. Concrete washout systems shall be cleaned, removed, filled, graded, and stabilized at the completion of concrete operations.

2.4 EROSION CONTROL BLANKETS

A. Short-term (less than 6 month functional longevity) Erosion Control Blankets.
1. The blanket shall be 100% straw fiber matrix.
2. Stitching shall be photodegradable thread.
3. The blanket shall be double-net construction.
4. Contractor shall prepare soil according to the grading, seeding, fertilization and restoration requirements of the contract documents, prior installing erosion control blankets.
5. Installation of erosion control blankets shall conform to the details provided in the Contract Documents.
6. Anchoring shall be by means of 6" to 12" staples or pins and installed per manufacturers recommendations for specific application.
7. The blanket shall conform to the minimum requirements listed in the following table:

Erosion Control Blanket Requirements		
Short-Term Installation (Less than 6 Months Functional Longevity)		
Physical Property	Unit	Min. Value
Top Net Weight	lbs/1,000 ft^2	1.5
Straw Fiber Density	lbs/yd^2	0.5
Bottom Net Weight	lbs/1,000 ft^2	1.5
Anchoring	Anchors/yd^2	1.5

B. Long-term (more than 12 month functional longevity) Erosion Control Blankets.
1. The blanket shall be constructed of straw fiber and coconut fiber combination, with a minimum coconut content of 30%.
2. Stitching shall be photodegradable thread.
3. The blanket shall be double-net construction.
4. Contractor shall prepare soil according to the grading, seeding, fertilization and restoration requirements of the contract documents, prior installing erosion control blankets.
5. Installation of erosion control blankets shall conform to the details provided in the Contract Documents.
6. Anchoring shall be by means of 8" to 12" staples or pins and installed per manufacturers recommendations for specific application.
7. The blanket shall conform to the minimum requirements listed in the following table:

Erosion Control Blanket Requirements

Long-Term Installation (6 - 12 Months Functional Longevity)		
Physical Property	Unit	Min. Value
Top Net Weight	lbs/1,000 ft^2	3
Straw Fiber Density	lbs/yd^2	0.35
Coconut Fiber Density	lbs/yd^2	0.15
Bottom Net Weight	lbs/1,000 ft^2	1.5
Anchoring	Anchors/yd2	2

2.5 CHECK DAMS

A. HDPE CHECK DAMS
1. Provide temporary HDPE check dams as indicated on Drawings.
2. Materials
   a. Check dam shall be made of injection molded UV stabilized HDPE. Provide the following:
      1) Georidge Standard as manufactured by Nilex.
      2) Or equal.
   b. Provide 10" metal anchor spikes.
3. Installation:
   a. Follow manufacturer's recommended installation procedures.
   b. A section of erosion control blanket shall be placed transverse to the flow line direction of the ditch prior to the installation of the HDPE check dam. The length of the section shall extend from the top of one side of the ditch to the top of the opposite side of the ditch, while the width of the section shall be one roll width of the blanket or no less than 4 ft.
   c. The upstream edge of the erosion control blanket shall be secured in a 4" trench. The blanket shall be secured in the trench with 6" minimum staples placed at 1.67 ft intervals along the edge before the trench is backfilled.
   d. Once the upstream edge of the blanket is secured, the downstream edge shall be secured with 6" minimum staples placed at 1 ft intervals along the edge. The HDPE check dam shall be installed in the middle of the erosion control blanket. Re-compact the soil in the trench.
   e. For multiple HDPE check dam panels in the same row, overlap panels a minimum 2". Cut a slot in the crest of the overlapping berm to allow contact between the foot of the berm and the soil.
   f. Anchor HDPE check dam with a 10" metal spikes. Anchor spacing depends on soil condition and density. Minimum recommendation is 3 anchors on the upstream side and 2 anchors on the downstream side. Install to prevent water from going around or under the HDPE check dam.
   g. Subsequent panels shall extend both across the bottom of the ditch and opposite the side slope, as well as up the original backslope or side slope at the distance determined by the Engineer.

HDPE Check Dam Spacing

Gradient	Spacing
1%	75.0
2%	37.5
3%	25.0
4%	19.0
5%	15.0
6%	12.5
7%	10.5
8%	9.5
9%	8.5
10%	7.5

4. Maintenance:
    a. Contractor shall immediately notify Engineer if significant erosion occurs between dams.
    b. Remove accumulated sediment when it reaches one-half the height of the dam to maintain channel capacity, allow drainage through the dam, and prevent large flow from displacing sediment.

B. ROCK CHECK DAMS
1. Provide rock check dams as indicated on Drawings.
2. Materials
    a. A nonwoven geotextile fabric, shall be used for separation of subbase and base aggregate materials. Refer to Section 31 05 19-Geosynthetics for Earthwork for geotextile fabric requirements.

    b. The aggregate shall be as defined by INDOT Standards for revetment riprap, must be crushed stone and must meet the following gradations.

INDOT Revetment Riprap Gradation	
Size, In. (mm)	Revetment
30 (750)	
24 (600)	
18 (450)	100
12 (300)	90-100
8 (200)	
6 (150)	20-40
3 (75)	0-10
1 (25)	

Depth of Riprap, minimum	18 in. (450 mm)

c. The filter medium shall be well-graded INDOT #5 aggregate.

3. Installation
   a. Excavate a cutoff trench into the channel bottom and ditch banks, extending it a minimum of 18 inches beyond the top of the ditch bank.
   b. Install and anchor filter fabric in the channel and cutoff trench.
   c. Place riprap in the cutoff trench and channel to the lines and dimensions shown on the Drawings. The center of each dam must be at least nine inches lower than the uppermost points of contact between the riprap dam and channel banks.
   d. Extend the riprap at least 18 inches beyond the top of the channel banks to keep overflow water from eroding areas adjacent to the channel banks before it re-enters the channel.
   e. Place filter medium (INDOT #5 aggregate) on the up-slope side of the dam. Place filter medium over the entire face of the dam up to the base of the overflow weir notch.
   f. Stabilize the channel above the uppermost dam.
4. Maintenance
   a. Contractor shall immediately notify Engineer if significant erosion occurs between dams.
   b. Remove accumulated sediment when it reaches one-half the height of the dam to maintain channel capacity, allow drainage through the dam, and prevent large flow from displacing sediment.
   c. Add riprap and aggregate as needed to maintain design height and cross section of the dams.
   d. areas.

2.6 TEMPORARY SEDIMENT CONTROL DEWATERING BAG

A. General
   1. A temporary sediment control dewatering bag shall be installed at the discharge point of all dewatering pipes and hoses.
   2. Dewatering bags shall be proprietary devices and shall be submitted for approval prior to installation.
   3. Proprietary dewatering bags shall provide a filtering efficiency that removes at least 80% of the Total Suspended Solids.

B. Material
   1. Dewatering bags shall be made of non-woven geotextile fabric and shall be constructed specifically for the purpose of sediment control from dewatering pipes and hoses.
   2. Geotextile fabrics shall be non-woven. Refer to Section 31 05 19-Geosynthetics for Earthwork for geotextile fabric requirements.

C. Installation
   1. Dewatering bag installation shall conform to the manufacturer recommendations.

2. Dewatering bags should only be used on pipe or hoses sizes that they were specifically designed for.
3. Dewatering bags shall be placed on an aggregate underlayment for stabilization.
4. A nonwoven geotextile fabric shall be installed for separation of sub-base and aggregate underlayment. Geotextile fabrics shall conform to the following table:

Non-Woven Geotextile Fabric Requirements			
Dewatering Bag Aggregate Underlayment Installation			
Physical Property	Test Method	Unit	Min. Value
Grab Tensile Strength	ASTM D 4632	lbs.	200
Grab Tensile Elongation	ASTM D 4632	%	50
Puncture Strength	ASTM D 4833	lbs.	500
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	#80
Flow Rate	ASTM D 4491	gal/min/ft^2	95

D. Maintenance
1. Remove accumulated sediment when the bag is half full of sediment or as required to maintain the capacity of the dewatering system.
2. All sediment shall be removed and disposed of off-site.
3. Dewatering bags shall be removed from the Site at the completion of dewatering and shall not be buried or left on Site.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL

A. All erosion and sediment control items shall be installed in strict conformance with the manufacturer's instructions for proprietary items. On-site construction methods shall conform to the Indiana Storm Water Quality Handbook.

B. Prior to site work, erosion control measures shall be installed to control erosion and prevent sediment laden water from exiting the site. This shall include, but not be limited to, the installation of temporary earthen berms, silt fences, filter curtains, riprap, drainage piping, catch basins, inlet protection and other items that are needed to control sediment.

C. Both temporary and final seeding is required. Should any areas outside of the project area remain inactive for a period of 8 days or more, it shall be seeded with a temporary or permanent vegetative cover such as oats, wheat or rye.

D. Construction operations shall be carried out in such a manner and sequence that erosion shall be minimized and held within acceptable limits. It is important that material excavated from this Project be contained.

3.2 INSPECTION AND MAINTENANCE SCHEDULE

A. The Project area shall be inspected no less than once per week, and after every rainfall event greater than 0.5" in 24 hours. Deficiencies and damages to the erosion control measures must be rectified within 24 hours.

B. An Inspection and Maintenance form or record log shall be kept by the Contractor.

C. The following Erosion Control Schedule shall be used for this Project:

CONTROL MEASURE	INSTALLATION SEQUENCE	INSPECTION AND MAINTENANCE
Construction Entrance	Prior to Clearing and Grading	Minimum of (-) Entrances shall be Provided
Silt Fence Perimeter Protection	Prior to Clearing and Grading	Weekly, after Storm Events and as Needed
Existing Inlet/Drain Pipe Protection	Prior to Clearing and Grading	Weekly, after Storm Events and as Needed
Tree Protection	Along with Rough Grading	Weekly, after Storm Events and as Needed
Temporary Seeding	After Rough Grading	Water as Needed
Permanent Seeding	After Finish Grading	Water as Needed
Erosion Control Matting (Blankets)	After Finish Grading	Weekly, after Storm Events and as Needed
Inlet Protection	After Each Inlet is Placed	Weekly, after Storm Events and as Needed
Soil Stabilization (Seeding)	After Finish Grading Around Finished Inlets	Water as Needed
Removal of Inlet Protection	After All Areas Draining to These Areas Are Stabilized	N/A
Removal of Perimeter Protection	After All Areas Draining to These Areas Are Stabilized	N/A

+ + END OF SECTION + +

SECTION 01 65 00

PRODUCT DELIVERY REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. This Section includes the General Requirements for preparing for shipping, delivering, and handling materials and equipment.
   2. Contractor shall make all arrangements for transporting, delivering, and handling of materials and equipment required for prosecution and completion of the Work.
   3. When required, move stored materials and equipment without additional compensation and without changes to the Contract Times.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 SUBMITTALS

A. Refer to individual Specification Sections for submittal requirements relative to delivering and handling materials and equipment.

1.4 PREPARING FOR SHIPMENT

A. When practical, factory-assemble materials and equipment. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable, protective coating.

B. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate the associated purchase order number, bill of lading number, contents by name, Owner's contact name and number, Contractor name, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Protect materials and equipment from exposure to the elements and keep thoroughly dry and dust-free at all times. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Lubricate bearings and other items requiring lubrication in accordance with manufacturer's instructions.

D. Do not ship materials and equipment until:
   1. Related Shop Drawings, Samples, and other submittals have been approved or accepted (as applicable) by Engineer, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.

2. Manufacturer's instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Engineer in accordance with the Specifications.
3. Results of source quality control testing (factory testing), when required by the Contract Documents for the associated materials or equipment, have been reviewed and accepted by Engineer.
4. Facilities required for handling materials and equipment in accordance with manufacturer's instructions are in place and available.
5. Required storage facilities have been provided.

1.5 DELIVERY

A. Scheduling and Timing of Deliveries:
   1. Arrange deliveries of materials and equipment in accordance with the accepted Progress Schedule and in ample time to facilitate inspection prior to installation.
   2. Schedule deliveries to minimize space required for and duration of storage of materials and equipment at the Site or delivery location, as applicable.
   3. Coordinate deliveries to avoid conflicting with the Work and conditions at Site, and to accommodate the following:
      a. Work of other contractors and Owner.
      b. Storage space limitations.
      c. Availability of equipment and personnel for handling materials and equipment.
      d. Owner's use of premises.
   4. Deliver materials and equipment to the Site during regular working hours.
   5. Deliver materials and equipment to avoid delaying the Work and the Project, including Work of other contractors, as applicable. Deliver anchor system materials, including anchor bolts to be embedded in concrete or masonry, in ample time to avoid delaying the Work

B. Deliveries:
   1. Shipments shall be delivered with Contractor's name, Subcontractor's name (if applicable), Site name, Project name, and Contract designation (example: "ABC Construction Co., City of Somewhere, Idaho, Wastewater Treatment Plant Primary Clarifier Improvements, Contract 25, General Construction") clearly marked.
   2. Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Engineer.
   3. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number.
   4. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner, and Contractor shall be responsible for the associated delays and additional costs, if incurred.

C. Containers and Marking:
   1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
   2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.

D. Inspection of Deliveries:
   1. Immediately upon delivery, inspect shipment to verify that:
      a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) submittals.
      b. Quantities are correct.
      c. Materials and equipment are undamaged.
      d. Containers and packages are intact and labels are legible.
      e. Materials and equipment are properly protected.
   2. Promptly remove damaged materials and equipment from the Site and expedite delivery of new, undamaged materials and equipment, and remedy incomplete or lost materials and equipment to furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
   3. Advise Engineer in writing when damaged, incomplete, or defective materials and equipment are delivered, and advise Engineer of the associated impact on the Progress Schedule.

1.6 HANDLING OF MATERIALS AND EQUIPMENT

A. Provide equipment and personnel necessary to handle materials and equipment, including those furnished by Owner, by methods that prevent soiling or damaging materials and equipment and packaging.

B. Provide additional protection during handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and surrounding surfaces. No onsite storage facilities will be available for use by the Contractor, unless otherwise noted.

C. Handle materials and equipment by methods that prevent bending and overstressing.

D. Lift heavy components only at designated lifting points.

E. Handle materials and equipment in safe manner and as recommended by the manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during handling. Hand-carry or use suitable handling equipment.

F. The Contractor shall not block or restrict the use of public right-of-way, access roads, or private property with stored materials.

G. The Contractor shall not store products where they interfere with operations of the Owner or other contractors.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section includes General Requirements for storing and protecting materials and equipment.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 STORAGE

A. Store and protect materials and equipment in accordance with manufacturer's recommendations and the Contract Documents.

B. Contractor shall make all arrangements and provisions necessary for, and pay all costs for, storing materials and equipment. Excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed to avoid damaging the Work and existing facilities and property, and so that free access is maintained at all times to all parts of the Work and to public utility installations in vicinity of the Work. Store materials and equipment neatly and compactly in locations that cause minimum inconvenience to Owner, other contractors, public travel, and owners, tenants, and occupants of adjoining property. Arrange storage in manner to provide easy access for inspection.

C. Areas available at the Site for storing materials and equipment shall be within the existing rights-of-way along project area roadways as shown or indicated in the Contract Documents, or as approved by Engineer.

D. Contractor shall be fully responsible for loss or damage (including theft) to stored materials and equipment.

E. Do not open manufacturer's containers until time of installation, unless recommended by the manufacturer, required to verify all contents or otherwise specified in the Contract Documents.

F. Do not store materials or equipment in structures being constructed unless approved by Engineer in writing.

G. Do not use lawns or other private property for storage without written permission of the owner or other person in possession or control of such premises. Prior to use, written permission must be submitted to Engineer for record purposes.

1.4 PROTECTION

A. Equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipping, handling, and storage, in accordance with Section 01 65 00, Product Delivery Requirements.

B. Store all materials and equipment off the ground or floor on raised supports such as skids or pallets.

C. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Painted equipment surfaces that are damaged or marred shall be repainted in their entirety in accordance with equipment manufacturer and paint manufacturer requirements, to the satisfaction of Engineer.

D. Protect electrical equipment, controls, and instrumentation against moisture, water damage, heat, cold, and dust. Space heaters provided in equipment shall be connected and operating at all times until equipment is placed in operation and permanently connected.

1.5 UNCOVERED STORAGE

A. The following types of materials may be stored outdoors without cover on supports so there is no contact with the ground:
   1. Reinforcing steel.
   2. Structural steel.
   3. Piping.
   4. Precast concrete materials.
   5. Castings.
   6. Handrails and railings.
   7. Grating.
   8. Metal access hatches.
   9. Rigid electrical conduit.
   10. Loose granular material.
   11. Others as directed by Owner.

1.6 COVERED STORAGE

A. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
   1. Rough lumber.
   2. Masonry units.
   3. Grout and mortar materials.
   4. Others as directed by Owner.

B. Tie down covers with rope, and slope covering to prevent accumulation of water.

1.7 FULLY PROTECTED STORAGE

A. Store all material and equipment not named in Articles 1.5 and 1.6 of this Section on supports in buildings or trailers that have concrete or wooden flooring, roof, and fully closed walls on

all sides. Covering with visquine plastic sheeting or similar material in space without floor, roof, and walls is not acceptable. Comply with the following:

1. Provide heated storage for materials and equipment that could be damaged by low temperatures or freezing.
2. Provide air-conditioned storage for materials and equipment that could be damaged by high temperatures.
3. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.
4. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

1.8 HAZARDOUS PRODUCTS

A. Prevent contamination of personnel, storage area, and the Site. Comply with Laws and Regulations and manufacturer's instructions.

1.9 MAINTENANCE OF STORAGE

A. On scheduled basis, periodically inspect stored materials and equipment to ensure that:
   1. State of storage facilities is adequate to provide required conditions.
   2. Required environmental conditions are maintained on continuing basis.
   3. Materials and equipment exposed to elements are not adversely affected.

B. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's instructions for servicing each item, with notice of enclosed instructions shown on exterior of container or package.
   1. Comply with manufacturer's instructions on scheduled basis.
   2. Space heaters that are part of electrical equipment, shall be connected and operated continuously until equipment is placed in service and permanently connected.

1.10 MICROPROCESSORS, PANELS, AND INSTRUMENTATION STORAGE

A. Microprocessor-based equipment, store panels, electronics, and other devices subject to damage or decreased useful life because of temperatures below 40 degrees F or above 100 degrees F, relative humidity above 90 percent, or exposure to rain or exposure to blowing dust in climate-controlled storage space.

B. Requirements:
   1. Storage location shall be provided by contractor and submitted to Owner and Engineer for approval prior to use. Owner and Engineer have the right to inspect materials and equipment during normal working hours.
   2. Placed inside each panel or device a desiccant, volatile corrosion inhibitor blocks (VCI), moisture indicator, and maximum-minimum indicating thermometer.
   3. Check panels and equipment at least once per month. Replace desiccant, VCI, and moisture indicator as often as required, or every six months, whichever occurs first.
   4. Certified record of daily maximum and minimum temperature and humidity in storage facility shall be available for inspection by Owner and Engineer. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of

desiccant, VCI, and moisture indicator, shall be available for inspection by Owner and Engineer.

C. Costs for storing climate-sensitive materials and equipment shall be paid by Contractor. Replace panels and devices damaged during storage, or for which storage temperatures or humidity range has been exceeded, at no additional cost to Owner. Delays resulting from such replacement are causes within Contractor's control.

D. Do not ship panels and equipment to the Site until conditions at the Site are suitable for installation, including slabs and floors, walls, roofs, and environmental controls. Failure to have the Site ready for installation shall not relieve Contractor from complying with the Contract Documents.

1.11 RECORDS

A. Keep up-to-date account of materials and equipment in storage to facilitate preparation of Applications for Payment, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 71 16.13

VIDEO DOCUMENTATION OF CONDITIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. Prior to the beginning of construction, Contractor shall create a video with audio sound, of the entire Project Site, and any off-site areas used for hauling, dumping, access, storage, etc. This video shall include all Right-of-Entry Sites.

B. A copy of the completed video(s) shall be submitted to the Owner prior to beginning of construction for the Owner's use during the Project. The discs shall remain available for viewing by the Contractor and Engineer and may be reviewed by the Contractor or Engineer at any time for assistance in resolving disputes that arise with property owners claiming improper restoration of their properties or damage to their properties during construction. The video(s) shall be used as a guide by the Owner and Engineer, prior to issuance of final payments, in determining the adequacy of restoration and/or determination of the extent of damages attributable to the Contractor's Work. The video(s) shall also be used by the Owner to address any complaints received by property owners during construction and after the completion of the Project.

C. Notify Owner or Engineer in writing at least 48 hours in advance of video activities.

D. If requested by Owner, conduct all documentation in the presence of Owner or Engineer.

E. The video shall become property of the Owner who shall maintain same for viewing by the Contractor for a period not to exceed 1 year after completion of the Project.

F. Coverage:
   1. The recording shall include coverage of all surface features located within construction zone-of-influence including, but not limited to:
      a. The area within the permanent and temporary easements and areas adjacent to these easements which may be affected by routine construction operations.
      b. The road right-of-way and areas adjacent to these right-of-ways which may be affected by routine construction operations.
      c. The areas directed by the Owner.
   2. The surface features within the construction zone shall include, but not be limited to, all roadways, pavements, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, buildings, landscaping, shrubbery and fences. Of particular concern shall be existence or non-existence of any faults, fractures, or defects.

1.2 MEASUREMENT AND PAYMENT

A. Video Documentation of Conditions

1. Work Item Number and Title
   01 71 16.13-A Video Documentation of Conditions
2. Payment under this item shall be on a lump sum basis. All requirements shall be met to receive full pre-construction video payment.
3. The lump sum price shall constitute full compensation for providing all labor, materials, and equipment, both temporary and permanent, and other cost associated with this item.

1.3 QUALITY ASSURANCE

A. Videographer Qualifications:
   1. Videographer shall have a minimum of 3 years' experience producing substantially similar video to that specified in this Section and shall be able to document, at Owner's request, at least 3 satisfactory clients by submitting client names and phone numbers.

1.4 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Pre-construction Video Documentation: Submit acceptable pre-construction video documentation prior to mobilizing to and disturbing the Site. However, neither the Engineer nor Owner assumes responsibility for the contents of the video. The Contractor shall be responsible for ensuring that the quality and contents of the video adequately show the Work area.
   2. Submit three copies of each video disc.

PART 2 PRODUCTS

2.1 VIDEO DOCUMENTATION

A. Videography:

   1. The camera shall be a high quality color unit.
   2. The video portion of the recording shall reproduce bright, sharp, clear pictures with accurate colors and shall be free from distortion, tearing, rolling, or any other form of imperfection.
   3. The video(s) shall be on provided in digital format. A video log shall accompany all videos providing a description of the area, street name, addresses recorded as well as date, time, and name of person or company recording the video.
   4. The video(s) shall be formatted with separate chapters for each section or Work area of the Project.
   5. The audio portion of the recording shall reproduce precise and concise explanatory notes by the camera operator with proper volume, clarity and freedom from distortions.
   6. The video(s) shall clearly show all physical features along the route and shall provide a complete record of the physical conditions of the entire Project before construction.

PART 3 EXECUTION

3.1 PRODUCTION

A. At the start of production and at the beginning of a new street or easement, an identification summary shall be read into the record while using a wide-angle view of the video to display numeric displays for visual record. This summary shall include:
   1. DVD Number.
   2. Job Title.
   3. Job Location.
   4. Positional location at start of job.
   5. Date and Time.
   6. Weather.
   7. Any other notable conditions.

B. Visibility:
   1. No recording shall be performed during periods of significant precipitation, mist or fog. The recording shall only be done when sufficient sunlight is present to properly illuminate the subjects of recording. No recording shall be performed when the ground area is covered with snow unless otherwise authorized by the Engineer or Owner.

C. Rate of Travel:
   1. The rate of travel of the vehicle used to perform the recording or the walking speed shall not exceed 48feet per minute. The rate of travel shall be indirectly proportional to the number, size, and value of the surface features within the construction area's zone-of-influence.

D. Reference Points
   1. When recording video, provide reference points to document video location. Acceptable reference points include, but is not limited to, property addresses or existing structure standard identification numbers.
   2. Reference points shall be included for rear lot easements and properties.

+ + END OF SECTION + +

SECTION 01 71 23

FIELD ENGINEERING

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall provide field engineering services and professional services of the types indicated for the Project, including:
   1. Furnishing civil, structural and other professional engineering services specified or required to execute Contractor's construction methods.
   2. Developing and making all detail surveys and measurements required for construction.
   3. Providing materials required for benchmarks, control points, batter boards, grade stakes, structure and pipeline elevation stakes, and other items.
   4. Keeping a transit, theodolite, or total station (theodolite with electronic distance measurement device); leveling instrument; and related implements such as survey rods and other measurement devices, at the Site at all times, and having a skilled instrument person available when necessary for laying out the Work.
   5. Being solely responsible for all locations, dimensions and levels. No data other than Change Order, Work Change Directive, or Field Order shall justify departure from dimensions and levels required by the Contract Documents.
   6. Rectifying all Work improperly installed because of not maintaining, not protecting, or removing without authorization established reference points, stakes, marks, and monuments.
   7. Providing such facilities and assistance necessary for Engineer to check lines and grade points placed by Contractor.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in bid item for construction engineering.

1.3 CONTRACTOR TO PROVIDE CONSTRUCTION PERSONNEL

A. Employ and retain at the Site a field engineer with experience and capability of performing all field engineering tasks required of Contractor, including:
   1. Preparing and maintaining daily reports of activity on the Work. Submit reports to Engineer including the following information, at minimum:
      a. Number of employees at the Site.
      b. Number employees at the Site for each Subcontractor.
      c. Breakdown of employees by trades.
      d. Major equipment and materials installed as part of the Work.
      e. Major construction equipment utilized.
      f. Location of areas in which construction was performed.
      g. Materials and equipment received.
      h. Work performed, including field quality control measures and testing.
      i. Weather conditions.

j. Safety.
k. Delays encountered, amount of delay incurred, and the reasons for the delay.
l. Instructions received from Engineer or Owner.

2. Submit two copies of Contractor’s daily reports at Engineer’s field office by 9:00 a.m. the next working day after the day covered in the associated report. Daily report shall be signed by responsible member of Contractor’s staff, such as Contractor's project manager or superintendent, or foreman designated by Contractor as having authority to sign daily reports.
3. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with the Contract Documents.
4. Maintain field office files and Drawings, record documents, and coordinate field engineering services with Subcontractors and Suppliers as appropriate. Prepare layout and coordination Drawings for construction operations.
5. Check and coordinate the Work for conflicts and interferences, and immediately advise Engineer and Resident Project Representative, if any, of all discrepancies of which Contractor is aware.
6. Cooperate as required with Engineer and Resident Project Representative, if any, in observing the Work and performing field inspections.
7. Review and coordinate the Work with Shop Drawings and Contractor's other submittals.

1.4 CONTRACTOR’S SURVEYOR

A. Employ or retain the services, as needed, at the Site a surveyor with experience and capability of performing surveying and layout tasks required in the Contract Documents and as required for the Work. Surveyor's tasks include, but are not necessarily limited to, the following:
   1. Providing required surveying equipment, including transit or theodolite, level, stakes, and surveying accessories.
   2. Establishing required lines and grades for constructing all facilities, structures, pipelines, and Site improvements.
   3. Preparing and maintaining professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the Work.
   4. Prior to backfilling operations, survey, locate, and record on a copy of the Contract Documents accurate representation of buried Work and Underground Facilities encountered.
   5. Complying with requirements of the Contract Documents relative to surveying and related Work.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Field Engineering:
      a. When requested by Engineer, submit documentation verifying accuracy of field engineering including but not limited to Contractor’s survey notes and field notes for Record Documents.

1.6 RECORDS

A. Maintain at the Site a complete and accurate log of control and survey Work as it progresses.

1. Survey data shall be in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in Indiana. Original field notes, computations, and other surveying data shall be recorded by Contractor's surveyor in Contractor-furnished hard-bound field books. Completeness and accuracy of survey Work, and completeness and accuracy of survey records, including field books, shall be responsibility of Contractor. Failure to organize and maintain survey records in an appropriate manner that allows reasonable and independent verification of calculations, and to allow identification of elevations, dimensions, and grades of the Work, shall be cause for rejecting the survey records, including field books.
2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SURVEYING

A. Reference Points:
   1. Refer the General Conditions, as may be modified by the Supplementary Conditions, regarding reference points.
   2. The Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction related activities. Any disturbed monuments must be replaced by an Indiana Registered Land Surveyor, and approved by the Engineer, at the Contractor's expense.
   3. From Owner-established reference points, establish lines, grades, and elevations necessary to control the Work. Obtain measurements required for executing the Work to tolerances specified in the Contract Documents.
   4. Establish, place, and replace as required, such additional stakes, markers, and other reference points necessary for control, intermediate checks, and guidance of construction operations.

B. Surveys to Determine Quantities for Payment:
   1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of Work performed or placed. Perform surveys necessary for Engineer to determine final quantities of Work in place.
   2. Notify Engineer at least 24 hours before performing survey services for determining quantities. Unless waived in writing by Engineer, perform quantity surveys in presence of Engineer.

C. Construction Surveying: Comply with the following:
   1. Alignment Staking: Provide alignment stakes at 50-foot intervals on tangent, and at 25-foot intervals on curves.

2. Slope Staking: Provide slope staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Re-stake at every ten-foot difference in elevation.
3. Structure: Stake out structures, including elevations, and check prior to and during construction.
4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
5. Road: Stake out roadway elevations at 50-foot intervals on tangent, and at 25-foot intervals on curves.
6. Cross-sections: Provide original, intermediate, and final staking as required, for Site Work other locations as necessary for quantity surveys.
7. Easement Staking: Provide easement staking at 50-foot intervals on tangent, and at 25-foot intervals on curves. Also provide wooden laths with flagging at 100-foot maximum intervals.
8. Record Staking: Provide permanent stake at each blind flange and each utility cap is provided for future connections. Stakes for record staking shall be material acceptable to Engineer.

D. Accuracy:
1. Establish Contractor's temporary survey references points for Contractor's use to at least second-order accuracy (e.g., 1:10000). Construction staking used as a guide for the Work shall be set at least third-order accuracy (e.g., 1:5000). Basis on which such orders are established shall provide the absolute margin for error specified below.
2. Horizontal accuracy of easement staking shall be plus or minus 0.1 feet. Accuracy of other staking shall be plus or minus 0.04 feet horizontally and plus or minus 0.02 feet vertically.
3. Survey calculations shall include an error analysis sufficient to demonstrate required accuracy.

+ + END OF SECTION + +

SECTION 01 71 33

PROTECTION OF THE WORK AND PROPERTY

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall be responsible for taking all precautions, providing all programs, and taking all actions necessary to protect the Work and all public and private property and facilities from damage, as specified in the General Conditions and this Section.

B. To prevent damage, injury, or loss, Contractor's actions shall include the following:
   1. Storing apparatus, materials, supplies, and equipment in an orderly, safe manner that will not unduly interfere with progress of the Work or Work of other contractors or utility company.
   2. Providing suitable storage facilities for materials subject to injury by exposure to weather, theft, breakage, or otherwise.
   3. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work.
   4. Frequently cleaning up refuse, rubbish, scrap materials, and debris caused by Contractor's operations so that, at all times, the Site is safe and orderly, and workmanlike in appearance.
   5. Providing barricades and guard rails around the following: openings, scaffolding, temporary stairs and ramps, around excavations, elevated walkways, and other hazardous areas.

C. Do not, except after written consent from proper parties, enter or occupy privately-owned land with personnel, tools, materials or equipment, except on lands and easements provided by Owner.

D. Contractor has full responsibility for preserving public and private property and facilities on and adjacent to the Site. Direct or indirect damage done by, or on account of, any act, omission, neglect, or misconduct by Contractor in executing the Work, shall be restored by Contractor, at his expense to condition equal to that existing before damage was done.

E. The Contractor is responsible for the restoration of all property corners and control monuments damaged or destroyed by construction related activities. Any disturbed monuments must be replaced by an Indiana Professional Land Surveyor, and approved by the Engineer, at the Contractor's expense.

1.2 MEASUREMENT AND PAYMENT

A. This item shall be included in overall Project cost and not bid as a separate Work item.

1.3 BARRICADES AND WARNING SIGNALS

A. Barricades and Warning Signals – General:

1. Where Work is performed on or adjacent to roadway, access road, right-of-way, or public place, Contractor shall provide barricades, fences, lights, warning signs, danger signals, watchmen, and take other precautionary measures for protecting persons, property, and the Work.
2. Contractor shall paint barricades to be visible at night.
3. From sunset to sunrise, Contractor shall furnish and maintain at least one light at each barricade.
4. Contractor shall erect sufficient barricades to keep vehicles from being driven on or into Work under construction.
5. Contractor shall furnish watchmen as required to protect the Work.
6. Contractor's responsibility for maintaining barricades, signs, lights, and for providing watchmen shall continue until the Work is accepted, by the Owner, in accordance with the General Conditions.

B. Temporary Fencing. Contractor shall provide and maintain temporary security fencing to protect Work if required.

1.4 TREE AND PLANT PROTECTION

A. Tree and Plant Protection – General:
1. Contractor shall protect existing trees, shrubs, and plants on or adjacent to the Site, shown or designated to remain in place, against unnecessary cutting, breaking, or skinning of trunk, branches, bark, or roots.
2. Do not store materials or park equipment within the drip line.
3. In areas subject to traffic, Contractor shall provide temporary fencing or barricades to protect trees and plants.
4. Fires are not allowed.
5. Within the limits of the Work, Contractor shall water trees and plants that are to remain to maintain their health during construction operations.
6. Cover all exposed roots with burlap, which shall be kept continuously wet. Cover exposed roots with earth as soon as possible. Protect root systems from mechanical damage and damage by erosion, flooding, runoff, or noxious materials in solution.
7. If branches or trunks are damaged, prune branches immediately and protect cut or damaged areas with emulsified asphalt compound specifically for horticultural use in manner acceptable to Engineer.
8. Trees that may be damaged during construction shall be trimmed before construction commences. This includes private trees that overhang the public right-of-way. All cuts shall be in accordance with the standards of National Arborist Association.
9. Trenching must be no closer than having the inside wall of the trench six feet (6') from the trunk of trees, 15 inches (15") in diameter and larger. On trees 15 inches (15") and smaller, the inside wall of the trench must be no closer than three feet (3'). When trenching is to be done closer than said restrictions, the trees and stumps should be removed by a competent tree specialist who holds an adequate certificate of insurance. Trees removed shall be removed completely, including stump and major roots, and disposed of properly by the Contractor off-site.
10. All trees and shrubs located within the permanent and temporary easements that are removed to facilitate construction shall not be replaced unless otherwise noted on the Contract Drawings.

11. Coordinate Work in this Article with Section 31 11 00, Clearing and Grubbing.

1.5 PROTECTION OF EXISTING STRUCTURES

A. Underground Facilities:
   1. Underground Facilities are defined in the General Conditions.
   2. All Underground Facilities known to Owner and Engineer, except water, gas, sewer, electric, and communications services to individual buildings and properties, are shown. This information is the best available to Owner and Engineer but, in accordance with the General Conditions, is not guaranteed to be correct or complete.
   3. Contractor shall explore ahead of trenching and excavation Work and shall uncover obstructing Underground Facilities sufficiently to determine their location, to prevent damage to Underground Facilities, and to prevent service interruption to building or parcels served by Underground Facilities. If Contractor damages an Underground Facility, Contractor shall restore it to original condition, in accordance with requirements of the owner of the damaged facility and the General Conditions.
   4. Necessary changes in the location of the Work may be directed by Owner or Engineer to avoid Underground Facilities not shown or indicated on the Contract Documents.
   5. If permanent relocation of an existing Underground Facilities is required and is not otherwise shown or indicated in the Contract Documents, Contractor will be directed in writing to perform the Work. When the relocation Work results in a change in the Contract Price, Contract Time, or both, the relocation Work shall be paid after execution of associated Change Order, in accordance with the Contract Documents.

B. Surface Structures:
   1. Surface structures are existing buildings, structures, and other facilities at or above ground surface, including their foundations or any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage, exposed piping and utilities, poles, exposed wires, posts, signs, markers, curbs, walks, and other facilities visible at or above ground surface.
   2. Existing surface facilities, including but not limited to guard rails, posts, guard cables, signs, poles, markers, and curbs that are temporarily removed to facilitate the Work shall be replaced and restored to their original condition at Contractor's expense.

C. Protection of Underground Facilities and Surface Structures:
   1. Contractor shall sustain in their places and protect from direct or indirect injury all Underground Facilities and surface structures located within or adjacent to the limits of the Work. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility. Before proceeding with the Work of sustaining and supporting such structure or facility, Contractor shall satisfy Engineer that methods and procedures to be used have been approved by party owning same.
   2. Contractor shall bear all risks attending the presence or proximity of all Underground Facilities and surface structures within or adjacent to limits of the Work, in accordance with the Contract Documents. Contractor shall be responsible for damage and expense for direct or indirect injury caused by his Work to structures and facilities. Contractor shall repair immediately damage caused by his Work, to the satisfaction of owner of damaged structure or facility.

1.6 PROTECTION OF INSTALLED PRODUCTS AND LANDSCAPING

A. Protect installed products to prevent damage from subsequent operations. Remove protection facilities when no longer needed prior to completion of Work.

B. Control traffic to prevent damage to equipment, materials, and surfaces.

C. Coverings:
   1. Provide coverings to protect equipment and materials from damage.
   2. Cover projections, wall corners and jambs, sills, and soffits of openings, in areas used for traffic and for passage of products in subsequent Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 75 11

CHECKOUT AND STARTUP PROCEDURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall coordinate initial start-up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.
   2. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.
   3. Provide chemicals, lubricants, and other operating fluids required for start-up of equipment, unless otherwise specified.
   4. Provide fuel, electricity, water, filters, and other expendables required for start-up of equipment, unless otherwise specified.
   5. General Activities Include:
      a. Cleaning, as required under other provisions of the Contract Documents.
      b. Removing temporary protective coatings.
      c. Flushing and replacing lubricants, where required by manufacturer.
      d. Lubrication.
      e. Checking shaft and coupling alignments and resetting where required.
      f. Checking and setting motor, pump, and other equipment rotation, safety interlocks, and belt tensions.
      g. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.
      h. All adjustments required.

B. Coordination:
   1. Coordinate checkout and start-up with Owner, other Contractors and Subcontractors, as necessary.
   2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
   3. Owner will provide sufficient personnel to observe during equipment start up, but Contractor shall be responsible for proper operation.
   4. Supplier shall be present during checkout, start-up, and initial operation, unless otherwise acceptable to Owner or Engineer.
   5. Startup of heating and air conditioning equipment and systems is dependent upon the time of the year. Return to the Site at beginning of next heating or air conditioning season (as applicable) to recheck and start the appropriate systems.
   6. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals, in accordance with Section 01 78 23, Operations and Maintenance Data.

7. Do not start up system, unit process, or equipment until checkout and startup documentation has been submitted and approved by Owner or Engineer.

C. Owner's Assumption of Operational Responsibility for Equipment and Systems:
   1. Owner will assume operational responsibility for equipment and systems upon acceptance of Substantial Completion.
   2. Prior to turning over system or equipment operation and maintenance responsibility to Owner, Contractor shall:
      a. Provide training of operations and maintenance personnel in accordance with equipment technical specifications. Review equipment sections for applicable material.
      b. Complete system field quality control testing in accordance with the Contract Documents.
      c. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
      d. Obtain final certificate of Substantial Completion for the entire Work or the portion of Work being turned over to Owner.
      e. Transfer all keys and locks for the facility to the Owner.

1.2 RELATED SECTIONS

A. Section 33 32 19.

1.3 MEASUREMENT AND PAYMENT

A. This item is to be included in overall project cost and not bid as a separate work item.

1.4 DEFINITIONS

A. Checkout: Field inspection, testing, adjustments, and sign off by the approved representative of the manufacturer, indicating that the component, system, or unit process meets the manufacture's requirements.

B. Commissioning: Systematic process of ensuring systems perform interactively according to design intent and Owner's operational needs. Commissioning process encompasses and coordinates system documentation, equipment startup, instrumentation and control system calibration, testing and balancing, performance testing and training, and verification of actual performance.

C. Person-Day: One person for 8 hours within regular Contractor working hours.

D. Start-up: Placing a component, system or unit process in operation. Start-up can be a commissioning activity or a normal operating activity.

1.5 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment,

subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual technical specification section(s).

B. Representative subject to acceptance by Owner and Engineer

See Section 33 32 19.

1.6 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Prior to request for certificate of Substantial Completion of the Work or, specified part thereof, submit the following checkout and startup documents:
      a. Commissioning Submittals: Submit the following for each piece of operating equipment.
         1) Site/Structural/Mechanical Checklist
         2) Pump Manufacturer's Start Up Report
         3) Lift Station Electrical Inspection Field Documentation
         4) I&C Point to Point Checklist
         5) Start-Up Logs
         6) Test Reports
         7) Manufacturers Certificates
   2. Provide an electronic scan of the completed check out and start-up documents in a portable electronic document (PDF), or similar format.
   3. Scanned documents shall be clear and legible.
   4. Submit in accordance with Section 01 33 00, Submittal Procedures.
   5. Use templates for certification and checklists provided at the end of this specification Section, as required.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 FULFILLMENT OF SPECIFIED SERVICES

A. Furnish manufacturer's services, when required by an individual technical specification section(s), to meet the requirements of this section.
   1. Manufacturer's services shall be provided as required, regardless of any minimum time specified, until operation of the equipment is satisfactory to Owner, at no additional cost to Owner.

B. Contractor to prepare the commissioning plan for the project.
   1. Coordinate meetings for the purposes of completing the commissioning plan.
   2. Attendance and participation of the following groups at commissioning meetings are required.
      a. Engineer's project representatives

b. Owner's project representatives
c. Subcontractors
d. Installers
e. Programmers
f. Suppliers
g. Manufacturer's representatives as necessary.
h. Owner's maintenance crew personnel.
i. Owner's operations crew personnel.

3. Submit dates of startup of each item of equipment and system for review seven days prior to startup.
4. Re-submit anticipated startup dates as revised but not less than two weeks prior to startup.
5. Prefunctional Checklists, functional tests and systems demonstrations are to be performed in sequence from components, to subsystems, to systems.
   a. Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
   b. No sampling of identical or near identical item is allowed.
   c. These checklists do not replace manufacturer's recommended startup checklists, regardless of apparent redundancy.

C. Schedule manufacturer's services in coordination with Owner or Engineer to avoid conflict with other onsite testing or other manufacturer's onsite services.

D. Determine, before scheduling services, that conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill specified minimum services.

F. When not otherwise specified in individual technical specification sections, manufacturer's onsite services shall include:
   1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
   2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary Manufacturer's Certificate of Installation.
   3. Providing, on a daily basis, copies of manufacturer's representatives field notes and data to Engineer.
   4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
   5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
   6. Assistance during functional and performance testing, and facility startup and evaluation.

G. Training of Owner's personnel in the operation and maintenance of respective product as required.

3.2 MINIMUM START-UP REQUIREMENTS

A. General
   1. Start-up Logs, Test Reports, and Manufacturer's Certifications are to be filled out during system and equipment start-up.
      a. Start-up logs shall clearly demonstrate equipment is in conformance with the Contract Documents and assist maintenance personnel in servicing and adjusting equipment.
      b. Test reports shall be in accordance with testing standards and performed by a reliable independent testing laboratory or agency.
      c. Manufacturer's certificate of installation shall be submitted for products ,

B. Bearings and Shafting:
   1. Inspect for cleanliness, and clean and remove foreign matter.
   2. Verify alignment.
   3. Replace defective bearings and those that operate rough or noisy.
   4. Grease as necessary, in accordance with manufacturer's recommendations.

C. Motors:
   1. Check each motor for comparison to amperage nameplate value.
   2. Correct conditions that produce excessive current flow and conditions that exist due to equipment malfunction.

D. Pumps:
   1. Check glands and seals for cleanliness and adjustment before running pump.
   2. Inspect shaft sleeves for scoring.
   3. Inspect mechanical faces, chambers, and seal rings, and replace if defective.
   4. Verify that piping system is free of dirt and scale before circulating liquid through pump.

E. Valves:
   1. Inspect manual and automatic control valves, and clean bonnets and stems.
   2. Tighten packing glands to ensure no leakage, but allow valve stems to operate without galling.
   3. Replace packing in valves to retain maximum adjustment after system is determined to be complete.
   4. Replace packing on valves that continue to leak.
   5. Remove and repair bonnets that leak.
   6. After cleaning, coat packing gland threads and valve stems with appropriate surface preparation.

F. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

G. Tighten flanges and other pipe joints after system has been placed in operation. Replace gaskets that show signs of leakage after tightening.

H. Inspect all joints for leakage:

1. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.
2. Clean threads on both parts, and apply compound and remake joints.

I. After system has been placed in operation, clean strainers, drives, pockets, orifices, valve seats, and headers in fluid system to ensure freedom from foreign matter.

J. Open steam traps and air vents, where used, and remove operating elements. Clean thoroughly, replace internal parts, and place back into operation.

K. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

L. Set and calibrate draft gauges of air filters and other equipment.

M. Inspect fan wheels for clearance and balance. Provide factory-authorized personnel for adjustment when needed.

N. Check each electrical control circuit to verify that operation complies with the Contract Documents.

O. Inspect each pressure gauge, thermometer, and other instruments for calibration. Replace items that are defaced, broken, or that read incorrectly.

P. Repair damaged insulation.

Q. Excess Gasses and Fluids:
1. Vent gasses trapped in systems.
2. Verify that liquids are drained from all parts of gas or air systems.

3.3 ELECTRICAL SYSTEM STARTUP SERVICES

A. Tests and inspections shall establish:
1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energizing.

B. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

D. Set, test and calibrate protective relays, circuit breakers, fuses, power monitoring meters and other applicable devices in accordance with values established by short circuit, coordination, and harmonics studies as specified.

E. Adjust mechanisms and moving parts of equipment for free mechanical movement.

F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

G. Verify nameplate data for conformance to Contract Documents and approved submittals.

H. Realign equipment not properly aligned and correct discrepancies.

I. Properly anchor electrical equipment found to be inadequately anchored.

J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

L. Provide proper lubrication of applicable moving parts.

M. Electrical Enclosures:
   1. Remove foreign material and moisture from enclosure interior.
   2. Vacuum and wipe clean enclosure interior.
   3. Remove corrosion found on metal surfaces.
   4. Repair or replace, as determined by Engineer door and panel sections having dented surfaces.
   5. Repair or replace, as determined by Engineer, poor fitting doors and panel sections.
   6. Repair or replace improperly operating latching, locking, or interlocking devices.
   7. Replace missing or damaged hardware.
   8. Finish:
      a. Provide matching paint and touch up scratches and mars.
      b. If required due to extensive damage, as determined by Engineer, refinish entire assembly.

N. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved submittals.

3.4 ATTACHMENTS

A. Site/Structural/Mechanical Checklist

B. Pump Manufacturer's Start Up Report

C. Lift Station Electrical Inspection Field Documentation

D. I&C Point to Point Checklist

E. Commissioning Plan Template

+ + END OF SECTION + +

CERTIFICATE OF INSTALLATION SERVICES

Project	
Equipment	
Specification Section	
Contract	

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, functionally tested, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature	Date
Name (print)	
Title	
Representing	

CONTRACTOR

Signature	Date
Name (print)	
Title	

Comments:

This form shall be completed and submitted to ENGINEER prior to training of Owner's personnel in accordance with Section 01 79 23.

SPARE PARTS TRANSFER FORM

DATE: _____

PROJECT: _____ PROJECT NO: _____

CONTRACTOR: _____

	Spec No.	Quantity	Part No.	Manufacturer & Item Description
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				

Delivered By: _____ _____
CONTRACTOR Date

Witnessed By: _____ _____
ENGINEER Date

The above-listed spare parts have been inspected and inventoried and are hereby accepted, subject to all Contract Provisions, by the OWNER.

Received By: _____ _____
OWNER Representative Date

Copy
Original -
Second -
Third – Owner

Distribution
ENGINEER
CONTRACTOR

Project Name: _____ **Project No.:**_____		**Contractor Name:** _____ **Date:**_____

SITE, STRUCTURAL, & MECHANICAL FACILITY CHECK LIST

Completion Date	SITE
	Fence, gate, lock as specified
	Paving as specified, no birdbaths
	Storm drain grates clean and open
	Site graded to prevent ponding and flooding
	All grass areas growing and as specified; ____ inches of topsoil as required
	All shrubbery alive and as specified
	Fire hydrant as specified and operating, if applicable
	Stone provided over vinyl cloth weed barrier as specified
	HATCHES
	As specified in submittal review
	Bituminous coating on frame areas in contact with concrete
	Automatic hold open devices working
	Slam latch with removable key, spare keys furnished
	Flush handle

Completion Date	WET WELL LANDING
	Aluminum grating (section to be easily removable) and aluminum supports (bituminous coating in contact with concrete)
	All connection and anchors stainless steel fasteners
	Bar rack, removable debris basket and rake assembly as specified
	WET WELL
	_____Diameter precast concrete as specified
	Exterior coating in place per specification
	Joints sealed/good workmanship
	No infiltration or inflow observed
	Explosion proof lights with heavy duty guards
	Interior epoxy coating per specification
	Check electrical connection for adequacy for seals for location and gas tightness
	Multitrode
	Soil odor filter if specified
	Remove rebar used for setting wet well, if applicable

Completion Date	VALVE VAULT
	Pump around connections and valving as specified
	Couplings with dust plugs on brass chain in place
	Sump pits with floor sloped to drain (test with water)
	Exercise all valves from full open to full closed (control flow to prevent spills)
	Valve operator extensions in roadway boxes within one foot of grade and aligned with boxes
	PUMP
	Pump service record card completed
	Manufacturer's certifications at site
	Factory certification that pumps will perform satisfactorily at each design condition
	Pressure gauges as specified
	Packing and/or mechanical seals as specified
	Pump tags provided
	PUMP MOTORS
	_____Phase, _____Cycle, _____Volts
	_____Efficiency, _____Power factor at full load
	Vertical squirrel cage, cast iron body
	Class _____ insulation
	_____Service factor
	Starters balance with capacitors to give _____power factor
	Certification of factory test
	Check amp draw: Pump #1_____ Pump #2_____
	Check operating conditions (meet design conditions)

Completion Date	SUBMERSIBLE PUMPS
	Pull and reset each pump
	Check guide rails and pump connection seats
	Check electrical connections for adequacy and seals for gas tightness
	Check amp draw: Pump #1_____ Pump #2_____
	SPARE PARTS
	Number required – attach required form and have appropriate signatures
	Condition/preservation
	Released to Owner
	OPERATOR TRAINING
	Tour and familiarization
	Pumps and motors
	Odor control system
	Motor control centers
	PIPING
	Remove temporary pipe plugs
	Return City provided water meter if applicable

Completion Date	GENERAL
	Check safety equipment, safety climbing devices, rotating equipment guards, grounding system
	Check heater operations
	Check that pumps alternate lead/lag.
	Check operating condition of pumps at shut-off head
	Check Q vs. TDH for each pump: Q TDH Pump #1 ____ ____ Pump #2 ____ ____
	Check pump controls to insure H/O/A modes
	Check alarm signals
	Simulate power failure
	Check generator operation
	Operate both pumps simultaneously through total cycle ____volts ____amps
	Lighting available
	Alarm signal to panel
	Remove and cap temporary utilities
	O&M MANUALS
	____Hard copies delivered
	____Electronic copies delivered
	RECORD DRAWINGS
	____Copies delivered
	TESTING/ACCEPTANCE
	Testing/acceptance as per specifications
	Remove locks or lockout/tagout equipment

	PUMP MANUFACTURER'S START UP REPORT			
Project Name:			Project No.:	
Pump Station I.D.:			Date:	
Pump No. 1 Serial No.:			Impellor:	
Pump No. 2 Serial No.:			Impellor:	
Horse Power:			RPM:	
Voltage/Cycles/Phases:		Volts	Cycles	Phase
	PUMP NO. 1		**PUMP NO. 2**	
MEG Ohm Check				
Red – Black:		Ohms		Ohms
Red – White:		Ohms		Ohms
White – Black:		Ohms		Ohms
Moisture Sensor:		Ohms		Ohms
Voltage, Pump "Off"				
L1 – L2:		V		V
L2 – L3:		V		V
L3 – L1:		V		V
Voltage, Pump "On"				
L1 – L2:		V		V
L2 – L3:		V		V
L3 – L1:		V		V
Amperage				
L1		Amps		Amps
L2		Amps		Amps
L3		Amps		Amps
Flow		gpm		gpm
TDH		FT		FT
Shut-off Head		FT		FT
**Attach pump curve with design and operating conditions showing pump manufacturer:				
Pump Manufacturer:				
Authorized Manufacturer's Representative's Signature:		**Date:**		

I. Lift Station General Information:

Lift Station: _____ **Date (Site Visit): _____**

Location/Address: _____ **Inspected by (Engineer Representative):_____**

Inspected by (Onwer Representative):_____

A. Pump General Information:

Number of Pumps: _____ **Type: _____**

Horse Power (HP): _____ **Pump Manufacture: _____** **Model #: _____**

Date of Installation: _____

B. Electrical General Information:

Voltage: _____ V Current: _____ A Phase: _____ ϕ (if 1 ϕ fill out VFD info, otherwise disregard).

Back-up Power: No **(or)** Yes (dual feed, standby generator, and receptacle)

1) Station Load (Calculated & Actual)

Station Max KW (Calculated): _____ KW Station 80% Loaded KW (Calculated): _____ KW

(Based on Voltage at station and Discount (MTS) size)

2) Actual LS Current Reading: _____ A *(Station FLA)*

Station Max KW (Actual): _____ KW Station 80% Loaded KW (Actual): _____ KW

3) Control Panel FLA: _____ A *(As indicated on documentation-drawings at station)*

Station Max KW (Designed): _____ KW Station 80% Loaded KW (Designed): _____ KW

C. Electrical Utility General Information:

1) **Electric Utility Provider: _____**
2) **Meter Number: _____ Account Number: _____**
3) **Service: Overhead (or) Underground**
4) **Pole Number: _____** *(Provide pole numbers if applicable.)*
5) **Account Rep Contact Information**
   a. **Name: _____**
   b. **Phone Number: (office) _____ (cell) _____**
   c. **Email Address: _____**

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

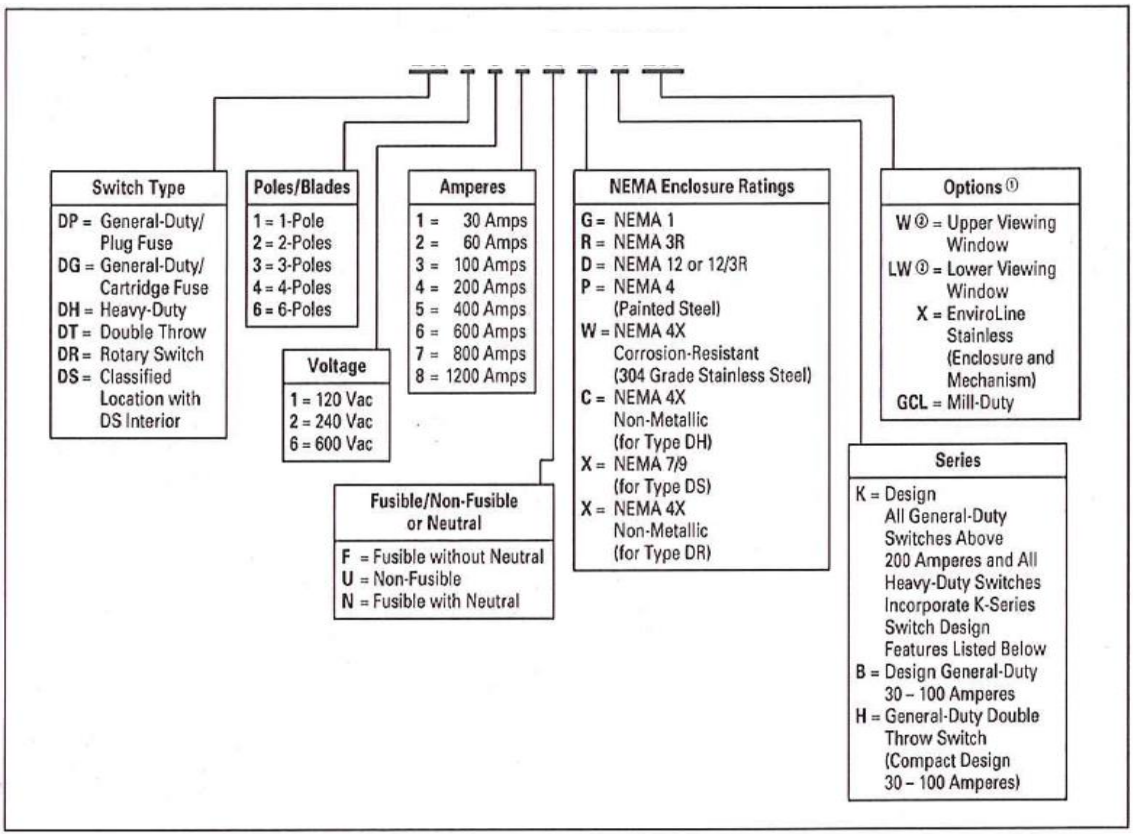
II. Lift Station Electrical Equipment:

A. (MTS) or Disconnect Information:

1. Manufacture: _____

(Use Table 1 Guide Below to Identify Safety Switch Type – Characteristics)

Table 1: Product Selection Guide



B. Pump Control Panel:

1. General Information

i. Panel Manufacture: _____

ii. Project Number: _____

iii. Drawing Number: _____

iv. **Line Voltage: _____ V Coil Voltage: _____ A Phase: _____ ϕ 60 Hz**

v. **Panel HP: _____ Panel FLP: _____**

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

2. **Documentation**
    i. **Laminated Electrical Drawings inside cabinet: Yes (or) No**
        1. **Updated (notes)**: _____
3. **Circuit Breaker**

Table 2
Circuit Breaker Information

Amp	Serves	Manufacture	Voltage

4. **Equipment**
    i. **Pump Controller**
        1. **Controller: MultiSmart MultiTrode Other**
            a. Manufacture: _____
            b. Serial #: __ __ __ __ __ __ __
            c. Build Version #: __ . __ . __
            d. Serial #: _____
            e. SITE CODE # **__ __: __ __: __ __: __ __: __ __:__ __**
            f. SITE KEY: (32 digits) __
        2. **Features:**
            a. Motor Protection ___ DNP3 ___ Modbus ___ Flow ___ PumpView ___ VFD ___ RTU ___
            b. Other Features: _____

Lift Station: _____ **Date (Site Visit): _____**

Location/Address: _____

ii. **Motor Starter**

Table 3
Motor Starter Information

Pump #	Manufacture	Size	Pole	Cat.	Style (AC/DC)	Model
1						
2						
3						
4						

iii. **Controller Transformer**

1. **_____kVA; _____Hz; _____UL**
2. **Manufacture: _____**

iv. **Flygt Mini-CAS**

1. **Part #: _____**

v. **Battery Charger**

2. _____V
3. **Manufacture: _____**

III. <u>Telemetry</u>

A. General Information:

1. **___Yes ___No**
2. **Radio Type: _____ Model #: _____**
   i. **MultiSmart RTU: ___Yes ___No**
   ii. **Zetron: ___Yes ___No**
      a. Part #: _____
      b. Model #: _____
      c. Serial #: _____

B. Radio Configuration Route Numbers and Tower Locations (repeater site)

i. Tower (Repeater Site): _____

ii. Route Number: _____

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

IV. Other Electrical Station Equipment (Specialized):

A. VFD (Variable Frequency Drive): ___Yes ___No {Purpose: Phase Conversion Only}

1. General Information:

i. Manufacture: _____

ii. Part #: _____

iii. Serial #: _____

iv. Model #: _____

v. Purpose: Phase Conversion Only

(Use Table 4 Guide Below to Identify VFD Type – Characteristics)

Table 4: VFD Product Selection Guide

20A

Drive	Voltage Rating	Rating	Enclosure	HIM (1)	Documentation (2)	Brake IGBT	Brake Resistor	Emission Class	Comm Slot	Control & I/O (3)	Feedback

Code	Type
20A	70

Code	Voltage	Ph.
B	240V AC	3
C	400V AC	3
D	480V AC	3
E	600V AC	3

Code	Type
A	English Manual
P	Portuguese Manual
S	Spanish Manual
N	No Manual

Code	w/Brake Resistor
Y	Yes
N	No

Code	w/Brake IGBT
Y	Yes

Code	version
C	ControlNet (Coax)
D	DeviceNet
E	EtherNet/IP
H	RS485 HVAC
R	RIO
S	RS485 DF-1
N	N/A

Code	Interface Module
0	Blank HIM
2	Digital LCD HIM
3	Full Numeric LCD HIM
4	Analog LCD HIM
5	Prog. Only LCD HIM

Code	Rating
A	Filtered (Excluding 600V AC)
	A(4) & B Frames (Optional)
	C & D Frames (Standard)
N	Not Filtered
	A & B Frames (Optional)
	C & D Frames NA (600V AC only)

Codes	Control	Safety I/O	Feedback
C0	Enhanced	None	None
G0	Enhanced	24V DC/AC	None

Code	Enclosure
A	Panel Mount - IP 20, NEMA Type 1
C	Wall/Machine Mount = IP66, NEMA 4X/12 (Indoor Use)
F	Flange Mount - Front = IP 20, NEMA Type 1; Heatsink = IP66, NEMA Type 4X/12
G	Wall/Machine Mount = IP54, NEMA Type 12

(1) IP66, NEMA 4X/12 (Code C) is available only with HIM codes 0, 3, or 5.
(2) All drives ship with multilingual Quick Starts.
(3) Frame E ratings are only available with Enhanced Control.
(4) Increases A Frame size to B.

Output Current @ 600V 60Hz Input			Output Current @ 480V 60Hz Input			Output Current @ 400V 50Hz Input			Output Current @ 240V 60Hz Input			Output Current @ 208V 60Hz Input		
Code	Amps	kW (HP)	Code	Amps	kW (HP)	Code	Amps	kW (HP)	Code	Amps	kW (HP)	Code	Amps	kW (HP)
0P9	0.9	0.37 (0.5)	1P1	1.1	0.37 (0.5)	1P3	1.3	0.37 (0.5)	2P2	2.2	0.37 (0.5)	2P2	2.5	0.37 (0.5)
1P7	1.7	0.75 (1.0)	2P1	2.1	0.75 (1.0)	2P1	2.1	0.75 (1.0)	4P2	4.2	0.75 (1.0)	4P2	4.8	0.75 (1.0)
2P7	2.7	1.5 (2.0)	3P4	3.4	1.5 (2.0)	3P5	3.5	1.5 (2.0)	6P8	6.8	1.5 (2.0)	6P8	7.8	1.5 (2.0)
3P9	3.9	2.2 (3.0)	5P0	5.0	2.2 (3.0)	5P0	5.0	2.2 (3.0)	9P6	9.6	2.2 (3.0)	9P6	11	2.2 (3.0)
6P1	6.1	4.0 (5.0)	8P0	8.0	3.7 (5.0)	8P7	8.7	4.0 (5.0)	015	15.3	4.0 (5.0)	015	17.5	4.0 (5.0)
9P0	9.0	5.5 (7.5)	011	11	5.5 (7.5)	011	11.5	5.5 (7.5)	022	22	5.5 (7.5)	022	25.3	5.5 (7.5)
011	11	7.5 (10)	014	14	7.5 (10)	015	15.4	7.5 (10)	028	28	7.5 (10)	028	32.2	7.5 (10)
017	17	11 (15)	022	22	11 (15)	022	22	11 (15)						
022	22	15 (20)	027	27	15 (20)	030	30	15 (20)						
			034	34	18.5 (25)	037	37	18.5 (25)						
			040	40	22 (30)	043	43	22 (30)						
			052	52	30 (40)	060	60	30 (40)						
			065	65	37 (50)	072	72	37 (50)						

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

B. Cooling Unit ___Yes ___No {Enclosures where pump control and VFD combined}

1. Manufacture: _____

(Use Table 5 Guide Below to Identify Cooling Unit Type – Characteristics)

Table 5
IceQube Information

Product #	BTU/HR	Volts/Hz	Max Amps	Max Temp	Weight	Dimensions
1						

C. Soft Start: ___Yes ___No {Purpose: Phase Conversion Only}

1. Manufacture: _____

2. Part #: _____

3. Serial #: _____

4. Model #: _____

V. Back-up Power

A. Dual Feed – Electric Utility Substation Information

1) Fed from: Sub Station #1: _____ Sub Station #2: _____

B. Standby Generator

1) Manufacture: _____ Generator Size: _____ KW

i. Fuel Type: Natural Gas or Diesel Service Provider (Company): _____

ii. Meter #: _____ Account # _____

2) Automatic Transfer Switch

i. Manufacture: _____

ii. Part Number: _____

C. Receptacle

1) General

i. Manufacture: Crouse-Hinds Appleton (Powertite Series) Hubbell

Other: _____

ii. Part Number: _____

iii. Cap Type: Spring Cape (or) Wing Nut **Condition: _____**

2) Portable Generator Information

i. Primary Portable Generator: 50kW 150kW 300kW

Jumper Cables Required: Yes No

(If Yes, use Table 6-8 to Identify Jumper Cable Required to Service LS)

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

Table 6
50kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End
240	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female
480	100	100 Amp Male	No Jumper Cables Needed		

Table 7
150kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End	Matting Plug
240	400	400 Amp Male	APR40428-S22	Connected to	200 Amp Female	AP20468-S22
240	400	400 Amp Male	APR40428-S22	Connected to	100 Amp Female	APJ10487-S22
480	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female	APJ10487-S22

Table 8
300kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End	Matting Plug
240	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female	APJ10487-S22
480	400	400 Amp Male	APR40428-S22	Connected to	200 Amp Female	AP20468-S22
480	400	400 Amp Male	APR40428-S22	Connected to	100 Amp Female	APJ10487-S22

i. <u>Secondary Portable Generator:</u> 50kW 150kW 300kW

Jumper Cables Required: Yes No

(If Yes, use Table 9-11 to Identify Jumper Cable Required to Service LS)

Table 9
50kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End
240	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female
480	100	100 Amp Male	No Jumper Cables Needed		

Lift Station: _____ **Date (Site Visit):** _____

Location/Address: _____

Table 10
150kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End	Matting Plug
240	400	400 Amp Male	APR40428-S22	Connected to	200 Amp Female	AP20468-S22
240	400	400 Amp Male	APR40428-S22	Connected to	100 Amp Female	APJ10487-S22
480	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female	APJ10487-S22

Table 11
300kW Generator

Voltage	Amperage	Generator End	Matting Connector	Description	Receptacle End	Matting Plug
240	200	200 Amp Male	APR20428-S22	Connected to	100 Amp Female	APJ10487-S22
480	400	400 Amp Male	APR40428-S22	Connected to	200 Amp Female	AP20468-S22
480	400	400 Amp Male	APR40428-S22	Connected to	100 Amp Female	APJ10487-S22

Miscellaneous Note: _____

_____

_____

_____

_____

_____

Lift Station: _____ **Date (Site Visit): _____**

Location/Address: _____

Station Electrical Riser Diagram

I & C Point to Point Checklist

Project Name: | **Project No.:**

PLC Supplier:_____

I&C Contractor Contact Information

Name:_____

Company: _____

Address: _____

Phone: _____

I/O Address	Location (Drop/Slot/Point)	Tag Type	I/O Description	Owner Initials	Designer Initials	Engineer's Initials	Date Completed	Comments
Example: 0430-PLC-1	Drop 2, Slot 9, Point 1	RO	Ferric Chloride Pump Air Valve #5	ZS	BB	BE	4/29/2011	Normally Closed

Project Commissioning Plan
**To be developed at a later time.

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:
   1. Submit prior to application for final payment.
      a. Record Documents: As required in General Conditions.
      b. Special bonds, Special Guarantees, and Service Agreements.
      c. Consent of Surety to Final Payment: As required in General Conditions.
      d. Releases or Waivers of Liens and Claims: As required in General Conditions.
      e. Releases from Agreements.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall project cost and not bid as a separate Work Item.

1.3 CONTRACT COMPLIANCE

A. Complete and submit all contract compliance documentation prior to final closeout and payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 RESTORATION, CLEANUP, AND FINAL INSPECTION

A. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions.

B. All Work shall be complete including:
   1. Final grading.
   2. Trees replaced, as required
   3. Restoration of lay-down area.
   4. Seeding.

C. Facilities Projects
   1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
   2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.

3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Broom clean exterior paved driveways and parking areas.
5. Hose clean sidewalks, loading areas, and other contiguous structures.
6. Leave water courses, gutters, and ditches open and clean.

3.2 SUBSTANTIAL COMPLETION

A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, complete the following, as applicable.
   1. Confirm all utility services and accounts have been transferred to Owner.
      a. Provide all account information.
   2. Confirm that all testing report documentation has been completed and transferred to Owner.
   3. Provide all Operations and Maintenance manuals to Owner.

B. Attached to the certificate of Substantial Completion will be a list of items to be completed or corrected before final payment.
   1. Contractor shall coordinate meeting location and time with Engineer for creation of the list.
   2. Contractor shall maintain list until all items are completed.

+ + END OF SECTION + +

SECTION 01 78 23

OPERATIONS AND MAINTENANCE DATA

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements in the Contract Documents.
   2. For each operation and maintenance manual, submit the following:
      a. Preliminary Submittal: Printed and bound copy of entire operation and maintenance manual, except for test data, service reports by Supplier, and electronic copies.
      b. Final Submittal: Printed and bound copy of complete operations and maintenance manual, including test data and service reports by Supplier, with electronic copies.

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 SUBMITTALS

1. Final Submittal of Operational and Maintenance Data
   a. Submit the operations and maintenance data indicated in the Contract Documents.
   b. Furnish final operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before scheduling training for operation and maintenance personnel of associated materials and equipment, unless submittal is specified as required prior to an interim milestone.
   c. Printed Copies: Three copies.
   d. Electronic Copies: Provide Operations and Maintenance data in a portable electronic document (PDF), or similar. Submit a compact disc (CD) , including the electronic copy.

1.4 FORMAT OF PRINTED COPIES

A. Binding and Cover:
   1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.
   2. Binders shall be locking three-ring/”D”-ring type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front of each volume.
   3. Do not overfill binders.

4. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
5. Provide the following information on cover of each volume:
    a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
    b. Name or type of material or equipment covered in the manual.
    c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
    d. Name of Project and, if applicable, Contract name and number.
    e. Name of building or structure, as applicable.
6. Provide the following information on spine of each volume:
    a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS".
    b. Name or type of material or equipment covered in the manual.
    c. Volume number, if more than one volume is required, listed as "Volume __ of __", with appropriate volume-designating numbers filled in.
    d. Project name and building or structure name.

B. Pages:
1. Print pages in manual on 30-pound (minimum) paper, 8.5 inches by 11 inches in size.
2. Reinforce binding holes in each individual sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of the manual, reinforcing of pages within booklet or pamphlet is not required.
3. Provide each page with binding margin at least one inch wide. Punch each page with holes suitable for the associated binding.

C. Drawings:
1. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing specified for pages.
2. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

D. Copy Quality and Document Clarity:
1. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals that contain copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable. Faxed copies are unacceptable.
2. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.

E. Organization:
1. Table of Contents:
    a. Provide table of contents in each volume of each operations and maintenance manual.

b. In table of contents and at least once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identification is unacceptable.

2. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

1.5 FORMAT OF ELECTRONIC COPIES

A. Electronic Copies of Operation and Maintenance Manuals:
   1. Each electronic copy shall include all information included in the corresponding printed copy.
   2. Submit electronic copy on CD
   3. Provide electronic documents with file sizes less than 200MB, multiple electronic documents are acceptable.
   4. File Format:
      a. Files shall be in "portable document format" (PDF), or similar.
      b. Files shall be electronically searchable.
      c. Submit separate file for each separate document in the printed copy.
      d. Within each file, provide bookmarks for the following:
         1) Each chapter and subsection listed in the corresponding printed copy document's table of contents.
         2) Each figure.
         3) Each table.
         4) Each appendix.

1.6 CONTENT

A. General:
   1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
   2. Completeness and Accuracy:
      a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
      b. Operations and maintenance manuals shall be complete and accurate.
      c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.

3. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

B. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

C. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
   1. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shut-downs.
   2. Recommended schedule for each preventive maintenance task.
   3. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
   4. Table of alternative lubricants.
   5. Troubleshooting instructions.
   6. List of required maintenance tools and equipment.

D. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall include:
   1. Manufacturer's name, address, telephone number, fax number, and Internet website address.
   2. Manufacturer's local service representative's or local parts supplier's name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.
   3. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
   4. For each part or piece include the following information:
      a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
      b. Part name or description.
      c. Manufacturer's part number.
      d. Quantity of each part used in each assembly.
      e. Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

E. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.

F. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

G. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

H. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

I. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

J. Submit copy of warranty bond and service contract as applicable.

K. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

+ + END OF SECTION + +

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. The purpose of the Record Documents is to provide the Owner and Engineer with factual information regarding all aspects of the Work, both concealed and visible, to enable future location, identification and modification of the Work without lengthy and expensive site measurement, investigation or examination.

B. Contractor shall maintain and submit to Engineer Record Documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.

C. Contractor shall update and maintain Record Documents concurrently as construction progresses.

D. Definitions
   1. **Record Documents** – Edited Contract Documents and supplemental documents, as required by section 1.3 below, that identify installed dimensions, location, and changes incorporated into the Work during the construction process. Edits shall include, but not be limited to, indication of the following types of modifications:
      a. Addenda
      b. Change Orders
      c. Field Orders
      d. Work Change Directives
      e. Request for Interpretations
      f. Engineer supplied supplemental drawings
      g. Installed field dimensions
      h. Surveyed locations of installation
   2. **Record Drawings** – Edited Drawings, submitted as part of Record Documents, that have been edited to identify installed dimensions, location, and changes incorporated into the Work during the construction process. Record Drawings shall include edits to the following drawing types, but not limited to:
      a. Plans
      b. Profile
      c. Elevations
      d. Sections
      e. Details
      f. Schedules
      g. Electrical Drawings
      h. P&ID
      i. Perspectives

3. **Programming Files** – Electronic copy of all executable files and narrative description of all programming developed and incorporated into the Work as part of the Project. Programming Files include, but are not limited to:
    a. HMI/OIT Program
    b. I/O Mapping
    c. Field Devices
    d. PID
4. **Contractor Field Survey** – A certified survey and survey data; submitted as part of Record Documents; signed and sealed by professional surveyor, showing dimensions, locations, angles and elevations of construction, Underground Facilities, and modifications encountered during the Work.

E. Maintenance of Record Documents:
1. Maintain in Contractor's field office, or other approved location, in clean, dry, legible condition, complete sets of the Record Documents.
2. Provide files and racks for proper storage and easy access to Record Documents for use by Contractor, Engineer, Owner and others on site.
3. Make Record Documents available monthly for inspection in conjunction with pay application approval or as requested by Engineer or Owner.
4. Do not use Record Documents for purpose other than serving as Project record. Do not remove Record Documents from Contractor's field office, or other approved area, without Engineer's approval.

F. Record Documents shall include certification, with original signature of official authorized to execute legal agreements on behalf of Contractor, reading as follows:

"[*Insert Contractor's corporate name*] has maintained and submitted record documentation in accordance with the General Conditions and Supplementary Conditions, Section 01 78 39, Project Record Documents, and other elements of Contract Documents, for the Montgomery County Regional Sewer District, State of Indiana, SR 32 / Nucor Road Area Sanitary Sewer Collection System. We certify that each record document submitted is complete, accurate, and legible relative to the Work performed under our Contract, and that the record documents comply with the requirements of the Contract Documents.

[*Provide signature, print name, print signing party's corporate title, and date*]"

1.2 MEASUREMENT AND PAYMENT

A. This item is to be included in overall Project cost and not bid as a separate Work item.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
1. Preliminary Submittal of Record Documents
    a. Prior to request for certificate of Substantial Completion of the Work or, specified part thereof, submit the following Record Documents:
        1) Record Drawings

a) Submit a color electronic scan of the up-to-date, original, Record Drawings. Scanned Record Drawings shall clearly show all edits and changes, as required by this specification section, made during construction of the facility, up through Substantial Completion.
b) Provide scanned drawings as a portable electrical document (PDF), or similar format.

2) Programming Files
a) Provide a narrative program description as an electronic document in a native programming language, or similar format.
b) Provide copy of original executable program file on CD or flash drive

2. Final Submittal of Record Documents
a. Final Payment and project closeout will not occur until final Record Documents have been completed, submitted, and approved.
b. Prior to final application for payment of the Work, submit the following Record Documents.
1) Record Drawings
a) Electronic Drawings –Submit an electronically edited document (not a scan of the original) that clearly show all edits and changes, as required by this specification section, made during construction of the facility, up through Final Completion. Edits shall also include all edits and notes previously submitted under the Preliminary Submittal of Record Documents.
b) Original Record Drawings - Submit the original hard copy of the Record Documents used to record changes during the Work.

c) Electronically Revised Contract Drawings – Contractor shall update Drawings, in original file format (.dwg or similar), with all changes and notations included in the Final Submittal of Record Documents.

2) Contractor Field Survey
a) Provide mapped survey in electronic format such as AutoCAD. (.dwg) , design review format (.dwf) or as a portable document format (PDF), or similar.
b) Provide survey data points in an electronic format such as, Microsoft Office Excel, or similar.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. At the start of the Project, label each Record Document to be submitted as, “PROJECT RECORD” using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.

B. Keep Record Documents current. Make entries on Record Documents within two working days of receipt of information required to record the change.

C. Do not permanently conceal the Work until required information has been recorded.

D. Accuracy of Record Documents shall be such that future location, identification and modification of the Work, both concealed and visible, shall be able to be completed without lengthy and expensive site measurement, investigation or examination.

E. Record changes on Drawings as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

F. Field Marking of Entries:
   1. Use red ink for marking changes, revisions, additions, and deletions to Record Documents.
   2. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of Record Documents into legible electronic files.
   3. Date all entries on Record Documents.
   4. Call attention to changes by drawing a "cloud" around the change(s) indicated.
   5. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.
   6. Make line weight thicker than the Drawings lines.

G. Electronically Recording Changes for final submittal of Record Documents
   1. Use a computer software editor such as Adobe Acrobat editor, AutoDesk Design Review or similar software.
   2. Make markups and changes legible in text boxes that when document is printed all changes are visible.
   3. Make markups and changes in red, with the line weight thicker than the Drawings.
   4. Do not incorporate changes in a comment format where the user must scroll over the electronic version to see the change.
   5. Ensure markups are electronically embedded into the file.
   6. Provide electronic documents with file sizes less than 200MB, multiple electronic documents are acceptable.

H. Documenting Contract Modifications
   1. Transfer contract modifications, including but not limited to: Field Orders, Work Change Directives, Change Orders, Request for Interpretations and Allowance Modifications, on the record documents.
   2. Record document title, number and date on the Drawings.

I. Supplemental Drawings:
   1. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with Record Documents submitted by Contractor. Supplemental Record Drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

2. Supplemental Drawings provided with Record Drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental Record Drawings shall be on sheets the same size as the Drawings.

3.2 RECORDING CONSTRUCTION DATA

Record actual construction data of the following items, including but not limited to:

A. Depths of various elements of foundation relative to Project datum.

B. Horizontal and vertical location of Underground Facilities referenced to permanent surface improvements. For each Underground Facility, including pipe fittings, provide dimensions to at least two permanent, visible surface improvements.

C. Location of exposed utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

D. Changes in structural and architectural elements of the Work, including changes in reinforcing.

E. Changes made in accordance with Change Orders, Work Change Directives, Allowance Modifications, Field Orders, and Request for Interpretations.

F. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

G. Site Conditions
   1. Legibly mark to record actual construction conditions; including changing in station, offset and/or elevation on all of the following:
      a. Driveway Layout
      b. Final Grading

H. Buried Utilities
   1. Legibly mark to record actual construction conditions; including changing in station, offset and/or elevation on all of the following:
      a. Manholes – Rims and inverts
      b. Building sewers – Location and depth at cleanout
      c. Air valves
      d. Service valves
      e. Line valves
      f. Pipe fittings – including, but not limited to: crosses, tees, elbows, bends
      g. Pipe sizes, lengths, slopes, and angles
      h. Restrained joint length – as measured from fitting to last joint restrained

I. Exposed Utilities
   1. Legibly mark to record actual construction conditions; including changing in station, offset and/or dimensions on the following:
      a. Exposed Piping

J. Electric Utilities Schematic Layouts:
   1. In some cases on the Drawings, arrangements of conduits, circuits, piping, ducts, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.
   2. Record on Record Documents all revisions to schematics on Drawings, including:
      a. Piping schematics
      b. Ducting schematics
      c. Process and instrumentation diagrams
      d. Control and circuitry diagrams
      e. Electrical one-line diagrams
      f. Motor control center layouts
      g. And other schematics when included in the Contract
   3. Record actual locations and installed dimensions of the following:
      a. Equipment – including but not limited to switch gear, motor control center, and control panels
      b. Lighting fixtures
      c. In-place grounding system – including but not limited to test wells, ground rods, ground rings, grounding arrangements and connections for separately derived systems, and grounding for sensitive electronic components.
      d. And other pertinent data
   4. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the Record Documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items
      a. Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.
      b. Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.
      c. Descriptions shall be sufficiently detailed to be related to Specifications.
   5. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

K. Existing Utilities
   1. Legibly mark and record any existing utilities (abandoned and in-service) located during construction. Record the station, offset and/or elevation in relation to the project.

L. Building Facilities
   1. Legibly mark to record actual construction including changing in station, offset and/or dimensions on the following:
      a. Building Corners
      b. Foundations
      c. Access Points

3.3 CONTRACTOR FIELD SURVEY

A. Contractor shall employ or retain the services, as needed, at the Site a licensed surveyor with experience and capability of performing surveying and layout tasks required in Contract Documents and as required for the Work.

B. Prior to backfilling operations, Surveyor shall survey, locate, and record on the Record Documents accurate representations of buried Work and Underground Facilities encountered and installed.

C. Facilities to be Located:
   1. In addition to the items listed in Article 3.2 - Recording Construction Data, during field survey locate the following:
      a. Utility Poles and Supports- Document the direction of the overhead utility line.
      b. Existing Utility locations, as marked byIndiana811.
      c. Electrical Vaults
      d. Traffic Signal Equipment
      e. Previously unmarked utilities discovered during construction
      f. Building corners
      g. Electrical duct banks

D. Refer to Section 01 71 23 Field Engineering for additional surveying requirements.

+ + END OF SECTION + +

SECTION 03 00 05

CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, forming, reinforcing, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of Portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
      b. Fabricating and placing reinforcing, including ties and supports.
      c. Design, erection, and removal of formwork.
      d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.
      e. Providing openings in concrete as required to accommodate Work under this and other Sections.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:
   1. Class “A” concrete includes the following:
      a. Sidewalks
      b. Curbs
      c. Gutters
      d. Drives
      e. Steel-reinforced structures
      f. All other concrete unless otherwise shown or indicated.
   2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
      a. Concrete fill.
      b. Duct banks.
      c. Unreinforced encasements.
      d. Thrust blocks.

1.2 MEASUREMENT AND PAYMENT

A. Concrete: (Unit Price)
   1. Work Item Number and Title
      03 00 05- A Concrete

2. Payment for concrete is to be on a unit price basis as noted in the Bid Schedule.
3. The payment quantity shall be per cubic yard of concrete placed. This includes, but is not limited to formwork, reinforcing, concrete, finishing and testing.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Concrete Institute.
      a. ACI 214R, Evaluation of Strength Test Results of Concrete.
      b. ACI 224R, Control of Cracking in Concrete Structures.
      c. ACI 301, Specifications for Structural Concrete.
      d. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
      e. ACI 305R, Hot Weather Concreting.
      f. ACI 306R, Cold Weather Concreting.
      g. ACI 309R, Guide for Consolidation of Concrete.
      h. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
      i. ACI 347, Guide to Formwork for Concrete.
      j. ACI SP-66, ACI Detailing Manual.
   2. ASTM International.
      a. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
      b. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      c. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
      d. ASTM C33/C33M, Specification for Concrete Aggregates.
      e. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      f. ASTM C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
      g. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
      h. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
      i. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
      j. ASTM C150/C150M, Specification for Portland Cement.
      k. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
      l. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
      m. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
      n. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      o. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
      p. ASTM C579, Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
      q. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

r. ASTM C989, Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
s. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
t. ASTM C1077, Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.
u. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
v. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
w. ASTM E329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
x. ASTM E1745, Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

3. U.S. Army Corps of Engineers.
   a. CRD-C 572, Specification for Polyvinylchloride Waterstops.
4. Concrete Reinforcing Steel Institute.
   a. CRSI 1MSP, Manual of Standard Practice.
5. NSF International.
   a. NSF 61, Drinking Water System Components – Health Effects.

1.4 QUALITY ASSURANCE

A. Concrete Testing Laboratory Qualifications:
   1. All standard tests specified in this Section and elsewhere shall be arranged by the Contractor. They shall be conducted by an approved independent laboratory and will be made at the expense of the Contractor, unless specifically noted otherwise.
      a. Testing agency shall be in accordance with ASTM E329 and ASTM C1077.
      b. Testing laboratory shall have been inspected and passed within previous two years by Cement and Concrete Reference Laboratory (CCRL) of NIST for: testing concrete aggregates, and for preparing and testing concrete trial batches with or without admixtures. Testing laboratory shall provide documentation indicating how deficiencies, if any, in most recent CCRL inspection report were corrected.
      c. Selection of testing laboratory is subject to Owner's acceptance.

B. Concrete Material Testing:
   1. A test shall be made, in advance, of cement, fine aggregate, coarse aggregate, and reinforcing steel used in the Work covered by this specification; and unless specifically stated otherwise, the ASTM test and specification for the type and class of material indicated shall be used for the test. A manufacturer's certificate of tests will generally be accepted by Engineer.

C. Certification of Concrete Mix:
   1. The requirement for trial batch will be waived upon compliance with requirements of this Paragraph. Verify compressive strength of each specified mix by data from series of at least 30 consecutive tests that have been made within previous 12 months. Test is the average strength of all specimens of the same age fabricated from sample taken from a single batch of concrete. Tests shall have been made on concrete with identical mix design to mix design proposed for the Work, including sources of aggregate and

manufacturers of cementitious materials and admixtures. Tests shall average above specified strength with no individual test falling more than 500 psi below specified strength and no three consecutive tests averaging below specified strength. Standard deviation for series of tests shall not exceed 640 psi in accordance with ACI 214.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4 inch to 1 foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.
   2. Product Data:
      a. List of concrete materials, concrete accessories, grout material, and concrete mix designs proposed for use. Include results of material tests or manufacturer certificate of tests performed to qualify the materials and to establish the mix designs.
      b. Manufacturers' Specifications with application and installation instructions for proprietary material and items, including admixtures and bonding agents.

B. Informational Submittals: Submit the following:
   1. Delivery Tickets: Copies of all delivery tickets for each load of concrete delivered to or mixed at the Site. Each delivery tickets shall contain the information in accordance with ASTM C94/C94M along with Project identification name and number (if any), date, mix type, mix time, quantity and amount of water introduced.
   2. Site Quality Control Submittals: Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.
   3. When requested by Engineer, submit Shop Drawings showing and indicating general construction of individual forms, including:
      a. Jointing.
      b. Special formed joints or reveals.
      c. Location, pattern, and details of form tie placement, removal, and repair procedures.
      d. Location and details for temporary openings.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:
   1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
   2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.

3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
5. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage:
1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. All cementitious materials, admixtures, curing compounds and other industrial produced material used in concrete, or for curing or repairing of concrete, that can contact potable water or water that will be treated to become potable shall be listed in NSF 61.

2.2 CEMENTITIOUS MATERIALS

A. Cement:
1. Portland cement shall be Type I or Type I/II ASTM C150/C150M.
2. Portland cement shall be produced by one facility. Alternate cement sources may be used provided that mix design has been approved and acceptable trial batch verifying performance has been made.
3. Do not use cement that has deteriorated because of improper storage or handling.

2.3 AGGREGATES

A. General:
1. Aggregate shall conform to ASTM C33, Class Designation 4S, and as specified in this Section.
2. Do not use aggregates containing soluble salts or other substances, such as iron, sulfides, pyrite, marcasite, ochre or other materials that can cause stains on exposed concrete surfaces.

B. Fine Aggregate:

1. Provide clean, sharp, natural sand that is free of loam, clay, lumps and other deleterious substances is acceptable.

C. Coarse Aggregate:
   1. Provide clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Slag, pit gravel and bank run gravel are unacceptable.

2.4 WATER

A. Water: Water used in producing and curing concrete shall be clean and free of injurieous quantities of oils, acids, alkalis, organic materials and other substances that may be deleterious to concrete and steel.

2.5 CONCRETE ADMIXTURES

A. Provide admixtures in accordance with product manufacturer's published instructions. Admixtures shall be compatible with each other. Admixtures shall not contain thiocyanates, shall not contain more than 0.05 percent chloride ion, and shall be non-toxic in the concrete mix after 30 days. Do not use admixtures that have not been incorporated and tested in the accepted mixes, unless otherwise approved by Engineer.

B. Air Entraining Admixtures: ASTM C260.
   1. Air entraining admixture shall be vinsol resin or vensol rosin-based.

C. Water-Reducing Admixture: ASTM C494, Type A.
   1. Proportion Class "A", and Class "B" concrete with non-air entraining, normal setting, water-reducing, aqueous solution of modified organic polymer. Admixture shall not contain lignin, nitrates, or chlorides added during manufacturing.

D. High Range Water-Reducing Admixture (HRWR): ASTM C494, Type F/G.
   1. Use high range water-reducing admixture in the concrete classifications so specified or indicated. Use of HRWR admixture is allowed at Contractor's option in all other classifications of concrete. When used, HRWR admixture shall be added to concrete in accordance with admixture manufacturer's published instructions. Specific admixture formulation shall be as recommended by admixture manufacturer for Project conditions.

E. Set Control Admixtures: In accordance with ASTM C494. Use the following as required:
   1. Type B, Retarding.
   2. Type C, Accelerating.
   3. Type D, Water reducing and Retarding.
   4. Type E, Water reducing and Accelerating.
   5. Type F, Water-reducing, high range admixtures.
   6. Type G, Water-reducing, high range, and retarding admixtures.

F. Calcium Chloride: Do not use calcium chloride.

2.6 PROPORTIONING AND DESIGN OF MIXES

A. Prepare concrete design mixes in accordance with Table 03 00 05-A:

TABLE 03 00 05-A
CONCRETE DESIGN MIX CRITERIA

Concrete Class	Coarse Aggregate[1]		Minimum Cementitious (lbs/cu yd)	Max. W/CM[4]	Slump[2]	Air (%)	Min 28 day. Comp Strength[3] (psi)
	Size A	Size B					
Class "A"	No. 57	No. 8	564	0.45	4" max.	6 +/- 1	4,000
Class "B"	No. 57 or No. 67		517	0.50	4" max.	6 +/- 1	3,000

Notes Applicable to Table 03 00 05-A:

1. Coarse aggregate size numbers refer to ASTM C33. Where Size A and B are designated in Table 03 00 05-A, it is intended that the smaller Size B aggregate is to be added, replacing a portion of the coarse or fine aggregate, in the minimum amount necessary to make a workable and pumpable mix with sand content not exceeding 41 percent of total aggregate.
2. Slumps indicated are prior to addition of high range water reducer (super plasticizer).
3. Mix designs shall be made so that the compressive strength achieved for laboratory trial batches will not be less than 125 percent of specified design strength.
4. Quantity of water to be used in the determination of water-cementitious materials (W/CM) ratio shall include free water on aggregates in excess of SSD and water portion of admixtures.

B. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, Site conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as approved by Engineer. Before using adjusted concrete mixes, laboratory test data and strength results shall be submitted to and approved by Engineer.

C. Admixtures:
   1. Use air-entraining admixture in concrete, unless otherwise shown or indicated. Add air-entraining admixture at admixture manufacturer's prescribed rate to produce concrete at point of placement having air content within prescribed limits.
   2. Use water-reducing or high-range water-reducing admixtures in all Class "A" concrete.
   3. Use amounts of admixtures recommended by admixture manufacturer for climatic conditions prevailing at the Site at time of placing. Adjust quantities and types of admixtures as required to maintain quality.

D. If adding water at the Site is desired, withhold water at the batch plant so that specified water-cement (or cementitious material) ratio is not exceeded. Addition of water shall be accordance with ASTM C94. After high-range water-reducing admixture is incorporated into the batch, addition of water is not allowed.

2.7 FORMS

A. Design Criteria:
   1. Design, erect, support, brace and maintain forming in accordance with ACI 347 so that forming safely supports vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by forming system or in-place construction that has attained adequate strength for the purpose. Construct forming so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
   2. Design forms and falsework to include values of live load, dead load, weight of moving equipment operated on forming, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
   3. Provide shores and struts with positive means of adjustment capable of taking up forming settlement during concrete placing operations, using wedges or jacks, or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
   4. Support form facing materials by structural members spaced sufficiently close to prevent beyond tolerance deflection, in accordance with ACI 117. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. For long-span members without intermediate supports, provide camber in forming as required for anticipated deflections resulting from weight and pressure of fresh concrete and construction loads.
   5. Design and construct forming to be readily removable without impact, shock or damage to concrete surfaces and adjacent materials.
   6. Provide forming sufficiently tight to prevent leakage of cement paste during concrete placing. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

B. Form Materials:
   1. Forms for Smooth Finish Concrete:
      a. Unless otherwise shown or indicated in the Contract Documents, construct forming for smooth concrete surfaces with plywood, metal, metal-framed plywood-faced, or other panel type materials acceptable to Engineer, to provide continuous, straight, smooth as-cast surfaces with no wood grain or other surface texture imparted by forming. Provide in largest practical sizes to minimize number of joints and to conform to joint system shown or specified in the Contract Documents. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
   2. Forms for Standard Finish Concrete:
      a. Form concrete surfaces designated to have standard formed finish with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side.
   3. Form Ties:
      a. Provide factory-fabricated metal form ties, designed to prevent form deflection, and to prevent spalling of concrete surfaces upon removal.
      b. Unless otherwise shown or indicated in the Contract Documents, provide ties so that portion of tie remaining within concrete after removal of exterior parts of tie is at

least 1.5 inches from the outer concrete surface. Unless otherwise shown or indicated in the Contract Documents, provide form ties that will leave a hole no larger than one-inch diameter in concrete surface.

c. Ties shall have waterstops on all exterior, below-grade walls, and walls subject to hydrostatic pressure.
d. Ties shall leave a uniform, circular hole when forms are removed.
e. Do not use removable ties unless accepted by Engineer. Removable ties are not allowed on exterior below-grade walls or walls subject to hydrostatic pressure. If removable ties are accepted, Contractor shall submit hole repair details for Engineer approval.
f. Wire ties are not allowed.
g. Do not use reinforcing bars shown by the Drawings as part of the form tie system unless approved by Engineer.

4. Form Coatings:
   a. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compounds. For concrete surfaces that will be in contact with potable water or water that will be treated to become potable, form coating shall be a mineral oil base coating.

2.8 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185/A185M.

C. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
   3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
   4. Provide precast concrete supports over waterproof membranes.

2.9 RELATED MATERIALS

A. Waterstops:
   1. PVC Waterstops:
      a. Manufacturers: Provide products of one of the following:
         1) W.R. Meadows, Inc.
         2) Greenstreak Plastic Products Company.
         3) Or equal.
      b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.

c. Minimum Thickness: 3/8 inch.
d. Provide waterstops with minimum of 7 ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8 inch in height.
e. Construction Joints: Waterstops shall be 6 inch wide flat-strip type.
f. Expansion Joints: Waterstops shall be 9 inch wide centerbulb type.

2. Hydrophilic Waterstops:
   a. Products and Manufacturers: Provide one of the following:
      1) Duroseal Gasket, by BBZ USA, Inc.
      2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
      3) Hydrotite, by Greenstreak Plastic Products Company.
      4) Or equal.
   b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
   c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
   d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
   e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
   f. Minimum cross-sectional dimensions: 3/16 inch by 3/4 inch.
   g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by Engineer.
   h. Hydrophilic Sealant: Shall adhere firmly to concrete, metal, and PVC in dry or damp condition and be indefinitely elastic when cured.
      1) Products and Manufacturers: Provide one of the following:
         a) Duroseal Paste, by BBZ USA, Inc.
         b) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
         c) Hydrotite, by Greenstreak Plastic Products Company.
         d) Or equal.

B. Vapor Retarder:
   1. Products and Manufacturers: Provide one of the following:
      a. Stego Wrap 10-mil Vapor Retarder, by Stego Industries LLC.
      b. Griffolyn 10-mil, by Reef Industries.
      c. Moistop Ultra, by Fortifiber Industries.
      d. Or equal.
   2. Vapor retarder membrane shall comply with the following.
      a. Water Vapor Transmission Rate, ASTM E96/E96M: 0.04 perms or lower.
      b. Water Vapor Retarder, ASTM E1745: Meets or exceeds Class C.
      c. Thickness of Retarder (plastic), ACI 302 1R: Not less than 10 mils.
      d. Provide accessories by same manufacturer as vapor retarder.

C. Concrete Curing Materials:
   1. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 10 ounces per square yard and complying with AASHTO M 182, Class 3.
   2. Curing Mats: Shall be heavy carpets or cotton mats, quilted at 4 inches on centers, and weighing minimum of 12 ounces per square yard when dry.

3. Moisture-Retaining Cover: Provide one of the following, complying with ASTM C171:
    a. Waterproof paper.
    b. Polyethylene film.
    c. White burlap polyethylene sheet.
4. Liquid Curing Compound: ASTM C309 Type 1-D (water retention requirements):
    a. Provide fugitive dye.
    b. Curing compound shall be applied by roller or power sprayer.

D. Epoxy Bonding Agent:
1. Two-component epoxy resin bonding agent.
2. Products and Manufacturers: Provide one of the following:
    a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
    b. Eucopoxy LPL, by the Euclid Chemical Company.
    c. Or equal.

E. Epoxy-Cement Bonding Agent:
1. Three-component blended epoxy resin-cement bonding agent.
2. Products and Manufacturers: Provide one of the following:
    a. Sika Armatec 110 EpoCem, by Sika Corporation.
    b. Duralprep A.C., by Euclid Chemical Company.
    c. Or equal.

F. Preformed Expansion Joint Filler:
1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

G. Joint Sealant and Accessories Used on Isolation Joints, Control Joints, and Expansion Joints:
1. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.
2. Do not install joint sealants when temperatures are below or above manufacturer's recommended limitations for installation.
3. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
4. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Wastewater:
    a. Provide one of the following two-component Polyurethane Sealant:
        1) Sikaflex- 2c NS by Sika Corporation.
        2) Vulkem 227 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
        3) Or equal.
5. Exterior and Interior Vertical Joints; Non-submerged:
    a. Provide one of the following two-component Polyurethane Sealant:
        1) Sikaflex- 2c NS by Sika Corporation.
        2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.

3) Or equal.

6. Exterior and Interior Horizontal Joints; Non-submerged:
   a. Provide one of the following two-component Polyurethane Sealant:
      1) Sikaflex- 2c SL by Sika Corporation.
      2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
      3) Or equal.

2.10 GROUT

A. Non-shrink Grout:
   1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site.
   2. Minimum 28-day Compressive Strength: 7,000 psi.
   3. Products and Manufacturers: Provide one of the following:
      a. NS Grout by Euclid Chemical Company.
      b. Set Grout by Master Builders, Inc.
      c. NBEC Grout by Five Star Products, Inc.
      d. Or equal.

B. Epoxy Grout:
   1. Pre-packaged, non-shrink, non-metallic, 100 percent solids, solvent-free, moisture-insensitive, three-component epoxy grouting system.
   2. Minimum Seven-day Compressive Strength: 14,000 psi, when tested in accordance with ASTM C579.
   3. Products and Manufacturers: Provide one of the following:
      a. Euco High Strength Grout, by Euclid Chemical Company.
      b. Sikadur 42, Grout Pak, by Sika Corporation.
      c. Five Star Epoxy Grout, by Five Star Products, Inc.
      d. Or equal.

C. Grout Fill:
   1. Grout mix shall consist of cement, fine and coarse aggregates, water, and admixtures complying with requirements specified in this Section for similar materials in concrete.
   2. Proportion and mix grout fill as follows:
      a. Minimum Cement Content: 564 pounds per cubic yard.
      b. Maximum Water-Cement Ratio: 0.45.
      c. Maximum Coarse Aggregate size: 1/2 inch, unless otherwise indicated.
      d. Minimum 28-day Compressive Strength: 4,000 psi.

PART 3 EXECUTION

3.1 INSPECTION

A. Concrete shall not be placed until the forms and reinforcement have been inspected and approved by the Engineer or their authorized representative.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. All debris and ice shall be removed from the space to be occupied by the concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
   1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
   2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to Engineer for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
   3. Removal time for formwork is subject to Engineer's acceptance.
   4. Repair form tie-holes following in accordance with ACI 301.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
   1. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Provide sufficient lap to transfer the stress between bars by bond and shear (minimum 24 diameters).

F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.

G. Do not place concrete until reinforcing is inspected and Engineer indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph will be rejected. Notify Engineer in writing at least two working days prior to proposed concrete placement.

H. Joints:
   1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
   2. Locations of joints shall be in accordance with the Contract Documents and as approved by Engineer in the Shop Drawings.
   3. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4 inch.

I. Installation of Embedded Items: Set and build into the Work anchorage devices and embedded items required for other Work that is attached to, or supported by, cast-in-place concrete. When applicable, coordinate with other sections and other contracts for locating and setting. Refer to Paragraph 1.1.B of this Section. Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.
   1. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
   2. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by Engineer.
   3. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
   4. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
   5. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
   1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
   2. Do not begin placing concrete until Work of other trades affecting concrete is completed.
   3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.
   4. For Structures other than precast manholes, deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
   5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than three feet during placing.
   6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. In no case shall a vibrator be extended into previously placed batches. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Cold Weather Placing:
   1. Protect concrete Work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures, in compliance with ACI 306R and the Contract Documents.
   2. When air temperature has fallen to or may be expected to fall below 40 degrees F, provide adequate means to maintain temperature in area where concrete is being placed between 50 degrees F and 70 degrees F for a period of seventy-two hours after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Maintain temporary heating and protection as necessary so that ambient temperature does not fall more than 30 degrees F in the 24 hours following the seventy-two hour period. Avoid rapid dry-out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.
   3. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing for concrete as required to obtain concrete mixture temperature not less than 70 degrees F and not more than 90 degrees F at point of placement.
   4. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Before placing concrete, verify that forms, reinforcing, and adjacent concrete surfaces are entirely free of frost, snow, and ice.
   5. Do not use salt or other materials containing antifreeze agents. Do not use chemical accelerators or set-control admixtures unless approved by Engineer and tested in mix design proposed for use.

6. During pouring and curing periods, a permanent temperature record shall be kept showing the date, hour outside temperature at several points within the enclosure to show the most favorable and unfavorable conditions to which the concrete is subjected. Thermometer readings shall be taken at the start of Work in the morning and again in the late afternoon, and the data so obtained shall be recorded in such a manner that it will show the location of each reading and any conditions which might have an effect on the temperature. A copy of the temperature record shall be made available to the Engineer.
7. Before concreting any section of a structure, the section shall be completely housed or enclosed in a manner that will provide the maintenance of the specified temperatures. The housing shall be left in place for the curing period specified. except that sections may be temporarily removed as required to accommodate the placing of column forms or concrete, provided that they are replaced immediately after the form or concrete is in its final position.
8. In placing floor slabs, tarpaulins supported on horses or other framework shall follow closely the placing of the concrete so that only a few feet of the finished slab is exposed to the outside atmosphere at any one time. Such tarpaulins shall be arranged so that the heated air from the space below can circulate freely in the space between the tarpaulin and the freshly placed concrete. If necessary, in order to maintain the proper temperature between the slab and the tarpaulins, temporary openings may be left in the floor and forms to facilitate the circulation of warm air in this space. Such openings shall not exceed 18 inches in their greatest dimension.
9. Top covers may be removed between the hours of 8:00 a.m. and 5:00 p.m. on days when the temperature is above 35 degrees F to permit erection of forms, but they shall be replaced not later than 5:00 p.m.
10. Within the enclosure, such means of artificial heat shall be provided as will maintain the temperatures specified continuously and with reasonable degree of uniformity in all parts of the enclosure. All exposed concrete surfaces within the heated area shall be wet with a hose stream at least once every 24 hours during the hardening period, except where a stream curing is provided.
11. The Contractor shall provide adequate fire protection accessible at all times where heating is in progress and shall maintain watchmen or other attendants to keep the heating units in continuous operation.
12. Heating appliances shall not be placed in such a manner as to endanger form work or centering or expose any area of concrete to drying out or other injury due to excessive temperatures.

F. Hot Weather Placing:
1. When hot weather conditions exist that would impair the quality and strength of concrete, place concrete in compliance with ACI 305R and the Contract Documents.
2. When ambient air temperature is at or above 90 degrees F and rising, cool ingredients before mixing concrete to maintain concrete temperature at time of placement below 80 degrees F. When ambient air temperature is at or above 90 degrees F and falling, cool the ingredients before mixing concrete to maintain concrete temperature at time of placement below 85 degrees F. In no case shall the concrete temperature at time of placement exceed 90 degrees F.
3. Mixing water may be chilled, or chopped ice may be used to control concrete temperature provided the water equivalent of ice is calculated in total amount of mixing water. If

required, reduce the time from addition of mix water to placement, or use set-retarding admixture.

4. Cover reinforcing materials with water-soaked burlap if ambient air temperature becomes too hot, so that reinforcing material temperature does not exceed ambient air temperature immediately before embedment of reinforcing in concrete.
5. Wet forms thoroughly before placing concrete.
6. Do not place concrete at temperature that causes difficulty from loss of slump, flash set, or cold joints.
7. Do not use set-control admixtures unless approved by Engineer in mix design.
8. Obtain Engineer's approval of substitute methods and materials proposed for use.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.

B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to the extent directed by Engineer, or repair to satisfaction of Engineer, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by Engineer shall be at no additional cost to Owner.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
   1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4 inch in ten feet when tested with a 10 foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.
   2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.

3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8 inch in 10 feet when tested with a 10 foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
    a. Interior exposed slabs, unless otherwise shown or indicated.
    b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Apply chemical floor hardener to exposed interior concrete floor areas when cured and dry, in accordance with hardener manufacturer's instructions.

C. Formed Finish:
1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8 inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2 inch in height.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify Engineer and do not proceed until obtaining Engineer's clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in providing proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

A. Site Testing Services:
1. Contractor shall employ independent testing laboratory to perform field quality control testing for concrete. Engineer will direct where Samples are obtained.
2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.

3. Contractor shall provide curing and necessary cylinder storage. Actual curing in the structure shall be closely paralleled.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during concrete placing, as follows:
      a. Sampling Fresh Concrete: ASTM C172.
      b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
      c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
      d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
      e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
      f. Compression Test Specimens:
         1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by Engineer.
         2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
      g. Compressive Strength Tests:
         1) In accordance with ASTM C39/C39M; 1 specimen tested at 7 days, and 3 specimens tested at 28 days.
         2) Concrete that does not comply with strength requirements will be considered as defective Work.
      h. Within 24 hours of completion of test, testing laboratory will transmit certified copy of test results to Contractor and Engineer.
      i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, Contractor shall employ the services of a concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M.

+ + END OF SECTION + +

SECTION 05 56 00

METAL CASTINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install metal castings.
2. Castings include metal items that are not part of miscellaneous metal fabrications or metal systems in other Specifications Sections.
3. Manhole riser rings and chimney seals are included in this Section.

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before metal castings Work.
2. Where coordination of Work by others is required, notify other contractors in advance of installing castings to provide other contractors with sufficient time for installing items included in their contracts to be installed with or before metal castings Work.

C. Related Sections:
1. Section 33 32 19, Public Utility Wastewater Pumping Stations; and 33 39 19, Sanitary Utility Sewerage Manholes

1.2 MEASUREMENT AND PAYMENT

A. Metal Castings Various Sizes and Types
1. Costs associated with castings are included with manholes or storm drainage structures and are not paid for separately.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
1. American Association of State Highway and Transportation Officials (AASHTO)
a. AASHTO H-20 Loading
2. ASTM International.
a. ASTM A48/A48M, Specification for Gray Iron Castings.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
1. Manufacturer shall have at least five years of experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all frame, lid or cover, and grate products included in this Section regardless of component manufacturer, from a single castings manufacturer.
   2. Castings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. Components shall be constructed for specified service conditions and shall be integrated into overall assembly by castings manufacturer.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Provide copies of manufacturer's catalog information for the products proposed for use, specifications, load tables, dimension diagrams, anchor details, and installation instructions. Include indication of specific products or models being used.

B. Informational Submittals: Submit the following:
   1. Qualifications Statements: Submit qualifications for the following:
      a. If submitting an unlisted product or manufacturer as a comparable equal to listed products and manufacturers.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
   2. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Protect materials from corrosion and deterioration.
   2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 CASTING MATERIALS

A. 24" Sanitary Casting:
   1. Material: ASTM A48/A48M, Class 35B.
   2. Products and Manufacturers: Provide one of the following:
      a. R-1772, manufactured by Neenah Foundry Company, with "Sanitary" lettered solid lid.
      b. 1022Z1, manufactured by East Jordan Iron Works, Inc, with 1020AHDGS "Sanitary Sewer" lettered solid lid.
      c. Or equal.

B. Watertight Sanitary Casting:

1. Material: ASTM A48/A48M, Class 35B.
2. Products and Manufacturers: Provide one of the following:
    a. R-1772, manufactured by Neenah Foundry Company, with “Sanitary Sewer” lettered, solid, bolted lid.
    b. 1022Z1PT, manufactured by East Jordan Iron Works, Inc, with “Sanitary Sewer” lettered, solid, bolted lid.
    c. Or equal.
    d.

2.2 CASTING FABRICATION

A. Fabrication, General:
1. Castings shall be of uniform quality, free of sand holes, gas holes, shrinkage cracks, and other surface defects.
2. Castings shall be ground smooth and well-cleaned by shot blasting in the shop.
3. Design and fabricate round frames and covers to prevent rocking and rattling under traffic loads that will be imposed in actual use.
4. Fabricate castings true to pattern so that component parts fit together.
5. Each casting shall be identifiable and, depending on its size, shall indicate the following: name of producing foundry, ASTM material designation, individual part number, and cast or heat date. Castings shall include all lettering shown or indicated on the Drawings.

2.3 RISER RINGS

A. Riser rings shall be precast concrete and shall have a minimum thickness of 2 inches and a maximum thickness of 6 inches.

B. Riser ring joints shall be sealed with the following method:
1. Preformed Flexible Joint Sealant in accordance with ASTM C990 and AASHTO- M198.
    a. Manufactures: Provide joint sealant from the following:
        1) EZ Stik, by Press-Seal Gasket Corporation.
        2) Kent Seal No 2, by Hamilton Kent.
        3) Or equal.

C. Sanitary Manhole Chimney Seal
1. In addition to the required riser ring joint seal, provide one of the following:
    a. External Chimney Seal, manufactured by Cretex Specialty Products.
    b. Wrapidseal manufactured by CANUSA-CPS.
    c. Or equal.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 RISER RINGS

A. Use riser rings to provide adjustment of the casting to finish grade.

B. Use precast concrete riser rings for all precast and masonry manholes and structures, where watertight castings are NOT required.

C. Riser rings shall be used for all precast and masonry manholes and structures, where required. Riser ring stacks shall be a maximum of 12-inches in height, and shall be provided between the top of the cone or slab and the underside of the manhole casting for adjustment of the casting to finished grade. No more than 2 grade rings shall be stacked together to reach the finished grade.

D. Riser rings shall be provided between the top of the cone or slab and the underside of the manhole casting.

E. Riser rings for precast manholes shall be laid in rubber base extrudable preformed gasket material and shall conform to details shown.

F. Joints between the casting, riser rings, and top section of the manhole shall be sealed using the applicable external chimney seal.

G. Where watertight castings are specified, a cast-in-place concrete section shall be used in lieu of riser rings. Cast-in-place section shall conform to details shown.

H. Engineer shall be notified if the above requirements cannot be met for specific field installations and Contractor shall not proceed without written approval from Engineer.

3.3 INSTALLATION

A. Comply with casting manufacturer's printed instructions and the Contract Documents. Where castings are installed on precast concrete, fabricated fiberglass, or other fabricated products, install casting in accordance with requirements of manufacturer of product on which casting will be installed.

B. Set castings accurately to required location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and levels. Where applicable, brace temporarily or anchor temporarily in formwork.

C. In paved streets:
   1. Where Work is in paved streets or areas which have been brought to grade, not more than 12 inches shall be provided between the top of the cone or slab and the underside of the manhole casting for adjustment of the casting to finished street grade.

D. In Unpaved Streets or Alleys:

1. Where Work is in unpaved streets or alleys, provide space for riser rings between the top of the cone or slab and the underside of the manhole casting for adjustment of the casting to finished grade. The top of the manhole casting shall be flush with the finished grade, unless otherwise directed by the Engineer.

E. Within Cultivated and Non-Cultivated Areas:
   1. Where Work is in cultivated areas, the top of the manhole casting shall be 1 foot above finished grade and in non-cultivated areas the casting shall be flush with the finished grade, unless otherwise directed by the Engineer.

+ + END OF SECTION + +

SECTION 31 00 05

TRENCHING AND EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide all labor, materials, equipment and incidentals required to perform all excavating, backfilling, filling and grading, and disposing of earth materials as shown, specified, and required for construction of structures, manholes, vaults, utilities, conduits, pipelines, roads, and any other facilities required to complete the Work in every respect.
2. All necessary preparation of subgrade for walks, drives, slabs, and pavements is included.
3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

B. Related Sections:
1. Section 31 05 19, Geosynthetics for Earthwork.
2. Section 33 05 37.13, PVC Non-Pressure Utility Piping.
3. Section 33 05 37.16, PVC Pressure Utility Piping.
4. Section 33 05 38.16, HDPE Pressure Utility Piping.
5. Section 33 31 00, Sanitary Sewer Piping Installation.
6. Section 33 32 19, Public Utility Wastewater Pumping Stations.
7. Section 33 39 13, Sanitary Utility Sewerage Manholes.

1.2 MEASUREMENT AND PAYMENT

A. Common Excavation:
1. Common excavation does not include excavation required for the installation of other Work items, including but not limited to utility piping, manholes, and structures. Unless specifically stated elsewhere, excavation required for the installation of other Work items shall be included in the measurement and payment of those Work items.

B. Excavation of Unsuitable Material
1. Work Item Number and Title
31 00 05-C Excavation of Unsuitable Material
2. This item shall include all cost associated with excavation below bottom elevation of structure bedding, or as directed by Engineer, temporary sheeting, shoring, disposal of excavated material, dewatering, and erosion control.
3. The quantity will be the cubic yard calculated in the rectangular cross section having a maximum width of 30 inches plus the outside diameter of the pipe laid therein. Depth shall be anything greater than 18 inches below the required pipe bedding, as is shown.

4. The payment shall be on a unit price basis per cubic yard.

C. Additional Special Backfill for Unsuitable Material
   1. Work Item Number and Title
      31 00 05-D Additional Special Backfill for Unsuitable Material
   2. This item shall include all cost associated with furnishing, placing, and compaction of special backfill to replace excavated unsuitable material, as directed by the Engineer.
   3. The quantity will be the cubic yards calculated for the area below that shown on the plans and as directed by the Engineer.
   4. The payment shall be on a unit price basis per cubic yard.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM International:
      a. ASTM D422, Test Method for Particle-Size Analysis of Soils.
      b. ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft – lbf/ft3).
      c. ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft – lbf/ft3)
      d. ASTM D2166, Test Method for Unconfined Compressive Strength of Cohesive Soils.
      e. ASTM D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
   2. Indiana Department of Transportation (INDOT) - Standard Specifications:
      a. 211, B Borrow and Structural Backfill
      b. 616.05, Placing Revetment Riprap
      c. 901.01(b), Portland Cement
      d. 901.02, Fly Ash as a Pozzolan
      e. 904.01, Aggregates
      f. 904.02, Fine Aggregate
      g. 904.03, Coarse Aggregate
      h. 912.03, Admixtures for Use in Concrete
      i. 913.01, Water

1.4 QUALITY ASSURANCE

A. Testing Services:
   1. General: Testing of materials, testing for moisture content during placement and compaction of fill materials, and testing of compaction for compliance with technical requirements of these Specifications shall be performed by a testing laboratory as specified in the Contract Documents. Testing shall conform to ASTM D422, ASTM D427, ASTM D1557, ASTM D 2166, ASTM D 698, and ASTM D4318.
   2. Contractor's Laboratory Services Scope:

a. Test proposed materials in the laboratory and/or field for compliance with the Contract Documents.
b. Perform field moisture content and density tests to verify that the specified compaction of backfill materials has been obtained.
c. Inspect and approve subgrades and fill layers are in compliance with the Contract Documents before further Work is performed thereon.
d. Report test results to the Engineer.

3. Authority and Duties of Testing Agency: Technicians representing the testing laboratory shall inspect the materials in the field, perform tests, and report their findings to the Engineer and Contractor. When the materials furnished or the Work performed fails to fulfill Specification requirements, the technician will direct the attention of the Engineer and Contractor to such failure.
    a. The technician shall not act as foreman or perform other duties for Contractor. Work will be checked as it progresses. Failure to detect any defective Work or materials at the time of installation shall not in any way prevent later rejection of the Work if defects are later discovered, nor shall it obligate the Engineer for final acceptance. Technicians are not authorized to revoke, alter, relax, enlarge, or release any requirements of the Contract Documents, nor to approve or accept any portion of the Work.
4. Responsibilities and Duties of Contractor, relative to testing:
    a. The use of testing services shall in no way relieve Contractor of the responsibility to provide Work in full compliance with the Contract Documents.
    b. To facilitate testing services, Contractor shall:
        1) Secure and deliver to the Engineer or to the testing agency, without cost, preliminary representative samples of the materials the Contractor proposes to use which are required to be tested.
        2) Furnish such casual labor as is necessary to obtain and handle samples at the Site or at other sources of material.
        3) Advise the laboratory service at least two days in advance of any backfill operations to allow for completion of quality tests and for the assignment of personnel.
    c. It shall be the responsibility of the Contractor to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of the Contractor to control their operations by confirmation tests to verify and confirm that Contractor has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
    d. Contractor shall demonstrate the adequacy of compaction equipment and procedures to the Engineer before exceeding any of the following amounts of earthwork quantities:
        1) 200 linear feet of Special Trench Backfill.
        2) 10 cubic yards of structural backfill.
        3) 100 cubic yards of embankment work.
        4) 50 cubic yards of base material.
    e. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
    f. Periodic compliance tests may be made by the Engineer to verify that compaction is conforming to the requirements previously specified, at no cost to Owner. Contractor shall remove the overburden above the level at which the Engineer

wishes to test and shall backfill and recompact the excavation after the test is complete.

g. If compaction fails to conform to the specified requirements, Contractor shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to the Engineer. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by Contractor. Contractor confirmation tests shall be performed in a manner acceptable to the Engineer. Frequency of confirmation tests for remedial Work shall be double the amount specified for initial confirmation tests.

5. The frequency of Contractor confirmation tests shall be not less than as follows: Each test location for trenches shall include tests for each layer, type, or class of backfill from bedding to finish grade.
    1) Trenches for Underground Facilities:
        a) In open fields: Two locations every 1,000 linear feet.
        b) Along dirt or gravel roads or off traveled Right-of-Way: Two locations every 500 linear feet.
        c) Crossing paved roads: Two locations along each crossing.
        d) Under pavement cuts or within two feet of pavement edges: One location every 400 linear feet.
    2) For Structural Backfill: On 30-foot intervals on all sides of the structure for every compacted lift, but no less than one per lift on each side of the structure for structures less than 60 feet long on a side.
    3) In Embankment or Fill: One per 1,000 square feet on every compacted lift.
    4) Base Material: One per 1,000 square feet on every compacted lift.
6. Copies of the test reports shall be submitted promptly to the Engineer. Contractor tests shall be performed by a soils testing laboratory acceptable to the Engineer.
7. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least 1 test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Engineer.

B. Permits and Regulations:
1. Engineer shall obtain all necessary permits for Work in roads, right-of-ways, railroads, and other property where permits are required. Also, obtain permits as required by local, state and federal agencies for discharging water from excavations.
2. Perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Samples:
    a. Submit samples of all select geotextiles, fill, gravel and base materials required: Deliver samples to Engineer.
2. Product Data:
    a. Submit source of materials, and when gradation is specified, submit gradation test for each type of material specified.

B. Informational Submittals: Submit the following:

a. Submit Monthly Test Reports for Borrow, Backfill, and Grading: Testing laboratory shall submit copies of the following reports directly to Engineer, with copy to the Contractor:
   1) Tests on borrow material.
   2) Test of excavation subgrade, including footers.
   3) Field density tests.
   4) Optimum Moisture: Maximum density curve for each soil used for backfill.
   5) Tests of actual unconfined compressive strength or bearing tests of each strata.
b. Submit the proposed compaction procedure and equipment to be used.
c. Submit the proposed sheet shoring and bracing procedure and equipment to be used.
d. Submit any additional reports from required field testing as specified in Part 3 of this specification.

2. Qualifications Statements:
   a. Submit qualifications for earthwork testing agency.

1.6 JOB CONDITIONS

A. Subsurface Information: Data on subsurface conditions is included in the Project Manual. It is not intended as a representation or warranty of continuity of conditions between soil borings nor of groundwater levels at dates and times other than date and time when measured. Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data is solely made available for the convenience of Contractor.
   1. Additional test borings and other exploratory operations may be made by Contractor, at no additional cost to the Owner.

B. Existing Underground Facilities: The Drawings show certain surface and underground structures and utilities adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of Contractor. Contractor shall explore ahead of the required excavation to determine the exact location of all structures. They shall be supported and protected from damage by Contractor. If they are broken or damaged due to the Contractor's construction activities, then they shall be restored immediately by Contractor at no additional cost to the Owner.
   1. Locate existing Underground Facilities in the areas of the Work. If facilities are to remain in place, provide adequate means of protection during all operations.
   2. Should uncharted or incorrectly charted piping, structures, or other utilities be encountered during excavation, consult utility owner and Engineer immediately for directions as to how to proceed. Cooperate with Owner and utility owner in keeping services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   3. In general, service lines to individual houses and businesses are not shown. Contractor shall assume that services exist for each utility to each house or business.
   4. Demolish and completely remove from the Site existing Underground Facilities indicated to be removed. Coordinate with utility owner for shut-off of services if lines are active.

C. The use of explosives will not be permitted.

D. Protection of Work and Property must conform to requirements in Contract Documents. Refer to Section 01 71 33 - Protection of Work and Property.

E. Dust Control must conform to requirements in Contract Documents. Refer to Section 01 57 00 - Temporary Controls.

F. Roadways and Walks: Unless otherwise approved by Engineer, excavated material and materials of construction shall be stockpiled, and the Work shall be conducted to maintain open and free for pedestrian traffic in all crosswalks, and for vehicular traffic, provide a roadway driving lane not less than ten feet wide. All hydrants, valves, fire alarm boxes, letterboxes, and other facilities which may require access during construction shall be kept accessible for use. During the progress of the Work, Contractor shall maintain such crosswalks, sidewalks, and roadways in satisfactory condition, and the Work shall at all times be conducted to cause a minimum inconvenience to public travel and to permit safe and convenient access to private and public property along the line of the Work.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS – FOR UTILITY PIPING AND STRUCTURES

A. Backfill:
1. Materials acceptable for use as backfill for underground utilities, against walls, foundations, underground ductbanks, and other structures shall be stockpiled native sandy clay or granular soils obtained from on-site excavations and which are uniformly mixed, contain no organic matter, nor contain rocks or fragments greater than 3 inches in size, nor have greater than 40 percent passing the 200 sieve. The maximum expansion of on-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D698 at two percent below optimum moisture content under a 100 psf surcharge pressure.
2. Backfill and fill materials from off-site sources shall consist of silty or clayey sand soils that are uniformly mixed, contain no organic matter and which have a Plasticity Index less than ten. The maximum particle size of imported soils shall be 3-inches or less, if required to satisfy trenching, landscaping, or other requirements. The maximum expansion of off-site materials shall be 1.5 percent as performed on a sample remolded to approximately 95 percent of the maximum dry density as determined in accordance with ASTM D698 at two percent below optimum moisture content under a 100 psf surcharge pressure.
3. All materials for use as backfill and fill material shall be tested by the laboratory services, as requested by the Engineer.
4. If on-site material is unsuitable, as determined by the Engineer, Special Backfill or approved off-site fill shall be used.

B. Special Backfill:
1. Materials acceptable for use as special backfill for use beneath pavements and structures and as shown on Drawings, shall be in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications latest edition, Sections 211 and 904.

2. The material shall be acceptable quality, free from large or frozen lumps, wood, or other extraneous matter.
3. Special backfill shall be in accordance with gradations for No. 53 or No. 73 coarse aggregate in accordance with the gradation requirements of INDOT Standard Specifications latest edition, Section 904.03(e). Coarse Aggregate No. 53 or No. 73 shall be crushed stone or air-cooled blast furnace slag (ACBF), Class D or higher.

2.2 BEDDING MATERIALS - FOR UTILITY PIPING AND STRUCTURES

A. Pipe Classifications
1. The following pipe materials are classified as Rigid:
   a. Reinforced Concrete Pipe (RCP)
2. The following pipe materials are classified as Flexible:
   a. Polyvinyl Chloride (PVC)
   b. High Density Polyethylene (HDPE)
   c. Fiberglass Reinforced Pipe (FRP)
   d. Ductile Iron Pipe (DIP)
   e. Corrugated Metal Pipe (CMP)
   f. Polypropylene Pipe (PP)

B. Bedding for Rigid Pipes
1. Compacted Granular Bedding Material: The compacted granular bedding shall consist of angular 1/4 inch to 1 1/2 inch, graded stone. INDOT Classification No. 5, No. 8 and No. 9 are acceptable. Required backfill is then placed on top of the compacted granular bedding.
2. Shaped Subgrade Bedding with compacted granular bedding: The subgrade material shall be No. 8 crushed stone. The compacted granular bedding shall consist of angular, 1/4 inch to 1 ½ inch graded stone. INDOT Classification No. 5, No.8 or No. 9 is acceptable. Required backfill is then placed on top of the compacted angular bedding.

C. Bedding for Flexible Pipes – Sanitary and Storm Sewers
1. All flexible pipes shall be bedded in Class "F" (crushed stone) bedding. The compacted granular bedding material shall consist of angular, graded stone. INDOT Classification No. 5, No. 8, No. 9 are acceptable. The crushed stone shall be placed from a minimum depth beneath the pipe of the outer pipe diameter divided by eight (4 inch minimum) to the pipe's springline. Compacted granular bedding material is then placed on top of the crushed stone, level across the trench, to a point a minimum of 12 inches above the crown of the pipe. Required backfill is then placed on top of the compacted angular bedding.

D. Bedding for Precast Concrete Structures
1. Precast concrete base sections for structures shall be placed on a well graded, compacted granular bedding material. The compacted granular bedding material shall consist of angular, graded stone. INDOT Classification No. 5, No. 8, No. 9, in accordance with INDOT 211, is acceptable. The bedding course shall extend to the limits as shown on the Drawings.

2.3 INDOT SIEVE ANALYSIS REQUIREMENTS

A. The following lists the coarse aggregate sieve analysis requirements in accordance with INDOT Section 903:

INDOT – Sieve Analysis Requirements

Sieve Sizes	COARSE AGGREGATE SIZES (PERCENT PASSING)									
	COARSE GRADED								DENSE GRADED	
	2	5	8	9	11	12	43(1)	91	53(1)	73(1)
4 in. (100 mm)										
3 1/2 in. (90 mm)										
2 1/2 in. (63 mm)	100									
2 in. (50 mm)	80-100									
1 1/2 in. (37.5 mm)		100					100		100	
1 in. (25 mm)	0-25	85-98	100				70-90	100	80-100	100
3/4 in. (19 mm)	0-10	60-85	75-95	100			50-70		70-90	90-100
1/2 in. (12.5 mm)	0-7	30-60	40-70	60-85	100	100	35-50		55-80	60-90
3/8 in. (9.5 mm)		15-45	20-50	30-60	75-95	95-100				
No. 4 (4.75 mm)		0-15	0-15	0-15	10-30	50-80	20-40		35-60	35-60
No. 8 (2.36 mm)		0-10	0-10	0-10	0-10	0-35	15-35		25-50	
No. 30 (600 µm)						0-4	5-20		12-30	12-30
No. 200 (75 µm)(2)							0-6.0		5.0-10.0(4)	5.0-12.0
Decant (PCC)(3)		0-1.5	0-1.5	0-1.5	0-1.5	0-1.5		0-1.5		
Decant (Non-PCC)	0-2.5	0-2.5	0-3.0	0-2.5	0-2.5	0-2.0		0-2.5		

Notes: 1. The liquid limit shall not exceed 25 (35 if slag) and the plasticity index shall not exceed 5. The liquid limit shall be determined in accordance with AASHTO T 89 and the plasticity index in accordance with AASHTO T 90. 2. Includes the total amount passing the No. 200 (75 µm) sieve as determined by AASHTO T 11 and T 27. 3. Decant may be 0-2.5 for stone and slag. 4. When slag is used for separation layers as defined in 302.01, the total amount passing the No. 200 (75 µm) sieve shall be 10.0 to 12.0.

PART 3 EXECUTION

3.1 INSPECTION

A. Provide Engineer with 2 business days notice and with means to examine the areas and conditions under which excavating, filling, and grading are to be performed. Engineer will notify Contractor, in writing, if conditions are found that may be detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 TEST PITS

A. General:
   1. Contractor shall excavate and backfill, in advance of the construction, test pits to determine conditions or location of the existing utilities and structures. Contractor shall perform all the Work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, backfilling and replacing pavement for the test pits.
      a. Contractor shall be responsible for the definite location of each existing facility involved within the area of excavation for the Work under this Contract. Care shall

be exercised during such location work to avoid damaging and/or disrupting the affected facility. Contractor shall be responsible for repairing, at his expense, damage to any structure, piping, or utility caused by his Work.

3.4 DEWATERING

A. Dewatering – General:

1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the Underground Facilities to be built therein area acceptable to Engineer and backfilling operations are completed and acceptable to Engineer.
2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
4. Contractor shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
5. Remove water from excavations as fast as water collects.

B. Temporary Dewatering System:

1. Contractor shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level three below the base of each excavation during all stages of construction operations.
2. Design and operate dewatering system to avoid settlement and damage to existing structures and Underground Facilities.
3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.
4. Maintain groundwater level at excavations two feet below lowest subgrade excavation until the structure or Underground Facility, as applicable, has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.

5. Operate dewatering system continuously, 24 hours per day, seven days per week. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining Engineer's acceptance for such discontinuation.
6. If, in Engineer's opinion, the water levels are not being lowered or maintained as required, provide additional or alternate temporary dewatering devices as necessary, at no additional cost to Owner.
7. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
8. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain Engineer's acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads.
9. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.
10. Before discontinuing dewatering operations or permanently allowing rise of groundwater level, prepare computations to demonstrate that structures affected by the water level rise are protected by fill or other means to sustain uplift. Use a safety factor of 1.25 when preparing such calculations.

C. Disposal of Water Removed by Dewatering System:
1. Contractor's dewatering system shall discharge to suitable location acceptable to Owner and owners of other properties potentially affected by water discharge, including owners adjacent to and downstream of dewatering system discharge. Operation dewatering system and disposal of water shall be in accordance with Laws and Regulations.
2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
4. Dispose of water in manner that causes no inconvenience to Owner, others involved in the Project, and adjacent and downstream properties.

3.3 GENERAL EXCAVATION

A. Perform all excavations required to complete the Work as shown, specified and required. Excavations shall include earth, sand, clay, gravel, hardpan, boulders not requiring drilling and blasting for removal, decomposed material, pavements, rubbish, abandoned utilities and all other materials within the excavation limits.

B. Provide excavation protection system(s) required by ordinances, codes, Laws, and Regulations to prevent injury to workers and to prevent damage to new and existing structures or utilities.

C. Where the structure or utility is to be placed below the ground water table, use well points, cofferdams or other acceptable methods to permit construction of said structure or pipeline under dry conditions. Dry conditions shall be maintained until concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and acceptably backfilled. Water level shall be maintained below subgrade until backfilling and compaction is completed.

D. Pumping of water from excavations shall be completed in such a manner to prevent the carrying away of unsolidified concrete materials, and to prevent damage to the existing subgrade.

E. Subgrades for roadways, structures and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which become soft or mucky on top due to construction operations, shall be reinforced with crushed stone or gravel. The finished elevation of stabilized subgrades shall not be higher than subgrade elevations shown.

F. Prior to placement of aggregate base for roadways, subgrade more than 100 feet in length shall be proof-rolled with a tri-axle dump truck loaded with 20 tons and approved by the Engineer. There shall be one or two complete coverages as directed by the Engineer. Tire tracks, irregularities, or failures shall be corrected.

3.4 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown, and which is not approved by Engineer, together with the removal and disposal of the associated material shall be restored at Contractor's expense. Unauthorized excavations shall be filled and compacted with backfill, or fill material as approved by Engineer, or concrete by Contractor at no additional cost to the Owner. Claims and damages resulting from unauthorized excavation will be the sole responsibility of the Contractor.

3.5 EROSION CONTROL, DRAINAGE AND DEWATERING

A. Erosion control, drainage, and dewatering must conform to requirements in Contract Documents. Refer to Section 01 57 13 Erosion and Sedimentation Control.

3.6 SHEETING, SHORING AND BRACING

A. General:
   1. Material utilized for sheeting, shoring, and bracing shall be in good condition, not damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary Work.
   2. Unless otherwise shown, specified, or directed, all materials used for temporary construction shall be removed when Work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent Work.
   3. Safe and satisfactory sheeting, shoring and bracing shall be the entire responsibility of Contractor.

3.7 TRENCH SHIELDS

A. Excavation of earth material below the bottom of a shield shall not exceed the limits established by ordinances, codes, Laws, and Regulations.

B. When using a shield for the installation of structures, the bottom of the shield shall not extend below the top of the bedding for the structures.

C. When a trench shield is removed or moved ahead, care shall be taken to prevent the movement of pipe or structures and the disturbance of the placed bedding and backfill for pipe or structures. Pipe, structures, bedding and backfill that are disturbed shall be removed and reinstalled as specified.

3.8 GENERAL REQUIREMENTS FOR BEDDING, BACKFILL, AND COMPACTION

A. Furnish, place and compact all Special Backfill, backfill, fill, bedding and other materials required for structures, embankments, pipelines, ductbanks, and other requirements.

B. Provide the finished grades as shown and as described herein to be furnished, placed and compacted by Contractor.

C. Backfill excavations as promptly as Work permits, but not until completion of the following:
   1. Inspection, successful completion and acceptance of testing, approval, and recording of locations of Underground Facilities.
   2. Removal of concrete formwork.
   3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.

D. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material as specified.

E. Replacement of Unacceptable Excavated Materials: In cases where over-excavation for the replacement of unacceptable soil materials is required, the excavation shall be backfilled to the required subgrade with special backfill material and thoroughly compacted as specified. Sides of the excavation shall be sloped in accordance to the maximum inclinations specified for each structure location.

F. Compaction Density Requirements:
   1. The degree of compaction required for all types of backfill, special backfill, fills and bedding shall be 95 percent density as determined by the Modified Proctor Test or as approved by Engineer. Compaction may be obtained by mechanically tamping the material in 6 inch lifts. Material shall be moistened or aerated as necessary to provide the moisture content that will facilitate obtaining the specified compaction.
      a. All backfill, special backfill and fill must be wetted and thoroughly mixed to achieve +2% or -1% of the optimum moisture content, with the following exceptions: On-site clayey soils optimum to plus 3 percent.
      b. Natural undisturbed soils or compacted soil subsequently disturbed or removed by construction operations shall be replaced with materials compacted as specified above.

2. Testing service shall perform tests required to provide data for selection of backfill, special backfill, fill, and bedding material and control of placement water content.
3. Field density tests, to ensure that the specified density is being obtained, shall be performed by testing service during each day of compaction Work.
4. If the tests indicate unsatisfactory compaction, Contractor shall provide the additional compaction necessary to obtain the specified degree of compaction. All additional compaction Work shall be performed by Contractor, at no additional cost to the Owner, until the specified compaction is obtained. This Work shall include complete removal of unacceptable (as determined by the Engineer) fill areas and replacement and recompaction until acceptable backfill, special backfill, fill and bedding is provided.
5. Compaction shall be performed with equipment suitable for the type of material being placed. Contractor shall select equipment that is capable of providing the minimum density required by these Specifications. Hand operated compacting equipment shall be used within a distance of ten feet from the wall of any completed below grade structure. Equipment shall be provided that is capable of compacting in restricted areas next to structures and around piping. The effectiveness of the equipment selected by Contractor shall be tested at the commencement of compaction Work by construction of a small section of material within the area where the material is to be placed. If tests on this section of material show that the specified compaction is not obtained, Contractor shall increase the amount of coverage, decrease the lift thicknesses or obtain a different type of compactor.
6. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe, manholes, inlets or structures.

3.9 UTILITY PIPING TRENCHING, BEDDING, BACKFILL AND COMPACTION

A. Pipe trench preparation:
1. No more than 100 feet of trench may be opened in advance of pipe laying. Trenches in rock shall be fully opened at least 30 feet in advance of where pipe is being laid.
2. Trench width shall be minimized to the greatest extent practical, but shall conform to the following:
   a. Sufficient to provide room for installing, jointing and inspecting piping.
   b. Sufficient for shoring and bracing, or shielding and dewatering.
   c. Sufficient to allow thorough placement and compaction of backfill adjacent to bottom half of pipe.
3. Where the existing material beneath the bedding material is considered unsuitable by Engineer, Contractor shall remove and replace it with backfill or fill material as approved by Engineer.
4. Depth of trench shall be as shown. If required and approved by Engineer, in writing, depths may be revised.
5. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
   a. Locate and retain soil materials away from edge of excavations.
   b. Do not store within drip line of trees to be protected.
   c. Dispose of excess soil material and waste materials as specified hereinafter.

d. Stockpiled excavated soils for use as subsequent fill shall be classified by laboratory as on-site granular or sandy clay soils. Use and placement of fill shall be performed as specified for each class.

B. Placement of pipe bedding:
   1. Bedding materials, both below the bottom and above the crown of the pipe, classes of bedding to be used, and placement and compaction of bedding materials shall conform to the following requirements:
      a. Granular bedding shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.
      b. After each pipe has been graded, aligned, placed in final position on the bedding material and shoved home, sufficient pipe bedding material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and to maintain alignment during subsequent pipe jointing and bedding operations.
      c. Bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
      d. The bedding material shall then be placed and compacted to a level elevation 12 inches above the top of pipe across the trench.
      e. Each layer of bedding material shall be compacted by at least two complete coverages of all portions of the surface of each lift using appropriate compaction equipment. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of the compacting surface of the compactor.
      f. The degree of compaction required for granular bedding is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698.

C. Backfill or special backfill in pipe trenches:
   1. Special backfill and backfill shall be placed to the grades shown. Bring special backfill, backfill around structures and piping up evenly on all sides. The lift thickness and compaction moisture content range given herein is approximate. These values shall be finally determined from the laboratory test results on the materials.
   2. Compacted special backfill shall be required for the full depth of the trench above the granular pipe bedding material. Where the trench for one pipe passes beneath the trench for another pipe or electrical ductbank, the lower trench shall be compacted to the level of the bottom of the upper trench.

3. Place all special backfill in pipe trenches which are below structures, other pipes, or paved areas, in horizontal layers or lifts not exceeding 6 inches in depth and thoroughly compact each before the next layer or lift is placed.
4. In other pipe trenches, compacted layers shall be 6 inches up to the pipe center line and 8 inches thereafter.
5. Prior to the installation of pipes which are to be installed in fill sections, place the fill as described herein, until a minimum height of two feet above the soffit of the pipe is reached, unless otherwise required in other Sections. The fill for the trench width shall then be excavated and the pipe installed and backfilled. The remainder of the fill shall then be placed.
6. Pipeline trenches may be backfilled prior to pressure testing, but no structure shall be constructed over any pipeline until it has been tested.
7. The degree of compaction required for special and native backfill is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698.

3.10 MANHOLES AND DRAINAGE STRUCTURES-TRENCHING, BEDDING, BACKFILL AND COMPACTION

A. Trench preparation:
   1. Trench size shall be minimized to the greatest extent practical, but shall conform to the following:
      a. Sufficient to provide room for installing, jointing and inspecting manhole or inlet.
      b. Sufficient for shoring and bracing, or shielding and dewatering, as required.
      c. Sufficient to allow thorough placement and compaction of backfill and bedding adjacent to structure.
      d. Where the existing material beneath the bedding material is considered unsuitable by Engineer, Contractor shall remove and replace it with backfill or fill material as approved by Engineer.

B. Placement of bedding:
   1. All manholes and structures shall be placed on required bedding, as described within this Section.
   2. Approved pipe bedding material (crushed stone #5, #8 or #9, per pipe bedding detail) must be used for backfill to an elevation of 12 inch above crown of all influent/effluent pipes.

C. Placement of backfill or special backfill:
   1. Backfill or special backfill should be placed evenly around manhole in 6 inch maximum lifts and should be thoroughly tamped to standard proctor density referenced herein, before the next layer is installed.

3.11 GRADING

A. General: Uniformly grade areas within limits of grading as shown or specified, including adjacent transition areas. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Finish surfaces free from irregular surface changes, and as follows:
   1. Turfed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than 1-inch above or below the required subgrade elevations.
   2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1-inch above or below the required subgrade elevation.
   3. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 1/2 inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a ten foot straightedge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum required for each area classification.

3.12 PAVEMENT SUBBASE COURSE

A. General: Place subbase material, in layers of specified thickness, over subgrade surface to support pavement base course.
   1. Refer to Division 32 Specifications for paving requirements.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12 inch width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.
   1. When a compacted subbase course is shown to be 6 inches thick or less, place material in a single layer. When shown to be more than 6 inches thick, place material in equal layers, except no single layer more than 6 inches or less than 3 inches in thickness when compacted.

3.13 DISPOSAL OF EXCAVATED MATERIALS

A. Materials removed from the excavations which do not conform to the requirements for fill or are in excess of that required for backfill shall be hauled away from the Site by Contractor and

disposed of in compliance with ordinances, codes, Laws and Regulations, at no additional cost to the Owner.

B. Contractor shall notify Owner in writing of all offsite locations for the disposal of excavated material.

C. Pavement, gutters, curbs, sidewalks, driveways or roadways disturbed or damaged by Contractor operations, except in areas designed as proposed Work, shall be restored by Contractor at his own expense to a condition equal to or greater than they were previous to the commencement of the Work and in accordance with applicable local and state highway Specifications or requirements.

+ + END OF SECTION + +

SECTION 31 05 19

GEOSYNTHETICS FOR EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide all labor, materials, equipment, and services required to provide and place geosynthetics as shown and specified.

1.2 MEASUREMENT AND PAYMENT

A. Geotextile:
1. Work Item Number and Title
31 05 19-A Geotextile
2. This item shall include all costs associated with Site grading, including compaction, where shown on the Drawings, to adjust existing grade to new elevations. This item also includes all costs associated with scraping existing pavement, where shown on the Drawings, to remove sediment and debris.
3. The payment shall be on a lump sum basis.
4. Areas included in this item are as shown on the Drawings. Areas within the limit of trench excavation shall not be included under this pay item and are included under the pay item for the pipe material.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
1. American Society for Testing and Materials, (ASTM).
a. ASTM D1505 – Test Method for Density of Plastics by the Density-Gradient Technique.
b. ASTM D1693 – Test Method for Environmental Stress-Cracking of Ethylene Plastics.
c. ASTM D4355 - Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
d. ASTM D4491 – 99a(2009) Test Methods for Water Permeability of Geotextiles by Permittivity
e. ASTM D4632 - 08 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
f. ASTM D5199 – Test Method for Measuring Nominal Thickness of Geosynthetics.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Geosynthetic manufacturer shall be a specialist in the manufacture of geosynthetic cushion fabric, and have produced and successfully installed a minimum of five million square feet.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Submit geosynthetic manufacturer's data, Specifications, installation instructions and dimensions.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit an affidavit certifying that the filter fabric furnished complies with all requirements specified herein.
      b. No fabric shall be shipped until the affidavit is submitted to the Engineer.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. All geosynthetics delivered to the Site shall be labeled by the manufacturer identifying the manufacturer's name and product identification.

B. All rolls and packages shall be inspected by Contractor upon delivery to the Site. Contractor shall notify Engineer if any loss or damage exists to geosynthetics. Replace loss and repair damage to new condition, in accordance with manufacturer’s instructions.

C. Geosynthetics shall be protected from ultraviolet light exposure, precipitation or other inundation, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. Geosynthetic rolls shall be shipped and stored in relatively opaque and watertight wrappings.

PART 2 PRODUCTS

2.1 GEOTEXTILE

A. Woven Geotextile – Driving Surface Aggregate Separation
   1. Geotextiles for aggregate separation shall be woven to prevent elongation and provide aggregate separation. Geotextile shall conform to the following:

Physical Properties	**Test Method**	**Unit**	**Minimum Value**	**Physical Properties**
			MD	**CD**
Tensile Strength (at ultimate)	ASTM D4595	lbs/ft	2640	2460
Tensile Strength (at 2% strain)			480	588
Tensile			1212	1356

Strength (at 5% strain)				
Tensile Strength (at 10% strain)			2340	2412
Factory Sewn Seam	ASTM D4884	lbs/ft	1250	Factory Sewn Seam
Flow Rate	ASTM D4491	gal/min/ft2	50	Flow Rate
Permeability		cm/sec	0.04	Permeability
Permittivity		sec-1	0.70	Permittivity
Apparent Opening Size (AOS)	ASTM D4751	U.S. Sieve	30	Apparent Opening Size (AOS)
UV Resistance (at 500hrs)	ASTM D4355	% strength retained	80	UV Resistance (at 500hrs)

2. Product and Manufacturer:
   a. Mirafi 140N.
   b. Or equal.

B. Non-Woven Geotextiles –Aggregate Separation
1. Install Geotextiles for aggregate separation including but not limited to these applications.
   a. Temporary sediment trap
   b. Rock check dam
   c. Riprap
   d. Dewatering bag aggregate underlayment
2. Non-woven geotextiles for aggregate separation shall conform to the following:

Physical Properties	Test Method	Unit	Min Value
Grab Tensile Strength	ASTM D 4632	lbs.	200
Grab Tensile Elongation	ASTM D 4632	%	50
Puncture Strength	ASTM D4833	lbs.	500
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	#80
Flow Rate	ASTM D 4491	gal/min/ft^2	95

C. Geotextiles for Underdrains
1. Non-woven geotextiles shall be used to protect the underdrains. Non-woven geotextiles for underdrains shall conform to the following:

Physical Properties	Test Method	Unit	Min Value
Grab Tensile Strength	ASTM D 4632	lbs.	80

Grab Tensile Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs.	30
Permittivity	ASTM D 4491	sec^{-1}	2.1
Flow Rate	ASTM D 4491	$gal/min/ft^2$	155

D. Woven Geotextiles for Gabion and Revetment Mattresses
   1. Woven geotextiles for gabion and revetment mattress shall conform to the following:

Physical Properties	Test Method	Unit	Min Value
Grab Tensile Strength	ASTM D 4632	lbs.	200
Grab Tensile Elongation	ASTM D 4632	%	15
Trapezoid Tear Strength	ASTM D 4533	lbs.	75
CBR Puncture	ASTM D6241	lbs.	700
Permittivity	ASTM D 4491	sec^{-1}	0.05
Flow Rate	ASTM D 4491	$gal/min/ft^2$	4
UV Resistance	ASTM D 4355	% Strength Retained	70 @ 500 hr

   2. Product and Manufacturer:
      a. Terra Text GS.
      b. Geotex 200 ST.
      c. Or equal.

E. Woven Geotextiles for Sediment Barriers – Silt Fences
   1. Install Geotextiles for aggregate separation including but not limited to these applications.
      a. Silt Fences
      b. Temporary inlet protection
   2. Geotextile fabrics for use in sediment barriers shall conform to the following table:

Woven Geotextile Fabric Requirements			
Sediment Barrier Installation			
Physical Property	Test Method	Unit	Min. Value
Grab Tensile Strength	ASTM D 4632	lbs.	95-125
Grab Tensile Elongation	ASTM D 4632	%	15
Puncture Strength	ASTM D 4833	lbs.	60
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Sieve	#30

Permittivity	ASTM D 4491	sec^{-1}	0.1
Flow Rate	ASTM D 4491	$gal/min/ft^2$	10

F.

2.2 GEOGRID FOR SUBBASE STABILIZATION

1. Provide the following geogrid:
   a. Geogrid TX140, as manufactured by Tensar Corporation.
   a. Geogrid TX160, as manufactured by Tensar Corporation.
   b. Or equal.
2. Structural Soil Reinforcement Geogrid – The geogrid shall be integrally formed and deployed as a single layer having the following characteristics:

TX140				
Index Properties	**Longitudinal**	**Diagonal**	**Transverse**	**General**
Rib pitch, mm (in)	40 (1.60)	40 (1.60)	-	
Mid-rib depth, mm (in)	-	1.2 (0.05)	1.2 (0.05)	
Mid-rib width, mm (in)	-	1.1 (0.04)	1.1 (0.04)	
Nodal thickness, mm (in)				3.1 (0.12)
Rib shape				rectangular
Aperture shape				triangular
Rib Aspect Ratio (height: width)				> 1.0
Structural Integrity				
Junction efficiency,(1) %				93
Aperture stability,(2) kg-cm/deg @ 5.0kg-cm				3.0
Radial stiffness at low strain,(3) kN/m @ 0.5% strain				225
Radial stiffness at low strain,(3) (lb/ft @ 0.5% strain)				15,430
Durability				
Resistance to chemical degradation(4)				100%
Resistance to ultra-violet light and weathering(5)				100%

TX160				
Index Properties	**Longitudinal**	**Diagonal**	**Transverse**	**General**

Rib pitch, mm (in)	40 (1.60)	40 (1.60)	-	
Mid-rib depth, mm (in)	-	1.8 (0.07)	1.5 (0.06)	
Mid-rib width, mm (in)	-	1.1 (0.04)	1.3 (0.05)	
Nodal thickness, mm (in)				3.1 (0.12)
Rib shape				rectangular
Aperture shape				triangular
Rib Aspect Ratio (height: width)				> 1.0
Structural Integrity				
Junction efficiency,[1] %				100
Aperture stability,[2] kg-cm/deg @ 5.0kg-cm				3.6
Radial stiffness at low strain,[3] kN/m @ 0.5% strain				430
Radial stiffness at low strain,[3] (lb/ft @ 0.5% strain)				29,500
Durability				
Resistance to chemical degradation[4]				100%
Resistance to ultra-violet light and weathering[5]				100%

PART 3 EXECUTION

3.1 INSPECTION

A. Contractor shall examine the conditions under which the Work is to be installed and notify the Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 GEOTEXTILE INSTALLATION - GENERAL

A. Cut geosynthetic to proper width prior to placement. Width should be enough to conform to the trench perimeter with at least a 6 inch top overlap.

B. Place the geosynthetic roll over the trench, and unroll enough geosynthetic that the geosynthetic can be placed down into the trench.

C. Anchor the edges of the geosynthetic with heavy objects to prevent the geosynthetic from falling into the trench.

D. Where overlaps are necessary between rolls, allow for 3 foot overlap from the upstream to the downstream roll.

E. All geotextiles shall be weighted with sandbags or the equivalent when required. Such sandbags shall be installed during placement and shall remain until replaced with cover material or geomembrane.

F. Contractor shall take any necessary precautions to prevent damage to underlying layers during placement of the geotextile.

G. Geotextiles shall not be exposed to precipitation prior to being installed, and shall not be exposed to direct sunlight for more than 15 days.

3.3 GEOTEXTILE REPAIR

A. Any holes or tears in the fabric shall be repaired as follows:
   1. On slopes: A fabric patch shall be sewn into place using a double sewn lock stitch (1/4-inch to 3/4-inch apart and no closer than 1-inch from any edge). Should any tear exceed ten percent of the width of the roll, that roll shall be removed from the slope and replaced.
   2. Non-slopes: A fabric patch shall be spot-seamed in place with a minimum of 24-inches of overlap in all directions.

3.4 PLACEMENT OF COVER MATERIALS

A. Contractor shall place all cover materials in such a manner to ensure the geotextile is not damaged; minimal slippage of the geotextile on underlying layers; and no excess tensile stresses in the geotextile.

3.5 GEOGRID INSTALLATION

A. Examination
   1. The Contractor shall check the geogrid upon delivery to verify that the proper material has been received. The geogrid shall be inspected by the Contractor to be free of flaws or damage occurring during manufacturing, shipping, or handling.

B. Preparation
   1. The subgrade soil shall be prepared as indicated on the construction drawings or as directed by the Engineer

C. Installation
   1. The geogrid shall be laid at the proper elevation and alignment as shown on the construction drawings.
   2. The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.
   3. The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement procedures or weather conditions or as directed by the Engineer.

4. Granular fill material shall be placed, spread, and compacted in such a manner that minimizes the development of wrinkles in the geogrid and/or movement of the geogrid.

D. Repair
   1. Any roll of geogrid damaged before, during and after installation shall be replaced by the Contractor at no additional cost to the Owner.
   2. Proper replacement shall consist of replacing the affected area adding 3ft of geogrid beyond the limits of the affected area.

E. Protection
   1. Follow the Manufacturer's recommendations regarding protection from exposure to sunlight.

+ + END OF SECTION + +

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
4. Limits of Clearing and Grubbing: Clear and grub the areas shown or indicated on the Drawings.

B. Related Sections:
1. Section 32 12 16, Asphalt Paving.

1.2 MEASUREMENT AND PAYMENT

A. Clearing and Grubbing
1. Work Item Number and Title
31 11 00-A Clearing and Grubbing
2. The pay quantity for this item shall be the percentage of Work completed at the time of billing (i.e., 10 percent of the lump sum amount will be earned at 10 percent of earned Contract amount).
3. Payment under this item is to be lump sum basis.
4. The lump sum price shall constitute full compensation for providing all labor, materials, and equipment, both temporary and permanent, and all other cost associated with clearing and grubbing.

B. Tree Remove
1. Work Item Number and Title
31 11 00-B Remove Tree(s)
2. The pay quantity shall be the actual numbers of tree(s) removed.
3. Payment for tree removal shall be on a unit price basis for all tree(s) to be removed, as shown on Contract Drawings or as indicated by the Engineer.
4. This item shall include all costs to furnish all labor, materials, and equipment, both permanent and temporary, needed to remove trees.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Permits required for the Work under this Section include:
a. Rule 5 permit, obtain from IDEM.

1.4 SUBMITTALS

A. Action Submittals: Submit the following
   1. Shop Drawings:
      a. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
      b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

A. Protection:
   1. Throughout the Project, protect existing Site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by Contractor to original condition or replace in kind, to satisfaction of Engineer, at no additional cost to Owner.
   2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by Engineer. Correct at Contractor's expense damage caused by Contractor outside the limits of clearing Work.
   3. Do not remove trees without approval of Engineer, unless shown or indicated for removal.
   4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:
   1. Clear all areas to be occupied by permanent construction or embankments of all trees, brush, roots, stumps, logs, wood and other materials and debris. Clean and strip vegetation, sod, topsoil and organic matter from subgrades for fills and embankments. All waste materials shall be removed from the Site and properly disposed by Contractor. Burning will not be permitted.
   2. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work.
   3. Delineation of Clearing and Grubbing Limits:
      a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvageable vegetation to be relocated.
      b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with Engineer before commencing removal of trees, vegetation, and other materials to be removed.
      c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and Engineer allows removal of flagging.

4. Erosion and Sediment Controls:
    a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
    b. Comply with erosion and sediment control requirements of Section 01 57 13, Erosion and Sedimentation Controls.
    c. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

A. Remove and dispose all trees, shrubs, stumps, roots, brush, logs, rubbish, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.
    1. Items of brush which consist of fallen trees, dead material, rubbish or debris shall be removed within the entire right-of-way and easement whenever an improvement is made.
    2. All saplings or heavy brush shall be cut off close to the ground, and in no case shall any stump be left to extend above the surface of the ground more than 3 inches.
    3. Whenever any stump is loosened by excavation, it shall be fully removed and disposed as brush, and the earth cut away to a solid soil and removed as directed by the Engineer.

B. Trees and Shrubs to be Removed:
    1. Unsalvageable trees, shrubs and other vegetation indicated on Drawings for removal and shall be removed in accordance with the general clearing and grubbing requirements in 3.2 A. and 3.2 F. Disposal of Cleared and Grubbed Materials, of this specification.

C. Trees and Shrubs Improperly Destroyed or Damaged on Private Lands and Easements:
    1. Contractor has the option to come to a mutually acceptable written agreement with the owner of the property for compensation of improperly destroyed or damaged trees and shrubs. For each tree or shrub to remain that is destroyed or damaged beyond repair by Contractor, the Contractor shall replace or otherwise compensate the owner of the property per the mutually signed agreement. A signed copy of all agreements between Contractor and the owner of private property must be submitted to Owner prior to Project completion.
    2. If an agreement between the owner of property and Contractor cannot be reached, the following requirements shall be met:
        a. Trees shall be replaced with new trees by a reputable tree specialist with a minimum 1 year's growth guaranteed. The size, type and number shall be approved by the Owner. The trees shall be replaced by Contractor at no additional cost to Owner, or owner of property.

D. Trees and Shrubs Improperly Destroyed or Damaged on Public Lands or Rights of Way:
    1. For each tree or shrub to remain that is destroyed or damaged beyond repair by Contractor, provide new trees by a reputable tree specialist with a minimum 1 year's growth guaranteed. The size, type and number shall be approved by the Owner. The trees shall be replaced by Contractor at no additional cost to Owner.

E. Disposal of Cleared and Grubbed Materials:

1. Dispose at appropriate off-site location: trees, stumps, rubbish, debris, and other cleared and grubbed material. Cleared or grubbed materials may remain at the Site only when allowed in the Contract Documents or when approved by Engineer in writing. Do not use cleared or grubbed material as fill, backfill, or in embankments.
2. Dispose of cleared and grubbed material in accordance with applicable Laws and Regulations.
3. Do not burn clearing debris at the Site, unless approved by Owner and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and applicable Laws and Regulations. If burning is permitted at the Site, also comply with Owner's requirements.
4. The Contractor may elect to dispose of certain material by “chipping”; this material is to be disposed in a manner acceptable to the Engineer.

3.3 TOPSOIL REMOVAL

A. Existing topsoil to be removed is defined as friable, clay loam, surface soil present in depth of at least 4 inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over 1 inch diameter and other objectionable material.

B. Stripping:
   1. Strip topsoil to depths encountered, in a manner that prevents intermingling of topsoil with underlying subsoil or other objectionable material. Remove heavy growths of grass and vegetation from areas before stripping.

C. Properly dispose of excess topsoil off-site at a location other than the Site.

+ + END OF SECTION + +

SECTION 32 05 19.19

GEOGRIDS FOR EXTERIOR IMPROVEMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes providing all material, labor, tools and equipment for installation of geogrids as shown in the Contract Documents and as specified in this Section.

B. The (--1--) System shall be used for surface protection.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 31 00 05, Trenching and Earthwork.
   3. Section 31 05 19, Geosynthetics for Earthwork.
   4. Section (--1--).

1.2 MEASUREMENT AND PAYMENT

A. Surface Protection
   1. Work Item Title and Number

      32 05 19.19-A GeoRunner System
      32 05 19.19-B GeoGrid System
      32 05 19.19-C GeoTerra System
      32 05 19.19-D Flexamat System

   2. The quantity of surface protection systems installed shall be per the square foot of successfully installed protection systems.
   3. Payment shall constitute full compensation for laying and securing surface protection system according to the Contract Documents.
   4. These Work items shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, to install the surface protection system as shown and specified. The Work includes, but is not limited to, surface protection surface treatment placement, required anchoring and jointing systems, infill material, infill material installation, surface preparation, restoration/replacement of all disturbed items not included under other Work items, protection of existing utilities and structures, incidentals for performing all Work as specified unless otherwise outlined as a separate Work item.

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM)

1. ASTM D 1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique.
2. ASTM D 1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
3. ASTM D 5199 – Standard Test Method for Measuring Nominal Thickness of Geosynthetics.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data
      a. Submit surface protection system manufacturer's data, installation instructions, and dimensions.
   2. Shop Drawings
      a. Submit Manufacturer’s shop drawings and section layout for surface protection system.
   3. Samples
      a. Submit Manufacturer’s product samples.

B. Informational Submittals: Submit the following:
   1. Qualifications Data
      a. Certifying the installer is experienced in the installation of the specified products.
      b. Qualifications of Manufacturer’s field representative certifying the field representative is experienced in the installation of the specified products.
   2. Certificates
      a. Manufacturer's certification of polyethylene used to make cellular confinement system including;
         1) Manufacturer's certification of percentage of carbon black.
         2) Resin manufacturer's certification of polyethylene density and environmental stress crack resistance (ESCR).
   3. Source Quality Control
      a. As requested, Submit Manufacturer’s certification of compliance to all applicable testing procedures and related specifications. Request for certification shall be submitted no later than the date of order placement.

C. Closeout Submittals: Submit the following:
   1. Warranty Documentation
      a. Submit written warranty, signed by Contractor and installer, as specified.

1.5 QUALITY ASSURANCE

A. The geogrid system material shall be provided from a single Manufacturer for the entire project.

B. The Manufacturer shall have a minimum of 10 years' experience producing geogrid systems.

C. Pre-Installation Meeting: Prior to installation of any materials, conduct a pre-installation meeting to discuss the scope of work and review installation requirements. The pre-installation meeting shall be attended by all parties involved in the installation of the geogrid system.

D. Manufacturer's Field Representative Qualifications:
   1. Manufacturer shall provide a qualified field representative on site at the start of construction to ensure the surface protection system is installed in accordance with the Contract Documents.
   2. Manufacturer's field representative shall have a minimum 5 years installation experience with the specified products in the specified application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Material delivery, storage and handling must conform to requirements in Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 CELLULAR CONFINEMENT SYSTEM

A. Cellular Confinement System General
   1. Cellular confinement system shall be polyethylene stabilized black and a perforated textured cell, and shall control shearing lateral and vertical movement of the surface. Carbon Black content shall be 1.5 to 2 percent by weight, through addition of a carrier with certified carbon black content.
   2. Cellular confinement system shall conform to the Drawings and the following:

Geoweb Property	**Test Method**	**Unit**	**Min Value**
Density	ASTM D 1505	lb/ft^3	58.4-60.2
ESCR	ASTM D 1693	hours	5000
Strip Sheet Thickness	ASTM D 5199	mil	50(-5%,+10%)
Textured Sheet Thickness	ASTM D 5199	mil	60 ± 6

B. Cellular Confinement System Manufacturer:
   1. Geoweb by Presto Geosystems
   2. Or equal

C. Base Materials
   1. Polyethylene Stabilized with Carbon Black

D. Cell Properties
   1. Individual cells shall be uniform in shape and size when expanded.
   2. Individual cell dimensions (nominal) shall be dimensions ± 10%.
   3. GW20V-Cell Dimensions
      a. Length shall be 8.8 inches
      b. Width shall be 10.2 inches.
      c. Nominal area shall be 44.8 in^2 ± 1%.
      d. Nominal depth shall be (--1--)-inches.
   4. GW30V-Cell Dimensions
      a. Length shall be 11.3 inches
      b. Width shall be 12.6 inches.
      c. Nominal area shall be 71.3 in^2 ± 1%.

E. Strip Properties and Assembly
   1. Perforated Textured Strip/Cell
      a. Strip sheet thickness shall be 50 mil, minus 5 percent, plus 10 percent in accordance with ASTM D 5199. Determine thickness flat, before surface disruption.
      b. Polyethylene strips shall be textured surface with a multitude of rhomboidal (diamond shape) indentations.
      c. Textured sheet thickness shall be 60 mil plus or minus 6 mil.
      d. Indentation surface density shall be 140 to 200 per in2.
      e. Perforated with horizontal rows of 0.4 inch diameter holes.
      f. Perforations within each row shall be 0.75 inches on-center.
      g. Horizontal rows shall be staggered and separated 0.50 inches relative to hole centers.
      h. Edge of strip to nearest edge of perforation shall be a minimum of 0.3 inches.
      i. Centerline of spot weld to nearest edge of perforation shall be a minimum of 0.7 inches.
      j. A slot with a dimension of 3/8 inch x 1-3/8 inch is standard in the center of the non-perforated areas and at the center of each weld.

F. Integral components:
   1. ATRA® Clip
      a. The ATRA Clip is a molded, high-strength polyethylene device available in standard (0.5 inch).
      b. ATRA clips can be installed as an end cap on standard (0.5 inch) steel reinforcing rods to form ATRA Anchors.
   2. ATRA® Key
      a. ATRA keys shall be constructed of polyethylene and provide a high strength connection.

b. ATRA keys shall be used to connect cellular confinement panels together at each interleaf and end to end connection.

G. Stake anchorage:
   1. ATRA® Anchors
      a. ATRA Anchors shall consist of standard (0.5 inch) or metric (10–12 mm) steel reinforcing rod with an ATRA® Clip attached as an end cap.
      b. ATRA anchors shall be assembled by inserting the ATRA Clip onto the reinforcing rod so that the end is flush with the top of the ATRA Clip. Prior to attaching the ATRA Clip, the reinforcing rod shall be free from all burrs and beveled.
      c. Stake length shall be as shown in the Drawings.
   2. ATRA® Glass Fiber Reinforced Polymer (GFRP) Anchors
      a. ATRA GFRP Anchors shall be pre-assembled units consisting of the ATRA Stake Clip inserted onto a GFRP stake.
      b. The glass reinforcement content shall be 75% minimum by weight and shall be continuous longitudinal filament.
      c. Polymer shall be vinyl ester, isophthalic polyester or other matrix material.
      d. The outer surface shall be sand coated and deformed by a helical wrap of glass.
      e. The minimum compressive strength shall be 95 kips in accordance with ASTM D 638.
      f. The anchor shall be non-magnetic, non-conducting and corrosion resistant.
      g. The anchor length and placement shall be as shown in the Drawings.

H. Tendon anchorage:
   1. Tendon Type
      a. Woven Polypropylene - TPP-55
         1) Material shall be bright yellow, high-tenacity, industrial-continuous-filament, polypropylene yarn woven into a braided strap.
         2) Minimum break strength shall be 1250 lbf
      a. Woven Polyester - TP-67
         1) Material shall be bright, high-tenacity, industrial-continuous-filament, polyester yarn woven into a braided strap.
         2) Elongation shall be 9 to 15 percent at break.
         3) Minimum break strength shall be 1506 lbf for TP-67.
      a. Woven Polyester -TP-93
         1) Material shall be bright, high-tenacity, industrial-continuous-filament, polyester yarn woven into a braided strap.
         2) Elongation shall be 9 to 15 percent at break.
         3) Minimum break strength shall be 2090 lbf for TP-93.
   2. Tendon Anchorage
      a. The ATRA Tendon Clip is a molded, high-strength polyethylene device with a locking member and post with minimum pull-through of 420 lbs.

b. The ATRA Tendon Clip is the recommended anchorage connection method for securing sections with tendons for additional system hold-down.

I. Geo-synthetic Separation Layer:
1. Provide the following (--1--) as specified in Section 31 05 19-Geosynthics for Earthwork.

J. Cell Infill Materials:
1. Cell infill material shall meet the requirements specified in Section 31 00 05, Trenching and Earthwork.
2. Infill material shall be free of any foreign material.
3. Infill material shall be free-flowing and not frozen when placed in the cellular confinement system sections.

K. Source Quality Control - Cell Seam Strength Tests
1. Minimum seam strengths are required by design and shall be reported in test results. Materials submitted with average or typical values will not be accepted. Written certification of minimum strengths must be supplied to the Engineer at the time of submittals.
2. Short-Term Seam Peel-Strength Test
   a. Cell seam strength shall be uniform over full depth of cell.
   b. Minimum seam peel strength shall be 480 lbf for 6 inch depth
3. Long-Term Seam Peel-Strength Test
   a. Conditions: Minimum of 7 days in a temperature-controlled environment that undergoes change on a 1 hour cycle from room temperature to 130 degrees F.
   b. Room temperature shall be in accordance with ASTM E41.
   c. Test samples shall consist of two, 4 inch wide strips welded together.
   d. Test sample consisting of 2 carbon black stabilized strips shall support a 160 pound load for test period.

2.2 TURF REINFORCEMENT MAT (TRM)

A. TRM Materials:
1. Provide the following TRM:
   a. GeoRunner as manufactured by Presto Geoystems
   b. Or equal.

B. Material Properties:
1. Material shall be constructed of polymer.
2. Color shall be green.
3. Color shall be uniform throughout all units in a pallet.
4. Mats shall provide corrosion and chemical resistance.

C. Unit Dimensions:

1. Nominal Width shall be 24 inches.
2. Nominal Length shall be 48.75 inches.
3. Nominal Depth shall be 0.5 inches.
4. Nominal Area shall be 8 ft^2.
5. Nominal mesh openings shall be 0.84 inches square.
6. Mesh open area shall be 55% of total area.
7. Nominal weight shall be 8 pounds.

D. Accessories
   1. Connection Accessories:
      a. Nylon, X-mas tree rivets shall be used to secure the panels together on the short end (2 feet). Three rivets are required for each panel. The rivets shall be 0.312 inches thick by 1.163 inches long.
      b. Heat treated metal side clips are used to secure the panels together on the long end (4 feet). Two side clips are required for each panel to panel connection. The side clips shall be 22 gauge heat treated steel with zinc clear chromate plate.
   2. Earth Anchor:
      a. The earth anchor consists of Duckbill® anchor, 3/32 galvanized cable, ferrule, Gripple® and anchor brace. Duckbill anchor break strength shall be 300 lb.
      b. Four anchors shall be provided for each surface protection mat. Six anchors are required on the row of panels on the upstream/upslope end of the project.
      c. The anchors shall be located per Manufacturer's instructions.
      d. The drive rod is used to engage and drive the Duckbill anchor head to the depth of the cable or until the desired resistance is achieved.

E. Finishing
   1. Provide (--1--), refer to Section 32 92 00- Lawns and Grasses.

2.3 OPEN STRUCTURAL MAT

A. Structural Mat Materials:
   1. Provide the following:
      a. GEOTERRA as manufactured by Presto Geosystems
      b. Or equal.

B. Material Properties:
   1. Material shall be constructed high-performance polyethylene.
   2. Color shall be black.
   3. Mats shall provide corrosion and chemical resistance.

C. Unit Dimensions:
   1. Nominal Width shall be 3.15 feet.
   2. Nominal Length shall be 1.57 feet.

3. Nominal Depth shall be 2 inches.
4. Cell size shall be 3.1 inches x 3.2 inches.
5. Nominal weight shall be 9.05 pounds.

D. Accessories
   1. Connection Accessories:
      a. Provide PadLoc® Connection Device to join the mats together.
   2. Earth Anchor:
      a. Provide GEOTERRA Earth Anchor 800-33 with 800 lbf resistance against pullout and (33 in) cable length.
      b. Earth anchor shall have a steel cable with a formed (stamped) steel anchor head at one end and a tensioning loop at the other end. A washer and cable stop move freely along the cable.

E. Geo-synthetic Separation Layer:
      a. Provide the following (--1--) as specified in Section 31 05 19-Geosynthics for Earthwork.

F. Finishing
   1. Provide (--1--) to fill in the structural mat system cells. Refer to Section (--2--).

2.4 TIED CONCRETE BLOCK MAT

A. Structural Mat Materials:
   1. Provide the following:
      a. FLEXAMAT as manufactured by Motz Enterprises, Inc.
      b. Or equal.

B. Material Properties:
   1. Tied concrete block mat shall be manufactured from individual concrete blocks tied together with high strength polypropylene bi-axial geogrid. Each block is tapered, beveled and interlocked and includes connections that prevent lateral displacement of the blocks within the mats when they are lifted for placement.
   2. Blocks
      a. Furnish blocks manufactured with concrete conforming to the cement requirements of ASTM C150 and to the aggregate requirements of ASTM C33. Meet a minimum compressive strength of 4,000 psi at 28 days. Furnish blocks that have a minimum weight of 3 lb. per block. Blocks shall be placed no further than 2 in. apart.
   3. Polypropylene Bi-axial Geogrid
      a. Provide revetment mat that is constructed of a high tenacity, low elongating, and continuous filament polypropylene fibers that is securely cast into and embedded within the base of the concrete blocks and obtains connection strength greater than that of the geogrid.
         1) Polypropylene Geogrid shall have 2% carbon black for UV stabilization.

2) Polypropylene Geogrid shall have an Ultimate Tensile Strength of 2000 lb./ft.

4. Backing Material - Standard
   a. Erosion control blanket (ECB) consists of a specific cut of naturally seed free Great Lakes Aspen curled wood excelsior with 80% six-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. The top and bottom of each blanket is covered with degradable polypropylene netting.
5. Backing Material – Plus
   a. Erosion control blanket (ECB) consists of curled wood excelsior with 80% six-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the blanket. The top and bottom of each blanket is covered with degradable polypropylene netting.
   b. Permanent non-degradable Turf Reinforcement Mat (TRM), consists of 100% post-consumer recycled polyester (green or brown bottles) with 80% five-inch fibers or greater fiber length. It is of consistent thickness with fibers evenly distributed throughout the entire area of the TRM. The top and bottom of each TRM is covered with heavy duty polypropylene net. Fibers are tightly crimped and curled to allow fiber interlock, and to retain 95% memory of the original shape after loading by hydraulic events. Fibers have a specific gravity greater than 1.0; therefore, the blanket will not float during hydraulic events.
4. Backing Material – Filter Fabric
   a. Non-woven filter fabric backing.

C. Unit Dimensions:
   1. Width shall be (--1--) feet.
   2. Length shall be (--2--) feet.
   3. Concrete blocks shall be 6.5" x 6.5" x 2.25". There is 1.5" spacing between the blocks.
   4. Weight per square foot shall be 10 pounds.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions are as indicated on the drawings. Notify the Engineer if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

B. Verify layout of structure is as indicated on the drawings. Notify the Engineer if layout of structure is not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

3.2 INSTALLATION OF THE CELLULAR CONFINEMENT SYSTEM – LOAD SUPPORT SYSTEM

A. Prepare subgrade and install load support system in accordance with Manufacturer's recommendations.

B. Subgrade Preparation:
   1. Excavate and shape foundation soils as indicated on the Drawings.
   2. Ensure foundation soil meets minimum strength requirements through proof rolling or other conventional method and is approved by the Engineer. If unacceptable foundation soils are encountered, excavate and replace with suitable quality material as directed by the Engineer.
   3. Compact to a minimum 95 percent Standard Proctor.
   4. Install non-woven geotextile separation layer on prepared surfaces ensuring required overlaps are maintained and outer edges of geotextile are buried at least 4-inches into the surrounding surface.

C. Cellular Confinement Section Placement and Connection
   1. Place cellular confinement sections and verify all sections are expanded uniformly to required dimensions and that outer cells of each section are correctly aligned. Interleaf or overlap edges of adjacent sections. Ensure upper surfaces of adjoining cellular confinement sections are flush at joint and adjoining cells are fully aligned at the cell wall slot.
   2. Connect the cellular confinement sections with ATRA keys at each interleaf and end to end connection. Insert the ATRA key through the cell wall slot before inserting through the adjacent cell. Turn the ATRA key 90 degrees to lock the panels together.

D. Anchorage with ATRA and ATRA GFRP Anchors
   1. Position collapsed cellular confinement sections in place and partially drive appropriate anchors in the outer edge cells and expand sections into place. Partially drive appropriate anchors in the perimeter cells to keep sections fully expanded.
   2. With cellular confinement sections fully expanded, drive appropriate anchors so the arm of the ATRA Clip is through the internal slots in the cellular confinement cell wall and anchors do not protrude over the top of the cell wall.
   3. Anchorage pattern and stake length shall be as indicated on the Contract Documents.

D. Anchorage with Tendons
   1. Position collapsed cellular confinement sections into place.
   2. Feed precut lengths of specified tendon material through the integral slots in cellular confinement cell walls before expanding individual sections into position. The number of tendons per section shall be in accordance with the Contract Documents. Connect the trailing edge of the tendons to ATRA Tendon Clips.

3. Expand the cellular confinement sections and hold the sections open with temporary stakes, sandbags or stretcher frames.
4. Install the ATRA Tendon Clips at the locations indicated on the Contract Documents.
5. Hold the tendon and connect to each ATRA Tendon Clip. Refer to the Channel Installation Manual for ATRA Tendon Clip tie-off instructions.

D. Anchorage with Tendons, ATRA or ATRA GFRP Anchors
1. Position collapsed cellular confinement sections into place.
2. Feed precut lengths of specified tendon material through the integral slots in cellular confinement cell walls before expanding individual sections into position. The number of tendons per section shall be in accordance with the Contract Documents. Connect the trailing edge of the tendons to appropriate anchors.
3. Expand the cellular confinement sections and partially drive appropriate anchors in the perimeter cells and expand sections in place.
4. Attach appropriate anchors to the tendons at locations as indicated on the Contract Documents.
5. Drive appropriate anchors so the arm of the ATRA Clip is over the tendon, or the tendon is wrapped around the ATRA Clip head.
6. Anchorage pattern and stake length shall be as indicated on the Contract Documents.

E. Infill Placement
1. Place the specified aggregate infill with suitable material handling equipment.
2. Infill material shall be free-flowing and not frozen when placed in the cellular confinement sections.
3. Overfill cells with aggregate infill material. Limit the drop height of infill material to 3 feet to avoid damage or displacement of the cell wall.
4. Level surface approximately 2 inches above cell walls. Maintain the 2 inch wear surface over the cellular confinement sections to prevent damage to the cell walls.
5. Compact infill to a minimum of 95 percent Standard Proctor.
6. Shape compacted surface to required elevation as indicated on the Drawings.

E. Concrete Infill Placement
1. Concrete shall be placed, finished and cured in accordance with Section 03 00 05-Concrete.
2. Once placing operation commences, it shall be carried out as a continuous operation until a designated section is completed or as approved by the Engineer.
3. Limit the drop height of concrete to 3 feet to prevent panel distortion. Elephant trunks and/or tremies shall be used to prevent free fall of concrete.
4. Where concrete chutes are used, the end of the chute shall be baffled to prevent segregation of the concrete.

5. The concrete shall be thoroughly compacted by means of an approved vibrator. The period of vibration shall not be less than 2 seconds nor more than 5 seconds at any one point.
6. Concrete shall be flush with the top of the walls.
7. Apply specified finish.

F. Surface Treatment
1. Vegetation shall be as specified in Section 32 90 00 - Planting, and installed immediately after the infill is placed and protected with mulch.
1. Surface protection shall be installed immediately after placement of the infill material and secured per the Manufacturer's instructions.

3.3 TURF REINFORCEMENT MAT (TRM) INSTALLATION

A. General Installation
1. Verify site conditions are as indicated on the drawings. Notify the Engineer if site conditions are not acceptable. Do not begin preparation or installation until unacceptable conditions have been corrected.

B. Sub Grade Preparation
1. Prepare sub grade as specified and install protection system in accordance with Manufacturer's instructions. No depressions should exist that can retain water.
2. Excavate or fill foundation soils as required to elevations and dimensions as indicated on the Drawings or as directed by the Engineer.
3. Ensure foundation soil meets specification requirements and is examined by the Engineer. If unacceptable foundation soils are encountered, excavate affected areas and replace these areas with suitable quality material as directed by the Engineer.

C. Surface Treatment
1. The specified surface treatment shall be installed immediately after the sub grade is prepared.
2. The surface treatment shall be fertilized and watered in accordance with the Contract Documents.
3. The TRM shall be placed after the surface treatment is installed and in accordance with Manufacturer's instructions. TRMs will be secured by the anchors.

D. Placement and Connection
1. Verify all surface protection panels are installed correctly and in accordance with Manufacturer's instructions.
2. Adjacent units should not protrude above the desired surface elevation.
3. The panels shall be placed with the long direction (4 foot length) in the direction of surface.
4. Interconnect the 2 foot ends of adjoining sections by nesting the overlapping tabs and connect with 3 rivets in the pre-drilled holes.

5. Interlock the 4 foot side connections and secure together with 2 side clips equally spaced.
6. The mat protection system can be assembled in-place or pre-assembled at an off-site area and moved into place. Individual units may be used to join pre-assembled mats.
7. The mats can be cut with a hand or power saw to custom fit contours and around obstructions.

E. Anchoring
1. If required, secure the mats to the surface with earth anchors.
2. Provide 4 anchors per mat per Manufacturer's instructions, with additional anchors to be placed at the high end of the slope.
3. Engage the drive rod with the Duckbill anchor head and drive into the soil to the length of the tendon or until the desired resistance is achieved.
4. Twist and remove the drive rod and slide the anchor brace/Gripple into panel opening.
5. Using a wire gripper or other method, pull the trailing end of the cable tight engaging the cable and Gripple. The Gripple will be recessed into the panel opening and below the top of the panel when tensioned.
6. Cut the cable approximately 2 inches above the panel and loop the end back into the Gripple head.
6. Cut the cable flush with the Gripple.

3.4 OPEN STRUCTURAL MAT INSTALLATION

A. Sub Grade Preparation:
1. Prepare sub grade as specified and install protection system in accordance with Manufacturer's instructions. No depressions should exist that can retain water.
2. Excavate or fill foundation soils as required to elevations and dimensions as indicated on the Drawings or as directed by the Engineer.
3. Ensure foundation soil meets specification requirements and is examined by the Engineer. If unacceptable foundation soils are encountered, excavate affected areas and replace these areas with suitable quality material as directed by the Engineer.

B. Placement on Geotextile Fabric:
1. Install geotextile directly on the prepared area, in intimate contact with the subgrade, and free of folds or wrinkles.
2. The geotextile filter fabric will be placed so that the fabric overlaps 10-inches minimum.

C. Placement of Plastic Units:
1. Assemble mat system in place by connecting individual units or use pre-assembled, mats and connect adjoining mat sections using the PadLoc connection devices.

2. Install PadLoc straps at each one of the PadLoc sizes groove.
3. Place the first unit or assembled mat section in position and place PadLoc straps at all grove locations under the unit mat edge.
4. Insert the lifting lever under the PadLoc strap, utilize multiple levers as required.
5. Make sure that the lifting lever is directly under the PadLoc strap. Step on the lifting lever to hold up the strap firmly against the bottom of the unit.
6. While stepping on the lifting lever, place the adjoining unit or mat section in position and over the in-place PadLoc strap.
7. Place the PadLoc clamp over the adjoining unit walls and into the groove such that it engages with the PadLoc strap.
8. Place the slotted end of the torsion tool over the end of the strap so it is fulle engaged. Twist the torsion tool 90-deg so the ends of the PadLoc strap secure the PadLoc clamp and strap together.

D. Anchoring Structural Mat System:
   1. Earth Anchors
      a. Install earth anchors after the structural units system is fully assembled.
      b. Engage the drive rod with the anchor head.
      c. Holding the drive rod and cable together, place the anchor head in on of the openings in the bottom of the structural units.
      d. Using a sledge hammer, drive the anchor head through the geosynthetic layer system into the soil to the length of the cable or until resistance is reached.
      e. Remove the drive rod.
      f. Position the washer in the bottom of the structural unit cell.
      g. Attached the hook of the earth anchor set tool to the tensioning loo on the end of the cable.
      h. Hold the handle and lift vertically to set the earth anchor.

3.5 TIED CONCRETE BLOCK MAT INSTALLATION

A. Prior to installing tied concrete block mat, prepare the subgrade as detailed in the plans. All subgrade surfaces to be smooth and free of all rocks, stones, sticks, roots, and other protrusions or debris of any kind that would result in an individual block being raised more than 3/4 in. above the adjoining blocks. When seeding is shown on the plans, provide subgrade material that can sustain growth.

B. Ensure the prepared subgrade provides a smooth, firm, and unyielding foundation for the mats. The subgrade shall be graded into a parabolic or trapezoidal shape in order to concentrate flow to middle of mat or mats.

C. When vegetation is required, distribute seed on the prepared topsoil subgrade before installation of the concrete mats in accordance with the specifications.

D. Install mats to the line and grade shown on the plans and per the manufacturer's guidelines. The manufacturer or authorized representative will provide technical

assistance during the slope preparation and installation of the concrete block mats as needed.

E. Provide a minimum 18 in. deep concrete mat embedment toe trench at all edges exposed to concentrated flows. Recess exterior edges subject to sheet flow a minimum of 3 in.

F. When needed, provide fastening or anchoring as recommended by the manufacturer or engineer for the site conditions.

G. For seams, parallel to the flow line in ditch or channel applications, center a minimum 3 ft. wide strip of soil retention blanket under the seam. Fasten along the seam at 5 ft. maximum spacing. Parallel seams in the center of the ditch shall be avoided when possible.

H. Shingle seams perpendicular to the flow line with the downstream mat recessed a minimum of 2 blocks under the upstream mat and fastened together along the seam at 2 ft. maximum spacing if required by manufacturer or engineer.

++END OF SECTION++

SECTION 32 12 16

ASPHALT PAVING

PART 1 GENERAL

1.1 DEFINITIONS

A. Combined Aggregate: All mineral constituents of asphalt concrete mix, including mineral filler and separately sized aggregates.

B. RAP: Reclaimed asphalt pavement.

C. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications latest edition, Section 402.

D. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.
   2. Section 33 31 00, Sanitary Sewer Piping Installation.
   3. Section 33 39 13, Sanitary Utility Sewerage Manholes.

1.2 MEASUREMENT AND PAYMENT

A. Hot Mix Asphalt Patching
   1. Work Item Number and Title
      32 12 16-A HMA Patching
      32 12 16-B HMA Patching
   2. The payment for HMA asphalt patching shall be based on the Contract unit price per square yard for the depth shown and shall include tack coat. HMA patching shall not include surface course.
   3. The asphalt patching shall be measured in square yards per the thickness installed. The pay limits shall be equal to the pay limits of the trench width plus 2 feet. (O.D. +30”+ 2’).

B. Asphalt Surface Overlay
   1. Work Item Number and Title
      32 12 16-C Asphalt Surface Overlay
      32 12 16-D Asphalt Surface Overlay
   2. The payment for asphalt surface overlay shall be based on the unit price per square yard for the depth and shall include tack coat. This work item does not include a base or intermediate course.
   3. The overlay of asphalt surface pavement shall be measured in square yards per the thickness installed. The pay limits shall be as shown on the project drawings or field determined by the Engineer or their representative.

C. Milling
   1. Work Item Number and Title
      32 12 16-E Milling
      32 12 16-F Milling
   2. Payment under this item shall be on a unit price basis per the thickness completed.
   3. The pay quantity shall be the square yards for the depth specified as shown on the plans or directed by the Engineer and actually milled.
   4. The unit price shall constitute full compensation for providing all labor, materials, and equipment, both temporary and permanent, and all other cost associated with pavement removal. This work item does not include the cost for milling over the trench.

D. Pavement Markings
   1. Work Item Number and Title
      32 12 16-G Pavement Markings
   2. This item is measured on a lump sum basis for work shown on the plans, otherwise specified, or necessary to complete work shown on the Drawings.
   3. Payment for pavement marking work shall be paid based on the percentage of the lump sum contract price corresponding to the percentage successfully completed of work specified in the Contract Documents or shown on the plans.
   4. Pavement marking layout shall be confirmed with Montgomery County Highway Department or with INDOT Standard Specifications latest edition prior to construction of the markings.
   5. This work shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, associated with pavement traffic markings work shown on the Contract Drawings and shall include the following: recording locations of existing pavement and curb markings prior to construction, cleaning pavement or curb to be painted or marked, furnishing and installing permanent pavement markings in accordance with Montgomery County Highway Department or INDOT, and any other requirements to complete the Work in accordance with these Drawings and Specifications, unless otherwise classified by the Engineer as a separate Work item.

E. Temporary Trench Repair
   1. Work Item Number and Title
      32 12 16-H 3-inch Temporary Pavement Repair
   2. Temporary pavement repair shall be utilized with permanent pavement is not available.
   3. Contractor shall avoid removing concrete panels to the nearest joint.
   4. Temporary pavement repair shall be measured by the square yard of the thickness specified including additional base aggregate as necessary, complete in place.
   5. Limits shall be equal to the pay limits of the trench width plus 1 foot. (O.D. +30”+ 1’).
   6. This item shall include all costs for furnishing and placing all materials including furnishing additional base aggregate to construct the temporary pavement level with existing paved surfaces, placing and temporary Cold Mixed Asphalt (CMA) as shown on the Drawings, removal of CMA and base aggregate as necessary to construct permanent surface restoration, base aggregate and removal as necessary for placement of final patching.
   7. 75 percent of the payment for each square yard of temporary pavement repair will be paid for installation and maintenance of said temporary surface. Upon removal of temporary surface the remaining percentage will be paid per square yard.

8. Contractor shall also monitor and repair temporary pavement surface as necessary until the permanent surface restoration.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM International:
      a. ASTM D242, Standard Specification for Mineral Filler for Bituminous Paving Mixtures.
      b. ASTM D692, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
      c. ASTM D1073, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures.
      d. ASTM D3666, Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials.
      e. ASTM D3910, Standard Practices for Design, Testing, and Construction of Slurry Seal.
   2. Asphalt Institute (AI):
      a. MS-22, Principles of Construction of Hot Mix Asphalt Pavements
   3. Indiana Department of Transportation (INDOT) - Standard Specifications:
      a. Section 402, Hot Mix Asphalt, HMA, Pavement.
      b. Section 406, Tack Coat.
      c. Section 808, Pavement Traffic Markings.
      d. Section 904, Aggregates.
      e. Section 916, Materials Certifications.
   4. Indiana Department of Transportation (INDOT) – Design Manual:
      a. Chapter 17, Quantity Estimating.
   5. Indiana Department of Transportation (INDOT) – ITM
      a. ITM 583- Certified Hot Mix Asphalt Producer Program

1.4 SUBMITTALS

A. Job Mix Designs: For each asphalt mix design the Contractor shall submit a copy of the following information on an INDOT Material and Test Division standard form or similar:
   1. Mixture course
   2. HMA mix type
   3. Source of each asphalt material
   4. Binder
   5. Material content and percentages
   6. Proposed gradation for each aggregate to be used in flexible paving. Submit gradation test results for the dame material furnished on a previous project.
   7. Indicate proportion of bituminous material from reclaimed asphalt pavement.

B. Provide a copy of the INDOT list of certified hot mix asphalt producers, dated within the last 12 months and highlight the plant name and certification number, on the list.

C. Provide a copy of the INDOT list of approved HMA mix design laboratories, dated within the last 12 months and highlight the laboratory name and certification number, on the list.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be an INDOT certified hot mix asphalt producer, in accordance with ITM 583, and shall be listed on the most recent version of the INDOT list of certified hot mix asphalt producers, unless otherwise approved by the Owner.

B. Laboratory Qualifications: Testing laboratory shall be an INDOT certified hot mix asphalt laboratory and shall be listed on the most recent version of the INDOT list of certified hot mix asphalt laboratories, unless otherwise approved by the Owner.

C. Testing Agency Qualifications: Testing agency shall be qualified according to ASTM D 3666 for testing indicated.

D. Regulatory Requirements: Comply with INDOT Standard Specifications latest edition, Section 402 and provisions thereto for asphalt paving Work.
   1. Asphalt-Paving Publication: Comply with Asphalt Institute (AI) MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

E. Pre-construction Meeting: Conduct conference at Project Site. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
   1. Review condition of subgrade and preparatory Work.
   2. Review requirements for protecting paving Work, including restriction of traffic during installation period and for remainder of construction period.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:
   1. Tack Coats: Minimum surface temperature of 60 deg F.
   2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
   3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 PRODUCTS

2.1 AGGREGATES

A. General: All aggregates used in asphalt mixture shall be in accordance with INDOT Standard Specifications latest edition, Section 904. Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, hard, strong; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Hot Mix Asphalt (HMA) material shall conform to applicable requirements of the INDOT Standard Specification latest edition, Sections 402.

B. Tack Coat: Rapid-cure liquid asphalt conforming to INDOT Standard Specification latest edition, Section 406.

C. Water: Potable.

D. Reclaimed Asphalt Pavement (RAP): Per INDOT Standard Specifications latest edition, Section 402.08 for Recycled Asphalt Pavement shall not exceed 25% by weight (mass) of the total mixture.

E. Reclaimed Asphalt Shingles (RAS) shall not be used on design mix formulas or job mix formulas.

2.3 TEMPORARY PAVEMENT REPAIR

A. Temporary pavement repair shall be Cold Mixed Asphalt (CMA) Intermediate, No. 8 or 9 in accordance with INDOT Standard Specifications latest edition, Section 403.

2.4 PAVEMENT MARKING MATERIALS

A. Pavement marking materials shall be in accordance with INDOT Standard Specifications latest edition, Section 808 for Pavement Traffic Markings.

B. Colors:
   1. Roadway Center Markings Between Opposing Traffic Lanes: Yellow.
   2. Roadway Side Striping: White, unless otherwise shown or specified. On roads with divided median, right-side striping of each direction shall be white, and left-side striping shall be yellow.
   3. Roadway Miscellaneous Lane Markings (turn lane arrows and text): White.
   4. No-Parking Areas: Yellow.
   5. Handicap Parking Spaces: Unless otherwise indicated with signs, provide handicap symbol on pavement with white paint on blue background.

2.5 MIXES

A. Hot-Mix Asphalt (HMA): Provide dense, hot-laid, hot-mix asphalt plant mixes with the following requirements:
   1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
   2. Surface Course: In accordance with INDOT Standard Specifications latest edition
   3. Intermediate Course: In accordance with INDOT Standard Specifications latest edition
   4. Base Course: In accordance with INDOT Standard Specifications lastest edition

PART 3 EXECUTION

3.1 GENERAL

A. Traffic Control:
   1. Provide traffic control in accordance with Section 01 55 26, Maintenance and Protection of Traffic.
   2. Minimize inconvenience to traffic, but keep vehicles off freshly treated or paved surfaces to avoid pickup and tracking of asphalt.

B. Driveways: Re-pave driveways as specified in the Construction Documents. Leave driveways in as good or better condition than before start of Work.

C. Plant discharge temperature shall not be greater than 315 deg F with PG 58-28, PG 64- 22, or PG 70-22 binders. And not greater than 325 deg F with PG 70-28 or PG76-22 binders.

3.2 WEATHER LIMITATIONS

A. HMA courses less than 110 lb/sq yd are to be placed when the ambient and surface temperature are 60° F or above.

B. HMA courses equal to or greater than 110 lb/sq yd but less than 220 lb/sq yd are to be placed when the ambient and surface temperatures are 45° F or above.

C. HMA courses equal to or greater than 220 lb/sq yd and HMA curbing are to be placed when the ambient and surface temperatures are 32° F or above.

D. Mixture shall not be placed on a frozen subgrade. However, HMA courses may be placed at lower temperatures, provided the density of the HMA course is in accordance with 402.16.

E. Do not place HMA Surface mix after October 1st.

3.3 LINE AND GRADE

A. Provide and maintain intermediate control of line and grade, independent of underlying base, to meet finish surface grades and minimum thickness.

B. Shoulders: Construct to line, grade, and cross-section shown.

3.4 PREPARATION

A. Prepare subgrade as specified in Section 31 00 05, Trenching and Earthwork or INDOT Standard Specifications latest edition, Section 402.11.

B. Existing Roadway:
   1. Modify profile by grinding, milling, or overlay methods as approved, to provide transition to existing adjacent pavement and surfaces and to produce smooth riding connection to existing facility.

2. Remove existing material to a minimum depth of 1 1/2 inches.
3. Paint edges of existing adjacent pavement with tack coat prior to placing new pavement.

C. Thoroughly coat edges of contact surfaces (curbs, manhole frames) with emulsified asphalt or asphalt cement prior to laying new pavement. Prevent staining of adjacent surfaces.

3.5 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.6 PATCHING

A. Pavement Removal: Saw cut perimeter of pavement to be removed and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete (PCCP) Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.000251 Ton/Syd (0.06 Gal/Syd) per INDOT Design Manual latest edition, Chapter 17 – Quantity Estimating.
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching Base: Fill excavated pavement with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

E. Patching Surface: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.7 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
   1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.00251 Ton/Syd (0.06 gal/Syd) per INDOT Design Manual latest edition, Chapter 17 – Quantity Estimating.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.8 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt surface course in single lift.
   2. Mix temperature at time of spreading shall not be less than 18 deg F the minimum mixing temperature listed on the approved design mix formula.
   3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
   4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

D. Paver speed shall not exceed 50 feet per minute.

3.9 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches and located within 12 inches of the lane line, as applicable.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints as described in INDOT Standard Specifications latest edition, Section 402.14.
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.10 COMPACTION

A. General: Compaction shall conform to INDOT Standard Specifications latest edition, Section 402.15 for the minimum number of rollers and coverage. Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still at the highest temperature where the mixture does not exhibit any possibility for distortions.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled sufficiently to prevent distortions.

3.11 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/4 inch.
   2. Surface Course: 1/8 inch
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.12 PAVEMENT OVERLAY

A. Preparation:
   1. Remove fatty asphalt, grease drippings, dust, and other deleterious matter.
   2. Surface Depressions: Fill with asphalt concrete mix, and thoroughly compact.
   3. Damaged Areas: Remove broken or deteriorated asphalt concrete and patch as specified in Article Patching.
   4. Portland Cement Concrete Joints: Remove joint filler to minimum 1/2 inch below surface.

B. Application:
   1. Tack Coat: As specified in this section.
   2. Place and compact asphalt concrete as specified in Article Pavement Application.
   3. Place first layer to include widening of pavement and leveling of irregularities in surface of existing pavement.
   4. When leveling irregular surfaces and raising low areas, the actual compacted thickness of any one lift shall not exceed 2 inches.
   5. Actual compacted thickness of intermittent areas of 120 square yards or less may exceed 2 inches, but not 4 inches.
   6. Final wearing layer shall be of uniform thickness, and meet grade and cross section as shown.

3.13 CHIP & SEAL PAVEMENT INSTALLATION

A. Install depth at shown of compacted No. 53 stone base.

B. Provide Type 6P seal coat in accordance with INDOT Section 404.04. Refer to table below for installation requirements. Table is an excerpt from INDOT Section 404.04. .
   1.

Type (see Note 1)	Application	Cover Aggregate Size No. and Course	Rates of Application per sq yd	
			Aggregate, lb	Asphalt Material Gal at 60 deg/ F
6 or 6P	Double	Top:11 Bottom:9	18-22 28-32	0.62-0.68 0.42-0.46
Note1 – AE-90S Shall be used for type P seal coats				

C. Protect all castings, valve boxes and other utility structures from oil spray. Remove protections after pavement installation is complete.

D. Place pavement in a uniform continuous spread and operations shall not proceed such that asphalt material is allowed to set up prior to installation of the cover coat.

E. Seal stone with oil using a meter bar with emulsion spray.

F. The area shall then be rolled with a rubber tire roller.

3.14 RESTORING AND RESURFACING EXISTING ROADWAYS AND FACILITIES

A. Place a thick temporary CMA surface in accordance with INDOT Standard Specifications latest edition immediately after backfilling trenches in traveled roadways, driveways, sidewalks, or otherwise improved surfaces, which are to be retained for permanent use. The type of temporary surface shall be approved by the Engineer, or approved in accordance with authorized cut permits. Maintain the surface of the paved area over the trench in good and safe condition during progress of the entire Work, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfilling. Immediately prior to constructing permanent pavement, remove and dispose of temporary surface. The permanent replacement pavement shall be in accordance with the Contract Documents. Permanent restoration shall be completed within thirty (30) days after installation of the utility, if in proper construction season.

B. Pavement, gutters, curbs, sidewalks, driveways or roadways disturbed or damaged by Contractor operations, except in areas designed as proposed Work, shall be restored by Contractor at his own expense to a condition equal to or greater than they were previous to the commencement of the Work and in accordance with applicable local and state highway Specifications or requirements

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional Work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to INDOT Standard Specifications latest edition, Sections 402.13 and 402.15.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

F. All required testing must be witnessed and approved by the Resident Project Representative, assigned by Owner.

3.16 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project Site.
   1. Do not allow excavated materials to accumulate on-site.

3.17 TESTING FREQUENCY

A. Quality Control Tests:
   1. Asphalt Content, Aggregate Gradation: Once per every 500 Tons of mix or once every 4 hours, whichever is greater.
   2. Mix Design Properties, Measured Maximum (Rice's) Specific Gravity: Once every 1,000 Tons or once every 8 hours, whichever is greater.

B. Density Tests: Once every 500 Tons of mix or once every 4 hours, whichever is greater.

3.18 PAVEMENT MARKINGS

A. All pavement markings removed or damaged during the course of construction shall be replaced.

B. . Pavement Markings: Provide pavement markings where shown or indicated.
   1. Preparation:
      a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
      b. Do not begin marking bituminous concrete pavement until approved by Engineer.
      c. When reflective glass beads are required, mix with paint prior to paint application.
   2. Application:
      a. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's recommendations.

+ + END OF SECTION + +

SECTION 32 13 00

RIGID PAVING

PART 1 GENERAL

1.1 DESCRIPTION

A. The Work shall consist of the construction of plain non-reinforced and rigid high-early strength concrete pavement on a prepared base in accordance with these Specifications and in close conformance with the lines, grades, thickness and typical cross sections shown on the plans or established by the Engineer.

1.2 MEASUREMENT AND PAYMENT

A. PCCP
   1. Work Item Number and Title
      32 13 00-A PCCP according to INDOT Standard Specifications latest edition
      32 13 00-B PCCP according to INDOT Standard Specifications latest edition
   2. PCCP will be measured by the square yard of the thickness specified.
   3. The accepted quantities for this Work will be paid for at the unit price per square yard for the thickness specified and as listed on the submitted Bid schedule, complete in place.
   4. Removal and replacement of PCCP found to be deficient or damaged by freezing shall be completed with no additional payment.
   5. The cost of furnishing and placing all materials, not specified as a pay item, shall be included in the cost of PCCP.
   6. The cost of finishing and furnishing and placing curing materials shall be included in the cost of the PCCP.

B. D-1 Contraction joints
   1. Work Item Number and Title
      32 13 00-C D-1 Contraction Joints according to INDOT Standard Specifications latest edition
   2. D-1 contraction joints will be measured by the linear foot.
   3. D-1 contraction joints will be paid for at the unit price per linear foot as listed on the submitted Bid Schedule, complete in place, unless otherwise specified.

A. Pavement Markings
   1. Work Item Title and Number
      32 13 00-D Pavement Markings according to INDOT Standard Specifications latest edition
   2. This item is measured on a lump sum basis for work shown on the plans, otherwise specified, or necessary to complete work shown on the Drawings.

3. Payment for pavement marking work shall be paid based on the percentage of the lump sum contract price corresponding to the percentage successfully completed of work specified in the Contract Documents or shown on the plans.
4. Pavement marking layout shall be confirmed with Montgomery County Highway Department or INDOT prior to construction of the markings.
5. This work shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, associated with pavement traffic markings work shown on the Contract Drawings and shall include the following: recording locations of existing pavement and curb markings prior to construction, cleaning pavement or curb to be painted or marked, furnishing and installing permanent pavement markings in accordance with Montgomery County Traffic Engineering, and any other requirements to complete the Work in accordance with these Drawings and Specifications, unless otherwise classified by the Engineer as a separate Work item.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Concrete Institute (ACI):
      a. ACI 305R, Hot Weather Concreting.
      b. ACI 306, Cold Weather Concreting.
   2. ASTM International:
      a. ASTM C78, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   3. Indiana Department of Transportation (INDOT) - Standard Specifications:
      a. Section 501, Quality Control/Quality Assurance, QC/QA, Portland Cement Concrete Pavement, PCCP.
      b. Section 502, Portland Cement Concrete Pavement, PCCP.
      c. Section 503, PCCP Joints.
      d. Section 901, PCC Materials.
      e. Section 904, Aggregates.
      f. Section 906, Joint Materials.
      g. Section 910, Metal Materials.
      h. Section 912, Concrete Curing Materials and Admixtures.
      i. Section 913, Soil Treatment Materials.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work in this Section.

B. Provide testing during construction as required in the Indiana Department of Transportation (INDOT) Standard Specifications latest edition; Section 901.01 (b), Portland Cement.

C. Provide Quality Control/Quality Assurance for Portland Cement Concrete Pavement (PCCP) per INDOT Standard Specifications latest edition, Section 502.

1.5 SUBMITTALS

A. Product Data: Within fifteen (15) calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. INDOT Material and Test Division standard form "INDOT Concrete Mix Design Spreadsheet for English Contracts", including mix design parameters and a list of all items proposed to be provided under this Section.
   2. Certificates, signed by the materials producer and the paving Subcontractor, stating that materials meet or exceed the specified requirements per INDOT Standard Specifications latest edition, Section 502.03.

PART 2 MATERIALS AND PRODUCTS

2.1 MATERIALS

A. The materials used in concrete shall conform to the applicable INDOT Standard Specifications latest edition, Section 502 – Portland Cement Concrete Pavement and shall meet the requirements of the following subsections of INDOT Standard Specifications latest edition, Section 901.

1.	Portland Cement	901.01(b)
2.	Fine Aggregate, Size No. 23	904
3.	Coarse Aggregate, Class AP, Size 8	904.03
4.	Joint Materials	906
5.	Reinforcing Steel	910.01
6.	Concrete Curing Materials	912.01 & 912.02
7.	Air-Entrance Admixtures	912.03
8.	Water	913.01

2.2 PAVEMENT MARKINGS

A. Pavement marking materials shall be in accordance with INDOT Standard Specifications latest edition, Section 808 for Pavement Traffic Markings.

B. Colors:
   1. Roadway Center Markings Between Opposing Traffic Lanes: Yellow.
   2. Roadway Side Striping: White, unless otherwise shown or specified. On roads with divided median, right-side striping of each direction shall be white, and left-side striping shall be yellow.
   3. Roadway Miscellaneous Lane Markings (turn lane arrows and text): White.
   4. No-Parking Areas: Yellow.
   5. Handicap Parking Spaces: Unless otherwise indicated with signs, provide handicap symbol on pavement with white paint on blue background.

2.3 MIX DESIGN

A. Portland Cement Concrete
   1. The mix design shall conform to INDOT Standard Specifications latest edition, Sections 502.04 and 502.05.

2. Portland cement content..... 564 lbs/yd3
Maximum water/cementitious ratio 0.487
Maximum cement reduction for GGBFS replacement 30%
70 Fly Ash/portland cement substitution ratio..... 1.25 by weight
Maximum cement reduction for fly ash replacement 20%
GGBFS/portland cement substitution ratio..... 1.00 by weight
Slump, formed ..... 2 in. to 4 in.
Slump, slipformed..... 1.25 in. to 3 in.
Air..... .... 5.0% to 8.0%
Minimum flexural strength, third point
loading, with fly ash..... 550 psi at 28 days
Relative yield ..... 0.98 to 1.02

B. High-Early Strength Concrete
1. The mix design shall conform to INDOT Standard Specifications latest edition, Sections 502.04 and 502.05.
2. Minimum Portland cement content (type I or III)..... 564 lbs/yd3
Maximum fly ash addition..... 10% of cement content
Maximum water/cementitious ratio (type I) 0.42
Maximum water/cementitious ratio (type III)..... .0.45
Maximum GGBFS addition..... 15% of cement content
Slump, formed ..... 2 in. to 4 in.
110 Slump, slipformed..... 1.25 in.to 3 in.
Air content .... 5.0% to 8.0%
Minimum flexural strength, third point
Loading. .... 550 psi at 2 days
Relative yield ..... 0.98 to 1.02

PART 3 EXECUTION

3.1 SUBGRADE

A. The construction of the subgrade shall conform to the lines, grades and cross sections as shown on the plans and INDOT Standard Specifications latest edition, Section 502.07 and provisions thereto for subgrade preparation.

B. The subgrade material shall be brought to a firm and unyielding condition with a uniform density. All soft and yielding material that will not compact readily when rolled or tamped shall be removed and replaced with suitable material. Paving material shall not be placed on a soft, spongy, frozen or otherwise unsuitable subgrade, sub-base or base.

C. During subgrade preparation and after its completion, adequate drainage shall be provided at all times to prevent water from standing on the sub-grade.

D. Prior to placement of concrete, the subgrade or subbase shall be thoroughly moistened, but the method of moistening shall not be such as to form mud or pools of water.

E. A leveling course is not required as long as the finished sub-grade conforms to the lines, grades and cross sections as shown on the plans. However, should a leveling course be used, it shall be the material as specified for the subbase.

F. Prior to placement of the pavement, proof rolling of the subgrade shall be required as evidence that the sub-grade is in a firm and unyielding condition and completed with a uniform density. Should the subgrade, including any portion of the construction of an embankment or required cut, not meet the compaction requirements, field density tests shall be taken to demonstrate 95 percent compaction has been achieved, based upon the maximum wet density.

3.2 FORMS

A. The subgrade beneath the forms shall be cut to grade and compacted so that the forms, when set, will be firmly in contact for their whole length and at the required elevation. The forms must be set and secured so as to resist springing, settlement or other movement resulting from the placement of concrete against them or from the weight or vibration of any equipment they support.

3.3 CURING

A. Curing shall conform to INDOT Standard Specifications latest edition, Section 502.15 and provisions thereto providing for curing.

B. Concrete shall be cured by protecting it against loss of moisture, rapid temperature change or mechanical injury for at least 96 hours after placement.

C. Approved materials for use in curing include burlap cloth, waterproof paper blankets, white burlap polyethylene sheets and liquid membrane forming compounds.

D. Other methods may be approved; however, the Engineer's prior approval is required.

3.4 JOINTS

A. Joints shall be in accordance with INDOT Standard Specifications latest edition, Section 503 and provisions thereto providing for joints. Longitudinal and transverse joints are required for all concrete pavements.

B. The length between transverse contraction joints (Type D-1 contraction joint) shall not exceed 20 feet and in no case shall a transverse construction joint be placed less than 10 feet apart.

C. Longitudinal and transverse sawed joints shall be cut to 25 percent of the full depth of pavement and filled with joint sealer.

D. A 1 day preformed expansion joint shall be placed at the end of each day’s Work and a ½ inch preformed expansion joint shall be made around all box outs for manholes and/or inlets and other structures.

E. Transverse contraction joints shall be placed at every inlet, manhole or other structure in line of the pavement. The location of these structures shall determine the exact location of the

joints. All joints shall be extended throughout the pavement section and curbs to the full width.

F. Transverse joints shall match existing adjacent joint patterns.

G. Whenever the width between forms of pavement under construction is greater than 12 feet, longitudinal joints shall be constructed so as to divide the pavement into strips.

H. Retrofitted tie bars shall conform with INDOT Standard Specifications latest edition, Section 503.

3.5 COLD WEATHER TEMPERATURE LIMITATIONS

A. No concrete shall be placed during the period November 15 to April 15 without prior authorization.

B. PCCP operations shall not begin until the ambient temperature is 35 degrees Fahrenheit and rising. PCCP operations shall be discontinued when the ambient temperature is descending and is 40 degrees Fahrenheit or below. PCCP may occur outside these temperatures when authorized in writing. Regardless of placement temperature, sufficient means shall be taken to prevent the PCCP from freezing prior to attaining opening to traffic strengths in accordance with INDOT Standard Specifications latest edition, Section 502.18. Any PCCP damaged by freezing shall be removed and replaced.

C. No concrete shall be deposited on a frozen subgrade or subbase.

3.6 HOT WEATHER CONCRETING

A. Hot weather conditions will produce a rapid rate of evaporation of moisture from the surface of the concrete and accelerated setting time. Adjustment will need to be made to the PCCP mix to ensure proper handling, placing, finishing, and curing as the weather becomes just slightly warmer and climatic factors of high winds, low relative humidity, solar radiation are present at the Project Site and as temperatures rise above 75 degrees fahrenheit.

B. In the case of hot weather conditions, effective precautions shall be implemented and conform to the American Concrete Institute (ACI) 305R Standard Specifications latest edition, Hot Weather Concreting and following procedures:.
   1. Modify PCCP mix design as appropriate. Retarders, moderate heat of hydration cement, pozzolanic materials, slag, or other proven local solutions may be used. Reduce the cement content of the mixture as much as possible, while ensuring the concrete strength will be attained.
   2. Have adequate manpower to quickly place, finish, and cure the concrete.
   3. Limit the addition of water at the job Site and add water only on arrival at the job Site to adjust the slump. Water addition shall not exceed about 2 to 2 ½ gallons per cubic yard. Adding water to concrete that is more than 1 ½ hours old should be avoided.
   4. On dry and/or hot days, when conditions are conducive for plastic shrinkage cracking, dampen the subgrade, forms and reinforcement prior to placing concrete, but do not allow excessive water to pond.

5. Begin final finishing operations as soon as the water sheen has left the surface; start curing as soon as finishing is completed. Continue curing for at least 3 days; cover the concrete with wet burlap and plastic sheeting to prevent evaporation or use a liquid membrane curing compound described in ACI 306, or cure slabs with water. Retention of moisture will optimize the cement hydration process and allow the concrete to develop its full strength potential. Failure to keep exposed surfaces from drying excessively fast may result in cracking and shrinking, and jeopardizes the PCCP integrity.
6. Do not use accelerators unless it is common practice to avoid plastic shrinkage cracking and expedite finishing operations.

C. Pavement shall be closed to traffic for 14 days after it is placed. Unless test beams are taken and tested to indicate a modules of rapture of at least 550 psi. The beams shall be tested as simple beams with third point loading in accordance with ASTM C78 except:
   1. The beam size shall be measured to the nearest 1/16 inch instead of 1/10 inch.
   2. The test results shall be discarded when the break occurs outside the middle 1/3 of the beam.

3.7 CONSTRUCTION REQUIREMENTS

A. All construction requirements shall be in accordance with applicable provisions of the INDOT Standard Specifications latest edition, Section 501.

3.8 PAVEMENT THICKNESS AND SUBBASE

A. Minimum thickness for local streets shall be 7 inches.

B. Minimum thickness for a collector street shall be 9 inches.

C. Minimum thickness for an arterial or industrial street shall be 12 inches.

D. Subbase, if part of the typical roadway section, shall be 4 inches to of coarse aggregate No. 53.

3.9 NORMAL CROWN

A. The pavement crown for all streets shall be computed at a minimum rate of 1/4 inch per foot, except as otherwise noted on the plans.

3.10 CONDITIONING OF EXISTING SURFACES

A. When the surface of the existing pavement or existing base is irregular, it shall be brought to uniform grade and cross-section as directed by the Engineer.

3.11 FIELD QUALITY CONTROL

A. Site Testing Services:
   1. Contractor shall employ independent testing laboratory to perform field quality control testing for concrete. Engineer will direct where Samples are obtained.
   2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete.

3. Contractor shall provide curing and necessary beam storage. Actual curing in the pavement shall be closely paralleled.

B. Quality control testing during construction
   1. Flexural Strength Test shall be done in accordance with ASTM C78 except:
      a. The beam size shall be measured to the nearest 1/16 inch instead of 1/10 inch.
      b. The test results shall be discarded when the break occurs outside the middle 1/3 of the beam.
   2. A set of three test beams shall be made once every 150 cu yd. or once per day pouring is occurring, whichever is more frequent.
      a. Beams shall be tested for compliance with flexural strength requirements at the following cure times:
         1) One test at 7 days
         2) One test at 10 days
         3) One test at request of Engineer
   3. Pavement shall be closed to traffic until such time a flexural strength of 550 psi is achieved, per ASTM C78 and the Field Quality Control requirements of this specification.
   4. Air Test shall be done in accordance with ASTM C231; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
   5. Slump Test shall be done in accordance with ASTM C143/C143M; one test for each concrete load at point of discharge.

3.12 PAVEMENT MARKINGS

A. All pavement markings removed or damaged during the course of construction shall be replaced.

B. . Pavement Markings: Provide pavement markings where shown or indicated.
   1. Preparation:
      a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
      b. Do not begin marking bituminous concrete pavement until approved by Engineer.
      c. When reflective glass beads are required, mix with paint prior to paint application.
   2. Application:
      a. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's recommendations.

+ + END OF SECTION + +

SECTION 32 16 00

DRIVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install Portland Cement Concrete (PCCP) drives.

B. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.

1.2 MEASUREMENT AND PAYMENT

A. Driveways
   1. Work Item Title and Number
      32 16 00-F- Ashphalt Driveways
      32 16 00-G- Concrete Driveways
      32 16 00-G- Gravel Driveways

   2. Payment of these items shall be on a unit price basis for the depth and type shown on the Drawings and includes the portion of the driveway on which the sidewalk and the approach are located.
   3. The accepted quantities for driveways shall be paid at the unit price per square yard as listed on the submitted Bid schedule, complete in place.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. Indiana Department of Transportation (INDOT) - Standard Specifications latest edition:
      a. Section 502, Portland Cement Concrete Pavement, PCCP
      b. Section 610, Approaches and Crossovers
      c. Section 702, Structural Concrete

1.4 QUALITY ASSURANCE

A. Installer: Shall have a minimum of two years' experience installing PCCP driveways.

PART 2 PRODUCTS

2.1 CONCRETE

A. Concrete shall be in accordance with INDOT Standard Specifications latest edition, Section 502 for PCCP and 702 for Concrete, Class A.

B. Unless otherwise specified on the Drawings, the Work shall be plain concrete.

C. Proportioning and Design of Class "A" Concrete Mix:
   1. Minimum compressive strength at 28 days: 4,000 psi.
   2. Maximum water-cement ratio by weight: 0.45.
   3. Minimum cement content: 564 pounds per cubic yard.

2.2 GRAVEL DRIVE RESTORATION

A. Pavement replacement for the gravel driveways shall consist of 2" of INDOT #73 on 6" of INDOT 53 compacted stone. Refer to Section 31 00 05 for material gradation requirements.

PART 3 EXECUTION

3.1 DESCRIPTION

A. The Work shall consist of the construction of PCCP driveways in accordance with these Specifications and in conformance with the lines and grades shown on the Drawings or established by the Engineer. Unless otherwise noted on the Drawings, all sidewalks shall be 4 inches thick and 6 inches thick through driveways.

B. PCCP residential driveway approaches shall be 6 inches thick on top of 4 inches compacted aggregate No. 53. PCCP commercial driveway approaches shall be a minimum 8 inches thick on top of 4 inches compacted aggregate No. 53.

3.2 EXCAVATION

A. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm, even surface conforming to the section view shown on the Drawings. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

B. For curb installation, the excavation shall be made to the required depth, and the base upon which the curb is to be set shall be compacted to a firm, even surface in accordance with the section view shown on the Drawings. All soft and unsuitable material shall be removed and replaced with compacted aggregate No.53 or as specified on the Drawings.

3.3 FORMS

A. Forms shall be of wood, metal or other approved material and shall extend for the full depth of the concrete. Forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

3.4 PLACING CONCRETE

A. Concrete shall be proportioned, mixed and placed in accordance with the requirements for the class of concrete specified. After the concrete for the curb is placed, it shall be tamped and spaded or vibrated until mortar entirely covers the surface. The top shall be floated smooth and the outer upper corner rounded to a 1/4 inch radius.

B. The face and the top of the curb shall be checked with a 10 foot straight-edge. Portions showing irregularities of 1/4 inch or more shall be removed and replaced at the expense of the Contractor.

C. Compaction of concrete placed in the forms shall be by vibration or other acceptable methods. Forms shall be left in place for 24 hours or until the concrete has set sufficiently so that they can be removed without injury to the curbing. Upon removal of the forms, the exposed curbing face shall be rubbed immediately to a uniform surface. Rubbing shall be accomplished by the use of water and a carborundum brick. For the purpose of matching adjacent concrete finishes or for other reasons, the Engineer may permit other methods of finishing. Plastering will not be permitted.

D. The foundation shall be thoroughly moistened immediately prior to the placing of the concrete. The proportioning, mixing and placing of the concrete shall be in accordance with the requirements for concrete Class A in compliance with INDOT Standard Specifications latest edition, Section 604.03(d).

3.5 FINISHING

A. Comply with INDOT Standard Specifications latest edition, Section 604.03(e) and provisions thereto for finishing Work.

B. The surface shall be finished with a float. No plastering of the surface will be permitted. All outside edges of the slab and all joints shall be edged with a 1/4 inch radius edging tool.

3.6 JOINTS

A. For curb and gutter installation, where the adjacent pavement contains joints, such joints shall be continued through the integral curb. Pavement contraction joints shall be carried through integral curb with preformed joint material 1/4 inch thick, shall conform to the cross section of the curb, and shall be set perpendicular to the face and top of the curb. Preformed expansion joints shall be placed at the beginning and end of all curb returns and also at all castings.

B. Curbing that is not constructed integral with adjacent pavement shall be constructed with intermediate planes of weakness, 1/3 depth, sawed at 10 foot intervals. The width shall not be less than 1/8 inch or more than 1/4 inch, and they shall be placed at the beginning and end of all curb returns and also at all castings.

C. Expansion joints shall be carried through the sidewalk, with preformed joint filler. Expansion joints shall be a minimum of 1/2 inch wide, full depth and spaced at a distance not to exceed 48 feet. Dummy transverse joints shall be evenly spaced between expansion joints and/or drives and steps with a maximum spacing of 6 feet. Remolded expansion joint filler 1/2 inch

thick shall be provided between new and old sidewalks and driveways and abutting existing buildings or steps.

D. Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalks. Pre-molded expansion joint filler 1/4 inch thick shall be installed in these joints. This expansion joint material shall extend for the full depth of the sidewalk.

3.7 CURING

A. Concrete shall be cured for at least 72 hours. Curing shall be by means of moist burlap or mats or by approved curing compounds. The method and details of curing shall be subject to Engineer's approval. During the curing period, all traffic, both pedestrian and vehicular, shall be excluded.

3.8 RECONSTRUCTED CONCRETE SIDEWALKS OR PCCP DRIVEWAYS

A. This Work consists of the satisfactory removal, disposal of removed material and replacement of existing concrete walk or drives or the placing of new sidewalks or driveways at the locations indicated on the plans or as directed.

B. Where an existing concrete sidewalk or PCCP driveway is to be reconstructed, all disintegrated concrete, stone, or other material shall be completely removed and replaced with new concrete sidewalk or driveway in accordance with this specification.

C. The proposed concrete sidewalk shall be constructed the same width as the adjoining walk, or to a width of no less than 18 inches from the face of curb, or to another width as directed or shown on the Drawings.

D. The removal of a concrete sidewalk or PCCP driveway shall be to uniform lines as directed. The Contractor may be required to cut the sidewalk or driveway to be removed in a straight line with an approved power driven concrete saw if an existing joint is not available. The sawing shall be such that the portion of sidewalk or driveway to remain in place will not be damaged in any way. Any portion of the sidewalk or driveway, which is damaged or removed back of the established line, shall be replaced at the Contractor's expense.

3.9 BACKFILLING

A. After the concrete has set sufficiently, the spaces in front and behind the curb shall be refilled with suitable material to the required elevation in layers of not more than 6 inches and be thoroughly tamped.

3.10 CURB MACHINE

A. Curb machines may be used to construct curb provided the curb can be constructed to the requirement of these Specifications.

3.11 INTEGRAL CURB WORK

A. If integral curb Work is specified or required it shall be constructed as shown on the Drawings using Concrete, Class A.

3.12 DRIVEWAY CLOSURE AND RESTORATION

A. Property owners shall be notified of work at driveway a week prior to driveway closure.

B. Replace and repair driveways back to original condition and as specified.

+ + END OF SECTION + +

SECTION 32 92 00

LAWNS AND GRASSES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all lawns and grasses.
2. Extent of lawns and grasses is shown.
3. Types of products required include the following:
   a. Topsoil.
   b. Lawn grass seed.
   c. Fertilizers.
   d. Mulches.
   e. Erosion-control materials.
   f. Accessories.

B. Coordination:
1. Review installation procedures under other sections and coordinate the installation of items that must be installed with, or before, lawns and grasses.
2. If applicable, notify other contractors in advance of the planting of lawns and grasses to provide them with sufficient time for the installation of items that must be installed with, or before, lawns and grasses.

C. Related Sections:

1. Section 31 00 05, Trenching and Earthwork

1.2 MEASUREMENT AND PAYMENT

A. Lawns and Grasses: (Unit Price)
1. Work Item Number and Title
   32 92 00-A Seeding, Lawns and Grasses

2. Payments shall be made at the unit price per square yard as listed on the submitted Bid schedule for seeding, which shall include all required fertilizer, topsoil, mulch, final grading and equipment, unless these items are classified separately in the Contract Documents.
3. Measure of surfaces seeded shall be made of the area within the rights-of-way or easements designated by the Engineer for restoration.

1.3 REFERENCES
1. ASTM International.
   a. ASTM D5268, Specification for Topsoil Used for Landscaping Purposes.

b. ASTM D977, Specification for Emulsified Asphalt.

2. Indiana Department of Transportation Standard Specifications
   a. 621 Seeding and Sodding.

1.4 DEFINITIONS

A. The term “finish grade” shall be used to describe the finished surface elevation of planting soil.

B. The term “subgrade” shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

C. The term “topsoil” is defined as friable, clay loam, surface soil present in depth of at least 4 inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over 1 inch diameter and other objectionable material.

D. Weeds include but are not limited to: Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nible Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.5 QUALITY ASSURANCE

A. Source Quality Control:
   1. Provide topsoil that is of good, rich, uniform quality, free from any material such as hard clods, stiff clay, hardpan, partially disintegrated stone, cement, bricks, ashes, cinders, slag, concrete, bitumen or its residue, boards, sticks, chips, or other undesirable material harmful or unnecessary to plant growth. Topsoil shall be reasonably free from perennial weeds and perennial wood seeds, and shall not contain objectionable plant material.
   2. Seed that has been stored at temperatures, or under conditions not recommended by the seed Supplier, or has become wet, moldy, or otherwise damaged, shall not be acceptable.

1.6 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Composition and analysis of commercial fertilizers.
      b. Proportions of each component contained in hydroseed mixture. Identify number of pounds of each component required for each 100 gallons of water. Include the number of square feet of lawn, grass meadow or wildflower meadow mixture that can be installed with each full tank of hydroseed mixture.
      c. Seed mixture for each type of seed and each seed lot. Include bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

B. Informational Submittals: Submit the following:
   1. Source Quality Control Submittals

a. Certification of Grass and Wildflower Seed: For each grass-seed monostand and seed mixture, furnish seed supplier's certification stating the botanical and common name, and percentage by weight of each species and variety, and percentage of purity, germination and weed seed. Include the year of production and date of packaging. Certify that seed has been stored in compliance with all recommendations of the seed supplier.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Material delivery, storage and handling must conform to requirements in Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

1.8 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Proceed with and complete lawn and grass planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn and grass planting required.
   2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of lawns and grasses.
      a. Do not spread seed when wind velocity exceeds five miles per hour.
      b. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.
   3. Begin maintenance immediately after each area is planted and continue until acceptable growth is established.
   4. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:
   1. Plant during one of the following periods:
      a. Spring Planting: April 1 to June 15.
      b. Fall Planting: September 1 to October 30.
      c. During other periods, the time of planting shall be determined by the Engineer.

1.9 WARRANTY

A. General Warranty: The special warranties specified in this Section shall not deprive Owner of other rights or remedies that Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties required by Contractor under the Contract Documents.

B. Special Warranties: The Contractor shall guarantee a good stand of grass in seeded areas by watering, regrading and reseeding eroded areas and otherwise maintaining all seeded areas until final acceptance. Any areas which do not show a uniform stand or have bare spots shall be reseeded and remulched at the Contractor's expense with the same seed mixture and mulch as originally used thereon and such reseeding and remulching shall be repeated until all affected areas are covered with grass. Final acceptance of all lawn areas may be required by the Contractor after 60 days from the date of installation. The above does not release the

Contractor from the standard provisions included in the Guaranty or Maintenance Bond agreement.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil:
   1. All soil accepted as topsoil, whether obtained from on-site or off-site sources, shall comply with specified topsoil requirements.
   2. Provide fertile, friable, natural topsoil, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 1/2 inch in diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D5268.
   3. Topsoil Source: Reuse surface soil stockpiled on-site, where possible. Verify suitability of stockpiled surface soil to produce topsoil, as specified. If not suitable, amend topsoil to meet requirements approved by the Engineer. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
      a. Supplement acceptable on-site soil with manufactured topsoil from off-site sources, when quantities available on-site are insufficient to complete the Work.

B. Lawn Grass Seed:
   1. Lawn Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by INDOT 621. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, specified.
   2. Seed Species:
      a. Apply “Lawn Grass Seed” at proportioned by weight as follows (residential areas):
         1) 50 percent Premium Grade Kentucky Bluegrass (2 types).
         2) 50 percent perennial ryegrass (2 types).
         3) 0 percent noxious weeds
      b. Apply “No Mow Grass Seed” at proportioned by weight as follows (banks, etc.):
         1) 50 percent Fawn Tall Fescue (contains Endophytes).
         2) 25 percent Annual Ryegrass.
         3) 25 percent Perennial Ryegrass.
         4) 0 percent noxious weeds

C. Fertilizers:
   1. Provide commercial grade complete fertilizer of neutral character, consisting of fast and slow release nitrogen with an analysis of 12-12-12.

D. Mulches:
   1. Provide air-dry, clean, mildew-free and certified seed-free and weed-free, mulch. Mulch may consist of straw or wood cellulose fiber mulch for hydroseeding.
   2. Fiber Mulch- Biodegradable, dyed-wood, cellulose-fiber mulch; non-toxic; free of plant growth or germination inhibitors; with maximum moisture content of fifteen percent and a pH range of 4.5 to 6.5.

3. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
4. Asphalt Emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant- growth or germination inhibitors.

E. Erosion-Control Materials (for slopes greater than 1 on 3)
1. Erosion-Control Blankets shall meet the requirements of Section 01 57 13, Erosion and Sedimentation Control.

F. Water:
1. Provide water acceptable for lawn and grass application, containing no material harmful to plant growth and establishment, and be free from oil, acids, alkalis, and salts.

PART 3 EXECUTION

3.1 INSPECTION

A. Contractor shall examine the areas and conditions under which lawn and grass Work is to be performed, and notify Engineer, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2 PREPARATION

A. Incorporate fertilizers, after spreading Topsoil, as specified, and at a rate of:
1. Fertilizer: 18 pounds per 1,000 square feet.

B. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
1. Protect adjacent and adjoining areas from hydroseeding overspray.

C. Provide erosion-control measures, in accordance with Section 01 57 13 Erosion and Sedimentation Control, to prevent erosion or displacement of seeded soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown. Refer to Section 31 00 05, Trenching and Earthwork.

E. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

A. Immediately prior to dumping and spreading topsoil, clean subgrade of all stones greater than 1 inch and all other extraneous matter. Remove all such material from Site. Notify Engineer that subgrade has been cleaned, and obtain approval prior to spreading topsoil.

B. Do not attempt to spread excessively wet, muddy or frozen topsoil. Do not spread topsoil more than five days before seeding or planting.

C. Spread topsoil to a depth of 2" but not less than required to meet finish grades after light rolling and natural settlement.
   1. The area to be seeded shall be made smooth and uniform and shall conform to the finished grade and cross section shown on the Drawings or as directed by the Engineer.

3.4 CONVENTIONAL SEEDING

A. General: Maintain grade stakes until removal is mutually agreed upon by all parties concerned.

B. Rake or harrow all seedbeds immediately prior to seeding to produce a rough, grooved surface, no deeper than 1 inch. Seed only when seedbed is in a friable condition and not muddy or hard.

C. Sow seed using a spreader or seeding machine.

D. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.

E. Sow lawn grass seed mixture at the rate of not less than 5 pounds for every 1,000 square feet.

F. All seeded areas shall be thoroughly mulched by a method approved by the Engineer. Mulching material shall be applied uniformly in a continuous blanket at a rate of 92 pounds per 1,000 square feet. Mulch shall be punched into the soil so that it is partially covered. The punching operation shall be performed longitudinally with a mulch tiller. Care shall be exercised to obtain a reasonably even distribution of mulch incorporated into the soil.

G. Using a uniform fine spray, irrigate lawn and grass plantings as required to obtain adequate establishment of lawns and grasses.

H. Reseed areas that remain without mulch for longer than 3 days.

I. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

J. Prevent foot or vehicular traffic, or the movement of equipment, over the mulched areas. Reseed areas damaged as a result of such activity.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

B. Mix slurry with asphalt-emulsion tackifier.

C. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry application at a rate of 7 pounds per 1,000 square feet, but not less than the rate required to obtain specified seed-sowing rate so that the seed comes into direct contact with topsoil.

D. Fertilizer shall be applied as specified at a rate of 2 1/2 to 4 pounds per square foot.

E. Application:
   1. Application Rate: 3,500 lbs per acre
   2. Prior to application and mixing of the hydraulic growth medium it is recommended that the site be measured and marked to known areas to ensure appropriate seed, amendment, and hydraulic growth medium application rates.
   3. Bring hydroseeder to appropriate operating speed and agitator speed for slurry application.
   4. Apply in a consistent and even manner across soil surface.
   5. Apply from opposite directions to ensure the highest level of coverage, effectiveness, and performance.
   6. If you need to stop spraying at any time, close the spray nozzle at the end of the hose to avoid water draining from the hose. If you are using a tower applicator, stop normally and upon restart remove the spray tip, discharge a small amount of hydraulic growth mediums, replace the tip and return to applying the product.
   7. Tillage of hydraulic growth medium into subsoil strictly not recommended in any situation.

3.6 RECONDITIONING EXISTING LAWNS AND GRASS AREAS

A. Recondition existing lawn damaged by Contractor's operations, including areas used for storage of materials or equipment and areas damaged by movement of vehicles. Recondition existing lawn and grass areas where minor regrading is required.

B. Recondition other existing lawn and grass areas shown.

C. Provide fertilizer, seed or sod and soil amendments, as specified for new lawns and grass areas, and as required to provide satisfactorily reconditioned lawns and grass areas. Provide new topsoil as required to fill low spots and meet new finish grades.

D. Till stripped, bare, and compacted areas thoroughly to a depth of 12 inches.

E. Remove diseased or unsatisfactory lawn and grass areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from Contractor's operations including oil drippings, stone, gravel and other construction materials.

F. In areas approved by Engineer, where substantial lawns and grass areas remain (but are thin), mow, dethatch, core aerate and rake. Fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers, as required. Apply seedbed mulch, if required, to maintain moist condition.

G. Water newly planted areas and keep moist until new lawns are established, as specified.

3.7 ACCEPTANCE CRITERIA FOR LAWNS AND GRASS AREAS

A. Lawn and grass Work will be considered acceptable when:
   1. Areas Seeded with "Lawn Grass Seed" Mixture: When a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 square feet and bare spots not exceeding 5 inches by 5 inches.
   2. Areas Seeded with "No-Mow Grass Seed" Mixture: When a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 20 square feet and bare spots not exceeding 12 inches by 12 inches.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris, created by lawn and grass Work, from paved areas. Clean wheels of vehicles before leaving Site to avoid tracking soil and topsoil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required protecting newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.

C. Take all precautions to ensure that hydroseed slurry is only placed on the areas designated. Completely clean any overspray, on areas not designated to receive slurry.

3.9 INSPECTION AND ACCEPTANCE

A. Where lawns and grass areas do not comply with specified acceptance criteria, reestablish lawns and grasses and continue extended service period until lawns and grasses comply with criteria for acceptance.

+ + END OF SECTION + +

SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall furnish and install pipe by horizontal directional drilling (HDD) construction methods, as shown on the drawings and conform to this specification. The Work includes, but is not limited to, excavation, dewatering, removal of all materials encountered in the drilling operations, disposal of all material not required in the Work, as shown on the drawings and as specified herein.
   2. Contractor shall be responsible for the final constructed product, and for furnishing the permits, qualified labor and superintendence necessary for this method of construction.

B. Coordination:
   1. Review construction sequencing and installation procedures under other Sections.
   2. Contractor responsible to coordinate between other construction contracts that may be on going simultaneously.

C. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.
   2. Section 33 05 38.16, HDPE Pressure Utility Piping.

1.2 MEASUREMENT AND PAYMENT

A. Measurement and payment for HDD installation of piping and associated appurtenances shall be included in the measurement and payment of each pipe material, except for specific Work items listed in other specification sections.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM International.
      a. ASTM D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
      b. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
      c. ASTM D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
      d. ASTM F-714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
   2. American Water Works Association
      a. AWWA C651, Disinfecting Water Mains

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including.
      a. Indiana Department of Environmental Management
      b. INDOT Right-of-Way permit and other permits deemed necessary by Owner
   2. Obtain required permits for Work in roads, rights of way, and other areas of the Work, unless otherwise stipulated by Owner.

B. The Contractor or sub-contractor performing the horizontal directional drilling work shall have previous experience with projects of similar size, type and complexity.

C. All supervisory personnel must be adequately trained in directional drilling.

1.5 SUBMITTALS

A. The Contractor shall prepare and submit for review only, prior to the start of construction, the following:
   1. Horizontal Directional Drilling Plan describing the equipment, methods, procedures (pilot hole drilling, insertion, reaming, pullback, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, purging, etc.), monitoring procedures (pressures, depth, alignment, placement, entrance and exit points, etc.), construction sequence and scheduling, contingency plans, and other items of concern to be performed during the horizontal directional drilling process.
   2. Project Safety Plan.

B. Informational Submittals: Submit the following:
   1. Field Quality Control Submittals:
      a. Results of each specified field quality control test.
   2. When requested by Engineer, submit:
      a. Information on previous horizontal directional drilling projects, both firm and employees, of similar size, type and complexity.
      b. A list of references of persons or firms who can attest to the quality of performed work.

   3. The following product data is required from the pipe supplier and/or fusion provider:
      a. Pipe Size
      b. Dimensionality
      c. Pressure Class per applicable standard
      d. Color
      e. Recommended Minimum Bending Radius
      f. Recommended Maximum Safe Pull Force
      g. Fusion technician qualification indicating conformance with this specification

C. Closeout Submittals: Submit the following:
   1. Record Documentation:

a. Maintain accurate and up-to-date record documents in accordance with 01 78 39, Project Record Drawings showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
c. Include profile drawings with buried piping Record Documents when the Contract Documents include piping profile drawings.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Material delivery, storage and handling must conform to requirements in Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
1. Refer to division 33 specification sections for pipe material requirements.

B. Equipment Requirements:
1. The Contractor shall ensure that appropriate equipment is provided to facilitate the installation. Equipment shall be matched to the size of pipe being installed and shall have appropriate torque and thrust/pullback capacity for the diameter and length of the intended drilling sections. The Contractor will ensure that the drill rod can meet the bend radius required for the proposed installation.

C. Drilling Fluids:
1. A mixture of bentonite clay or other approved slurry and potable water shall be used as the cutting and soil stabilization fluid. The viscosity shall be varied to best fit the soil conditions encountered. Water shall be clean and fresh. No other chemicals or polymer surfactant is to be used in the drilling fluid without the written consent of the Engineer and after a determination is made that the chemicals to be added are not harmful or corrosive to the facility and are environmentally safe.
2. The Contractor shall identify the source of fresh water for mixing the drilling mud. The Contractor shall be responsible for approvals and permits required for such sources as streams, rivers, ponds, or fire hydrants. Any water source other than potable water may require a pH Test.
3. Monitoring of the drilling fluids such as the pumping rate, pressures, viscosity, and density is required during the pilot bore, back reaming, and pipe installation stages, to ensure adequate removal of soil cuttings and the stability of the bore hole. Relief holes can be used as necessary to relieve excess pressure down hole. To minimize heaving

during pullback, the pull back rate is determined in order to maximize the removal of soil cuttings without building excess down hole pressure. Excess drilling fluids shall be contained at entry and exit points until they are recycled or removed from the site. Entry and exit pits shall be of sufficient size to contain the expected return of drilling fluids and soil cuttings.

4. The Contractor shall ensure that all drilling fluids are disposed of or recycled in a manner acceptable to the appropriate local, state, or federal regulatory agencies. When drilling in suspected contaminated ground, the drilling fluid shall be tested for contamination and disposed of appropriately. Any excess material shall be removed upon completion of the bore.
5. Restoration for damage caused by heaving, settlement, escaping drilling fluid (fracout) or the directional drilling operation, is the responsibility of the Contractor. Any pavement heaving or settlement damage requires restoration/replacement of the pavement per applicable standards of authorities having jurisdiction.

D. Buried Piping Identification
   1. Refer to applicable Division 33 installation Section.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Contractor shall install the pipelines by means of horizontal directional drilling as shown, specified and as recommended by the manufacturer.
   2. Contractor shall be responsible for his means and methods of directional drilling construction and shall ensure the safety of the work, the Contractor’s employees, the public, and adjacent property, whether public or private.
   3. Contractor shall anticipate that portions of the drilled excavation will be below the groundwater table.
   4. Contractor shall comply with all local, state, and federal laws, rules, and regulations at all times to prevent pollution of the air, ground, and water.
   5. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from Engineer before proceeding.
   6. The pipe shall be installed in the location and to the line and grade designated on the drawings.
   7. Provide for testing and cleanup as soon as practicable, so these operations do not lag far behind pipe installation. Perform preliminary cleanup and grading operations immediately after backfilling.
   8. All surfaces shall be finish graded to original contours and ground cover.
   9. Excavated material, which is not removed from the immediate site, shall be stockpiled so as to cause as little inconvenience to the property owners as possible. Driveways and street crossings must be kept clear.
   10. Excavation for entry, recovery pits, slurry sump pits, or any other excavation shall be carried out in accordance with Specification Section 31 00 05, Trenching and Earthwork. Sump areas or holding tanks are required to contain drilling fluids.

11. After completing installation of the product the work site shall be restored. The work site shall be cleaned of all excess slurry left on the ground. Removal and final disposition of excess slurry or spoils as the product is introduced shall be the responsibility of the Contractor.
12. Excavated areas shall be restored in accordance with the Contract Documents. The cost of restoring damaged pavement, curb, sidewalk, driveways, lawns, storm drains, landscape, and other facilities is borne by the Contractor.
13. If underground utilities and/or structures not shown on the Drawings are encountered, notify the Owner and do not proceed until instructions are obtained. Notify the Owner if springs or running water are encountered.

B. Utility Verification (Potholing)
1. Prior to the start of water main construction, Contractor shall verify all underground utilities (potholing) that may conflict with water main construction. Cost of potholing shall be included in the cost of the pipe installation unit price.
2. Potholing results shall be presented to the Engineer on a full set of drawings showing accurate locations of utilities. Information marked on the plans should include horizontal tie downs as well as depths related to USGS elevation.
3. Alignment of the proposed water main (horizontal and vertical) may be adjusted in the field upon review of potholing results by the Engineer.

C. Locating and Protecting Existing Building Sewers.
1. Building sewers are considered "private" and are not part of the public sewer system and begin at the inside face of the public sewer.
2. City Utilities will televise the sanitary sewer main and furnish the Contractor with sanitary sewer tap locations, to the best of their ability, as a measurement from the downstream manhole.
3. It shall be the Contractor's responsibility to pothole and verify the location of the underground utility that may be in conflict with the water main construction.
4. It shall be the Contractor's responsibility to protect building sewers during all construction activities.
5. Any and all costs associated with locating, protecting, and repairing building sewers shall be considered incidental to the project cost and the responsibility of the Contractor.

D. Drilling Operations:
1. Bore path and alignment are as indicated in the Contract Documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the Contract Documents.
2. Bend radii shown in the Contract Documents are minimum allowable radii and shall not be reduced.
3. Directional drilling/boring shall use techniques of creating or directing a borehole along a predetermined path to a specified target location. Directional drilling shall involve use of mechanical and hydraulic deviation equipment to change the boring course and Contractor shall use instrumentation to monitor the location and orientation of the boring head assembly along a predetermined course.
4. Drilling shall be accomplished with fluid assisted mechanical cutting. The spoils shall be transported from the Site and be properly disposed. Under no circumstances will the

drilling spoils be permitted to be disposed into waterways, sanitary, storm, or any other public or private drainage system.

5. Steering shall be accomplished by the installation of an offset section of drill stem that causes the cutterhead to turn eccentrically about its centerline when it is rotating. When steering adjustments are required, the cutterhead offset section is rotated toward the desired direction of travel and the drill stem is advanced forward without rotation. Pilot hole shall be drilled on bore path with no deviations greater than 5% of depth over a length of 100-feet. In the event that pilot does deviate from the bore path more than 5-feet of depth in 100-feet, Contractor will notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation. In the event that a drilling fluid fracture, inadvertent return, or returns loss occurs during pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and wait another 30 minutes. If mud fracture or returns loss continues, Contractor will discuss additional options with the Engineer and work will then proceed accordingly.

E. Locating and Tracking:
   1. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot bore/hole and measure drilling fluid flow and pressure.
   2. The Contractor shall describe the method of locating and tracking the drill head during the pilot bore. The Owner recognizes walkover, wire line, and wire line with surface grid verification, or any other system as approved by the Engineer, as the accepted methods of tracking directional bores. The locating and tracking system shall be capable of ensuring that the proposed installation is installed as intended. The locating and tracking system shall provide information on:
      a. Clock and pitch information
      b. Depth.
      c. Battery status.
      d. Position (x,y).
      e. Azimuth, where direct overhead readings (walkover) are not possible (i.e. subaqueous or limited access transportation facility.)
      f. Alignment readings or plot points shall be taken and recorded every 5 feet.
      g. Before commencement of a directional drilling operation, proper calibration of the equipment (if required) shall be undertaken.
   3. Contractor shall provide Engineer access to all data and readout pertaining to the position of the bore head and fluid pressures and flows.
   4. All facilities shall be installed in such a way that their location can be readily determined by electronic designation after installation. For non-conductive installations this shall be accomplished by attachment of tracing wire, as buried piping identification.
   5. The drill path shall be accurately surveyed with entry and exit areas placed in the appropriate locations within the areas indicated on drawings. If using a magnetic guidance system, drill path will be surveyed for any surface geomagnetic variations or anomalies.
   6. Entry and exit areas shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe supplier.

F. Ream and Pullback:

1. After an initial bore has been completed, a reamer will be installed at the termination/exit pit and the pipe will be pulled back to the starting/entry pit.
2. Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor.
3. Back ream hole diameter shall be no greater than the sum of the maximum product outside diameter (OD) plus 6 inches.
4. The maximum allowable pull exerted on the pipe pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.
5. A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
6. The lead end of the pipe shall be closed during the pullback operation.
7. The pipelines shall be adequately supported by rollers and side booms and monitored during installations so as to prevent over stressing or buckling during the pullback operation.

G. HDPE Pipe Supports:
1. The Contractor shall protect the HDPE pipe from damage prior to installation. At no time shall the HDPE be dragged against rough or abrasive surfaces which may cause exterior scrapes, gouges or wear prior to the pullback operation. Provide pipe supports to protect pipe from scraping and gouging.
2. Support/Rollers shall be spaced at a maximum of 60 feet on centers, and the rollers shall be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback.

H. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

3.2 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
1. Locations of existing piping shown on the Drawings shall be considered approximate.
2. Contractor shall determine the true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by Contractor's Work.

B. Taking Existing Pipelines Out of Service:
1. Do not take pipelines out of service unless approved by Engineer.
2. Notify Engineer, in writing, at least 48 hours prior to taking pipeline out of service.

3.3 QUALITY CONTROL

A. A representative of the Contractor must be in control of the operation at all times. The representative must have a thorough knowledge of the equipment and the procedures to be performed, and must be present at the job site during the installation.

B. The Owner must be notified 48 hours in advance of starting work. The installation shall not begin until the Owner's representative is present at the job site and agrees that proper preparations have been made.

3.4 TESTING OF PIPING

A. General:
   1. Refer to Section 33 31 00, Sanitary Sewer Piping Installation specifications for testing requirements.
   2. When there is any indication a pipe has sustained damage and may leak, the Work is to be stopped and the damage investigated. The Engineer may require a pressure test. The testing may consist of one of the following methods but shall always meet or exceed Engineer's testing requirements:
      a. Manufacturer's pressure testing recommendations for the type of pipe being installed are followed. The Engineer shall be notified and at his/her option be present during the test for review of the test results for compliance. The pressure test shall be performed within twenty-four (24) hours. A copy of the test results shall be furnished to the Engineer. If the pipe is not in compliance with specifications, the Owner may require it to be filled with flowable fill.
      b. Product carrier pipes installed without a casing shall meet pressure requirements set by the Engineer. A copy of the test results shall be furnished to the Engineer. If the pipe is not in compliance with specifications the Owner may require it to be filled with flowable fill.

3.5 CLEANING AND DISINFECTION

A. General:
   1. Refer to applicable Division 33 piping installation specification for cleaning and disinfection requirements.

+ + END OF SECTION + +

SECTION 33 05 23.16

UTILITY PIPE JACKING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavation for approach trenches and pits
   2. Casing pipe
   3. Carrier pipe

B. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.
   2. Section 33 05 37.13, PVC Non-Pressure Utility Piping.

C. Utility pipe jacking shall comply with the following Specifications, as well as the requirements on the Drawings.

1.2 MEASUREMENT AND PAYMENT

A. Utility Pipe Jacking
   1. Work Item Number and Title
      33 05 23.16 Utility Pipe Jacking
   2. The quantity of utility pipe installed by jack and bore shall be measured horizontally along the centerline of the successfully installed steel casing as shown and specified.
   3. The payment of utility pipe jacking shall be based on the unit price per linear foot as listed on the submitted Bid schedule and shall include all labor, materials, tools, excavation, and equipment needed in accordance with the Contract Documents. Payment for any backfill or associated restoration shall be paid for under their respective Work items.
   4. This item shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, to install the utility pipe jacking as shown and specified. The Work includes, but is not limited to, pavement removal, boring and receiving pit excavation, disposal of excavated material, dewatering, furnishing and placement of bedding, carrier and casing pipe, casing pipe blocking plugging, end seals, casing spacers, placement of required backfill, required fittings and couplings, temporary surface, testing of materials, compaction of bedding and backfill, temporary sheeting, shoring and bracing, restoration/replacement of all disturbed items not included under other Work items, protection of existing utilities and structures, pressure and deflection testing and incidentals for performing all Work as specified unless otherwise broken down as a separate Work item.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:

1. American Association of State Highway and Transportation Officials.
    a. AASHTO M133 – Standard Specification for Preservatives and Pressure Treatment Processes for Timber.
    b. AASHTO T180 – Standard Specification for Moisture – Density Relations of Soils Using a 10-lb Rammer and a 18-inch Drop.
2. American Railway Engineering and Maintenance-of-Way Association.
    a. AREMA – Manual for Railway Engineering.
3. ASTM International.
    a. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
    b. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. ASTM C33 – Standard Specification for Concrete Aggregates
    d. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
    e. ASTM C150 – Standard Specification for Portland Cement.
    f. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
    g. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN – m/m3)).
4. American Welding Society:
    a. AWS D1.1 – Structural Welding Code – Steel.
5. National Utility Contractors Association:
    a. NUCA – Guide to Pipe Jacking & Microtunneling.
    b. NUCA – Trenchless Excavation Construction Equipment & Methods Manual

1.4 PERMITS

A. All crossing permits(s) will be obtained by the Contractor.

B. Contractor shall follow all requirements of the permits(s) obtained from the INDOT.

C. Contractor shall give notice to the INDOT prior to the start of Work. Do not start Work until all arrangements are completed and permission is granted by the INDOT to start the Work.

1.5 DESIGN REQUIREMENTS

A. Design casing pipe and joints for leak proof construction.
    1. Highway Crossings: Verify required loadings specified in the applicable permit and design casing for earth and/or other pressure loads present, plus AASHTO H20 live loading.
    2. Railroad Crossing: Verify required loadings specified in the applicable permit and design casing for earth and/or other pressure loads present, plus railroad E80 live loading with 50 percent added for impact.

B. Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe section and as conditions permit, to minimize tendency of ground material to “freeze” around casing pipe.

C. Meet all design requirements of the permitting entity responsible for this infrastructure being crossed.

1.6 SUBMITTALS

A. Qualification Data: Submit the following:
   1. Submit history of previous Work completed of equivalent nature and scope. Include qualification and experience of key personnel.
   2. Submit list of references upon request.

B. Installation Plan: Submit the following:
   1. Description of proposed construction plan, dewatering plan and plan to establish and maintain vertical and horizontal alignment. Construction plan shall include general layout and location of all bore pits, receiving pits, and material lay down areas required.

C. Project Record Documents:
   1. Record actual locations of casing or tunnel liner, carrier pipe, and invert elevations. Refer to Section 01 78 39 Project Record Document.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with INDOT and Motgomery County Highway Department, NUCA Trenchless Excavation Construction Equipment & Methods Manual, NUCA Pipe Jacking & Microtunneling Design Guide, AREMA, and Association guidelines.

B. When boring, jacking, or tunneling under INDOT property, make application for and obtain occupancy permit as required in the INDOT Specifications and requirements.

1.8 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum of (5) years documented experience.
   1. Work Experience: Include projects of similar magnitude and conditions.
   2. Furnish list of references upon request.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Material delivery, storage and handling must conform to requirements in

B. Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

C. Protect piping from entry of foreign materials and water by temporary covers, completing sections of Work, and isolating parts of completed system.

D. Accept system components on site in manufacturer’s original containers or configuration. Inspect for damage.

E. Use wooden shipping braces between layers of stacked pipe. Stack piping lengths no more than 3 layers high.

F. Support casing and carrier pipes with nylon slings during handling.

1.10 FIELD MEASUREMENTS

A. Verify invert elevations of existing Work prior to excavation and installation of casing.

PART 2 PRODUCTS

2.1 CASING AND JACKING PIPE MATERIALS

A. Furnish materials in accordance with the INDOT Standard Specifications latest edition.

B. Steel Casing Pipe:
   1. minimum yield strength,
   2. minimum wall thickness
   3. Full circumference welded joints in accordance with AWS D1.1. and able to withstand excavation forces.

2.2 CARRIER PIPE MATERIALS

A. Refer to INDOT Standard Specifications latest edition for pipe material requirements.

2.3 END SEALS AND COVER MATERIALS

A. Cover Materials
   1. Soil Backfill for Trench Approaches and Pits to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

B. End Seals:
   1. Brick and Mortar Grout Mix: One part Portland cement, and 6 parts mortar sand mixed with water to consistency applicable for brick and mortar grouting.
   2. Mortar Sand: ASTM C33
   3. Portland Cement: ASTM C150
   4. Carrier Pipe Padding: 15 pound Building Felt

2.4 ACCESSORIES

A. Casing Spacers:
   1. Products and Manufactures: Provide casing spacers from the following:
      a. CCS Series by Cascade Waterworks Mfg.
      b. Or approved equal.

B. Steel Strapping: ASTM A36/A36M.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify connection to existing piping system size, location, and invert elevations are in accordance with Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Locate, identify, and protect utilities indicated to remain from damage.

C. Protect plant life, lawns, and other features remaining as portion of final landscaping.

D. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Establish minimum separation from other services sanitary sewer piping, water, etc. piping in accordance with local code.

3.3 DEWATERING

A. Intercept and divert surface drainage precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps, or other means.

B. Develop substantially dry sub-grade for prosecution of subsequent operations.

C. Comply with State or Municipality requirements for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.

3.4 EXISTING WORK

A. Maintain access to existing facilities and other remaining active installations requiring access. Modify installation as necessary to maintain access.

3.5 PITS OR APPROACH TRENCHES

A. Excavate approach trenches or pits in accordance with installation plan or in accordance with Shop Drawings and as Site conditions require.

B. Ensure casing, entrance face as near perpendicular to alignment as conditions permit.

C. Establish vertical entrance face at least 1 foot above top of casing.

D. Install adequate dewatering measures and excavation supports as required to prevent damage to the INDOT property.

3.6 CASING END SEAL

A. The ends of the casing pipes shall be bulkheaded using brick and mortar construction in such a manner as to prevent entrance of foreign material, but not tightly sealed as to prevent escape of water in case of carrier pipe failure.

B. Place bricks and mortar as required to seal the casing pipe.

C. Pad carrier pipes at end seal with two layers of 15 lb. building felt.

3.7 PRESSURE GROUTING

A. Pressure grout annular space between casing pipe and surrounding earth.

3.8 CARRIER PIPE INSTALLATION

A. Clean, inspect, and handle pipe accordance with Contract Documents.

B. Place carrier pipe in accordance with Contract Documents. Exercise care to prevent damage to pipe joints when carrier pipe is placed in casing.

C. Support pipeline within casing so no external loads are transmitted to carrier pipe. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.

D. Brick and mortar ends of casing to seal.

3.9 BACKFILL

A. Backfill materials and execution for open cut sections of installation, boring and receiving pits, and other incidental excavations related to utility pipe jacking installation shall follow the backfill requirements of Section 31 00 05, Trenching and Earthwork.

B. No rock, boulders or stone larger than 8 inches in its greatest dimension may be used in backfilling within 1 foot of the top of the pipe.

C. Any deficiency in the quantity of material for backfilling trenches, making restoration, or filling depressions caused by settlement or caused by the rejection of unsuitable excavated material, shall be provided by the Contractor.

3.10 TOLERANCES

A. Do not over cut excavation by more than 1 inch greater than outside diameter of casing pipe.

B. Install casing pipe to vertical and horizontal alignment on Drawings within plus or minus 3 inches prior to installation of carrier pipe. The steel casing shall be installed so as not to restrict the installation of the carrier pipe to plan line and grade. Vertical and horizontal alignment shall be checked every 20’ to 40’.

C. Install pipe bells with minimum 1/2-inch clearance to casing.

D. Carrier pipe shall be installed to line and grade, as shown on the Drawings.

3.11 FIELD QUALITY CONTROL

A. Compaction Testing: In accordance with ASTM D1557.

B. When test indicate Work does not meet specified requirements, remove Work, replace and retest.

C. Frequency of Compaction Testing: One for each lift.

3.12 REMOVAL OF FACILITIES AND CONTROLS

A. Remove temporary facilities for casing installation and jacking operations in accordance with Contract Documents.

3.13 OBSTRUCTIONS

A. If an obstruction is encountered during installation which stops the forward progress of the pipe, and it becomes evident that it is impossible to advance the pipe, the Engineer shall be notified in writing immediately.

+ + END OF SECTION + +

SECTION 33 05 37.13

PVC NON-PRESSURE UTILITY PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install PVC pipe and fittings as shown and specified.

B. Coordination:
   1. Review installation procedures under this and other applicable sections and coordinate installation of items to be installed with, or before the PVC utility pipe Work.

C. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.

1.2 MEASUREMENT AND PAYMENT

A. PVC Non-Pressure Utility Piping
   1. Work Item Number and Title
      33 05 37.13-A SDR-26 Non-Pressure Utility Piping
   2. The quantity of pipe installed shall be the number of linear feet actually installed, backfilled, and tested, as measured from outside wall of structure to outside wall of structure, as measured along the centerline of the pipe.
   3. The payment of pipe shall be based on the unit price per linear foot as listed on the submitted Bid schedule for each size successfully installed. Payment for any associated restoration shall be paid for under its respective Work item.
   4. These Work items shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, to install the PVC non-pressure pipe as shown and specified. The Work includes, but is not limited to, trench excavation, dewatering, furnishing and placement of bedding, pipe, placement of required backfill, disposing of excess excavated material, required fittings, testing of materials, compaction of bedding and backfill, temporary sheeting, shoring and bracing, restoration/replacement of all disturbed items not included under other Work items, protection of existing utilities and structures, testing and incidentals for performing all Work as specified unless otherwise provided for as a separate Work item.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Association of State Highway and Transportation Officials.
      a. AASHTO Standard Specifications.
   2. ASTM International.

a. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
b. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
c. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
d. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
e. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
f. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
g. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
h. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
i. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
j. ASTM F679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
k. ASTM F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings.
l. ASTM F1760, Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Manufacturer: Shall have a minimum of 5 years' experience producing PVC pipe and fittings and shall be able to submit documentation of satisfactory service in at least 5 completed installations in operation for at least 5 years each.

B. Component Supply and Compatibility:
1. All pipe of each material type shall be furnished by the same manufacturer.
2. PVC pipe Supplier shall prepare, review, all Shop Drawings and other submittals for all materials furnished under this section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by PVC pipe Supplier.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Product Data:
a. Submit product data on pipe, fittings, gaskets, hardware, pipe gasket lubricant and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
1. Certificates:

a. Submit manufacturer's certificate of compliance standards referenced in this Section.

2. Qualifications Statements:
   a. Submit qualifications of manufacturer when requested by Engineer.
   b. Submit qualifications of installer when requested by Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship and store in accordance with manufacture's recommendations.

B. Inspect all materials during unloading process.

C. Notify Owner of any cracked, flawed or otherwise defective material.

D. Remove all materials from the Site that are found to be unsatisfactory.

E. Comply with Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
   1. Pipe materials shall be suitable for services intended.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   3. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated in the Contract Documents.

B. POLYVINYL CHLORIDE (PVC) PIPING
   1. Buried PVC Gravity Sewer Pipe (Diameter < 18 inch).
      a. Material SDR-26:
         1) Pipe shall comply with ASTM D3034.
         2) Wall Thickness and Pipe Stiffness: Pipe stiffness shall be determined in accordance with test methods in ASTM D3034.
            a) Main Line: SDR-26, with minimum ring stiffness of 46 psi.
            b) Service Laterals: SDR-35, with minimum ring stiffness of 46 psi.
      b. Fittings:
         1) Gasketed fittings shall comply with ASTM D3034 .
         2) Unless otherwise shown or indicated, saddle wyes are unacceptable.
      c. Joints:
         1) Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
         2) Jointing lubricant shall be as recommended by pipe manufacturer.

3) Provide elastomeric gaskets complying with ASTM F477 and ASTM D3212.

4) Solvent Weld: Comply with ASTM D2466.

d. Joints:

1) Solvent Weld: Use primer and solvent cement recommended by PVC pipe manufacturer for the application. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.

2.2 MARKING FOR IDENTIFICATION

A. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

2.3 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by Engineer, submit results of source quality control tests specified in reference standards.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. Buried Piping Installation
   1. Refer to the applicable Division 33 piping installation section.

B. Bedding and Backfill
   1. Refer to Section 31 00 05 Trenching and Earthwork.

C. Contractor shall be responsible for verification of pipe loading during construction. Pipe design is based on final installation depth and required cover.

3.3 FIELD QUALITY CONTROL

A. Complete pipe testing requirements in accordance with Section 33 31 00, Sanitary Sewer Piping Installation.

+ + END OF SECTION + +

SECTION 33 05 37.16

PVC PRESSURE UTILITY PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install PVC pipe and fittings as shown and specified.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with, or before, PVC piping Work.

C. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.
   2. Section 33 05 33, Ductile Iron Pressure Utility Piping.

1.2 MEASUREMENT AND PAYMENT

A. PVC Pressure Utility Piping
   1. Work Item Number and Title
      33 05 37.16-A SDR-21 PVC Pressure Utility Piping
   2. These Work items shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, to install the PVC pressure pipe as shown and specified. The Work includes, but is not limited to, trench excavation, dewatering, furnishing and placement of bedding, pipe, placement of required backfill, disposing of excess excavated material, required couplings and specials, testing of materials, compaction of bedding and backfill, utility verification, pavement removal and disposal if necessary, temporary sheeting, shoring and bracing, tracing wire, pressure testing, disinfection, restoration/replacement of all disturbed items not included under other Work items, protection of existing utilities and structures, and incidentals for performing all Work as specified unless otherwise provided for as a separate Work item. Specified restraint of mains not associated with fittings shall also be included in the unit price for the main.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Association of State Highway and Transportation Officials.
      a. AASHTO Standard Specifications.
   2. ASTM International.
      a. ASTM D3034, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

b. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
c. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

3. American Water Works Association.
   a. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-60 In. (100 mm-300 mm), for Water Transmission and Distribution
   b. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer: Shall have a minimum of 5 years experience producing PVC pressure pipe and fittings and shall be able to submit documentation of satisfactory service in at least 5 completed installations in operation for at least five years each.

B. Component Supply and Compatibility:
   1. All pipe of each material type shall be furnished by the same manufacturer.
   2. PVC pipe Supplier shall prepare and review all Shop Drawings and other submittals for all materials furnished under this section.
   3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by PVC pipe Supplier.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Submit product data on pipe, fittings, gaskets, hardware, pipe gasket lubricant and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit manufacturer's certificate of compliance with standards referenced in this Section.
   2. Source Quality Control Submittals:
      a. When requested by Engineer, submit results of source quality control tests. Ensure the quality control tests were completed on the same material installed.
   3. Qualifications Statements:
      a. Submit qualifications of manufacturer when requested by Engineer.
      b. Submit qualifications of installer when requested by Engineer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship and store in accordance with manufacture's recommendations.

B. Inspect all materials during unloading process.

C. Notify Owner of any cracked, flawed or otherwise defective material.

D. Remove all materials from the Site that are found to be unsatisfactory.

E. Comply with Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
   1. Pipe materials shall be suitable for services intended.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   3. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated in the Contract Documents.

B. POLYVINYL CHLORIDE (PVC) PIPING
   1. Buried PVC Sanitary Pressure Pipe:
      a. Material:
         1) Pipe shall comply with AWWA C900
         2) Material shall comply with ASTM D3034.
         3) Wall Thickness: SDR 21.
         4) Fabricate pipe with cast-iron pipe equivalent outside diameter.
      b. Fittings:
         1) Comply with AWWA C900, or AWWA C907, as applicable.
      c. Joints:
         1) Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
         2) Jointing lubricant shall be as recommended by pipe manufacturer.
         3) Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
         4) Restrained Joints: Provide restrained joints where shown or needed for trenchless installation.

2.2 MARKING FOR IDENTIFICATION

A. Pipe Markings:
   1. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

2.3 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by Engineer, submit results of source quality control tests specified in reference standards.

2.4 BURIED PIPING IDENTIFICATION

A. Provide piping tracing wire; refer to Section 33 31 00.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. Buried Piping Installation
   1. Refer to the applicable Division 33 piping installation section.

B. Bedding and Backfill
   1. Refer to Section 31 00 05 Trenching and Earthwork.

C. Contractor shall be responsible for verification of pipe loading during construction. Pipe design is based on final installation depth and required cover.

3.3 BURIED PIPING IDENTIFICATION INSTALLATION

A. Install piping tracing wire; refer to Section 33 31 00.

3.4 FIELD QUALITY CONTROL

A. Leakage Testing
   1. Complete pipe leakage testing; refer to Section 33 31 00, Sanitary Sewer Piping Installation.

+ + END OF SECTION + +

SECTION 33 05 38.16

HDPE PRESSURE UTILITY PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, test, and install the High Density Polyethylene (HDPE) utility pipe and fittings as shown and specified.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items with, or before, the HDPE utility pipe Work.

C. Related Sections:
   1. Section 31 00 05, Trenching and Earthwork.

1.2 MEASUREMENT AND PAYMENT

A. HDPE Pipe
   1. Work Item Number and Title

      33 05 38.16-A DR-11 HDPE Pressure Utility Piping
      33 05 38.16-B DR-11 HDPE Pressure Utility Piping
      33 05 38.16-C DR-11 HDPE Pressure Utility Piping

   2. These Work items shall include all costs to furnish all labor, materials, tools, and equipment, both permanent and temporary, to install the HDPE pipe as shown and specified. The Work includes, but is not limited to, trench excavation, pavement removal and disposal if necessary, dewatering, furnishing and placement of bedding, pipe, pipe installation, fusion jointing of pipe lengths, placement of required backfill, special backfill, compaction of bedding and backfill, utility verification, disposing of excess excavated material, testing of materials, temporary sheeting, shoring and bracing, tracing wire, pressure testing, disinfection, incidentals required for air gap, surface restoration, restoration/replacement of all disturbed items not included under other Work items, protection of existing utilities and structures, and incidentals for performing all Work as specified unless otherwise provided for as a separate Work item. Restraint of mains not associated with fittings shall also be included in the unit price for the main. Incidental costs associated with HDD installation are included in this item. The furnishing and installation of fittings is not included under this item.
   3. Up to 10% of the total pipe length may be installed by open excavation. Costs associated with open excavation are included in this item and will not be paid for separately.

B. HDPE Fittings
   1. Work Item Number and Title
      33 05 38.16- D 11.25, 22.5, 45 or 90 Degree Bend HDPE Fittings
      33 05 38.16- E Tee HDPE Fittings
      33 05 37.18-F Reducer HDPE Fittings
      33 05 37.18-G Cross HDPE Fittings
   2. The number of fittings to be measured for payment shall be the actual number installed of each size and type as shown and specified along a pipe that is successfully installed, pressure tested and disinfected.
   3. The payment for these items shall be based on the unit price as listed on the submitted Bid schedule. Payment for special backfill will be under its respective Work item. Payment for excavation, disposal of excavated materials, bedding, restoration, and pressure testing and disinfection shall be included under the Work items for the pipe unless otherwise broken down by the Engineer as a separate Work items.
   4. These Work items shall include all costs to furnish all labor, materials, tools and equipment, both permanent and temporary, to install and maintain the fittings as shown and specified unless otherwise directed by the Engineer.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, Inc., (ASTM).
      a. ASTM D3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
      b. ASTM D3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
      c. ASTM F714, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
      d. ASTM F1055, Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing.
      e. ASTM F2206, Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene.
      f. ASTM F2620, Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.
      g. ASTM F2880, Standard Specification for Lap-Joint Type Flange Adaptors for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3/4 in. to 65 in.
   2. American Water Works Association.
      a. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch, for Water Service.
      b. AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.
      c. AWWA M55, PE Pipe – Design and Installation.
   3. National Fire Protection Association
      a. NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
   4. National Science Foundation.
      a. NSF/ANSI Standard 61, Drinking Water System Components - Health Effects.

5. Plastic Pipe Institute.
    a. PPI TR-4: PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings For Thermoplastic Piping Materials or Pipe.
    b. PPI TN-38, Bolt Torque for Polyethylene Flanged Joints.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
    1. Manufacturer shall have a minimum of 5 years' recent experience producing HDPE pressure pipe and fittings for at least the specified sizes and lengths, and shall be able to submit documentation of at least 5 installations in satisfactory operation for at least 5 years.
    2. HDPE pipe and fittings manufacturers and distributors shall be listed as current members of the Plastics Pipe Institute (PPI).
    3. Contractor shall have a minimum of 5 year' recent experience installing HDPE pressure pipe and fittings for at least the specified pipe and fittings sizes and lengths and shall be able to submit documentation of at least 5 installations in satisfactory operation for at least 5 years.
    4. Fusion operators shall have received current training and certification per PPI TN-42.

B. Component Supply and Compatibility:
    1. All pipe and fittings of each material type shall be furnished by the same manufacturer.
    2. The HDPE utility pipe and fittings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.

1.5 SUBMITTALS

A. Certificate of Fusion:

        1) Submit fusion and EF parameters, test report.

B. Action Submittals: Submit the following:
    1. Product Data:
        a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

C. Informational Submittals: Submit the following:
    1. Certificates:
        a. Submit manufacturer's certificate of compliance standards referenced in this Section.
        b. Submit contractor's certificates of fusion, electrofusion operators training, and experience as described in Paragraph 1.4A.
        c. Submit fusion and EF parameters, test report.
    2. Source Quality Control Submittals:
        a. When requested by Engineer, submit results of source quality control tests. Ensure the quality control tests were completed on the same batch of material as installed.

3. Qualifications Statements:
    a. Submit qualifications of manufacturer when requested by Engineer.
    b. Submit qualifications of installer when requested by Engineer.

D. Post-Construction Submittals
    1. The following as-recorded data may be requested from the Contractor and/or fusion provider to the Owner upon request:
        a. Approved datalogger device reports
        b. Fusion joint documentation containing the following information:
            1) Pipe Size and Thickness
            2) Machine Size
            3) Fusion Technician Identification
            4) Job Identification
            5) Fusion Joint Number
            6) Fusion, Heating, and Drag Pressure Settings
            7) Heat Plate Temperature
            8) Time Stamp
            9) Heating and Cool Down Time of Fusion
            10) Ambient Temperature
        c. As-recorded Information
            1) The as-recorded plan and profile will reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.
            2) All fittings, valves, or other appurtenances will also be referenced and shown.
            3) A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include any and all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship and store in accordance with manufacture's recommendations.

B. Inspect all materials during unloading process and before installation.

C. Notify Owner of any cracked, flawed or otherwise defective material.

D. Remove all materials from the Site that are found to be unsatisfactory.

E. Handle pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense.

F. Handle pipe carefully and use rollers to move system; avoid dragging system on ground or over sharp objects.

G. Inspect delivered pipe for cracked, gouged, chipped, dented or other damaged material and immediately remove from site. Sections of pipe with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.

H. Comply with Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
1. Pipe materials shall be suitable for services intended.
2. Pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
3. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated in the Contract Documents.
4. Clean rework or recycled material generated by the manufacturer's own production may be used as long as the pipe or fittings produced meet all the requirements of this Section.
5. Pipe shall be capable of withstanding a minimum recurring surge pressure (water hammer) flow velocity of 4 ft/sec, 55 cycles/day, and 100-year estimated fatigue life, or higher if shown in the Drawings. Occasional and fire flow velocity of 10 fps per NFPA 24.

B. HDPE PIPE
1. Dimensions:
   a. Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size in accordance with AWWA C901 and/or AWWA C906 and/or ASTM F714.
   b. Wall thickness DR 11
   c. HDPE pipe shall be DIPS.
2. The pipe shall meet the requirements of the applicable AWWA C901 and/or AWWA C906 and/or ASTM F714.
3. Pipe shall be pressure rated to meet the service pressure requirements specified by Engineer.
4. Pipe material used for the manufacture of HDPE shall be high density polyethylene (HDPE) having a material designation code of PE 4710 or higher, meeting the requirements of ASTM D3350 with a minimum cell classification of PE 445574C-CC3.
5. Only smooth wall HDPE will be permitted.
6. Color:
   a. Sanitary – Black with green stripe
7. Physical Properties
   a. Materials used for the manufacture of polyethylene pipe and fittings shall meet the following physical property requirements:

Property	Unit	Test Procedure	Value
1. Material Designation	-	PPI/ASTM	-
2. PPI Material Listing	-	PPI TR-4	PE 4710
3. Material Classification	-	ASTM D 1248	III C 5 P34
4. Cell Classification	-	ASTM D 3350	445574C-CC3
5. Density	g/cm3	ASTM D 1505	>0.941
6. Melt Index (E)	g/10 min	ASTM D 1238	<0.15
7. Flexural Modulus	psi	ASTM D 790	>110,000
8. Tensile Strength	psi	ASTM D 638	<160,000
9. ESCR (C)	hours	ASTM D 1693	3,000 to 3,500
10. HDB	psi	ASTM D 2837	1,600 @ 23°C
11. UV Stabilizer (C)	%carbon black	ASTM D 1603	2 to 3
12. Elastic Modulus	psi	ASTM D 638	110,000
13. Brittleness	Temp F	ASTM D 746	<-180
14. Vicat Softening	Temp F	ASTM D 1525	255
15. Thermal Expansion	in/in/ F	ASTM D 696	8 x 10E-5
16. Hardness	Shore D	ASTM D 2240	64
17. Molecular Weight Category	-	-	Extra-High

b. There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with Article 2.4, below.
c. Ring Stiffness Constant (RSC) values for the pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.). The minimum RSC is 90 percent of the nominal.
d. 200 psi min, working pressure.
e. Color- Solid blue or black with a blue stripe.
f. Tubing shall be printed labeled with manufacturer, diameter, outside diameter control, working pressure rating, and ASTM and NSF approval.

C. HDPE JOINTS
1. General:
   a. Joints shall be as specified in the Contract Documents.
2. Butt Heat Fusion Joints:
   a. Shall be allowed for joining lengths of pipe in a straight run only.
   b. Shall conform to ASTM F2620 and PPI TR-33.
   c. Joint strength shall be equal to or greater than the strength of the pipe, as demonstrated by testing requirements.
3. Electro- Fusion Couplings:
   a. Electro-fusion couplings shall contain heating coils located at the sealing surface.
   b. The following are acceptable manufacturers:
      1) GF Central Plastics
      2) Plasson USA
4. Fused Mechanical Joint (MJ) Adaptors:
   a. Use mechanical joint (MJ) adaptors to connect HDPE pipe to ductile iron fittings and valves.
   b. Provide MJ adaptors with kit, manufactured in accordance with ASTM D3261. The adaptor shall consist of the following:

1) Molded HDPE MJ transition fitting
2) Rubber gasket
3) MJ backup ring
4) Corrosion resistant - Cor Blue bolts and nuts

c. Fused mechanical joint (MJ) adaptors shall have a pressure rating equal to the pipe unless otherwise specified and be provided by:
1) GF Central Plastics
2) Plasson USA

5. Flanged Joint Adaptors:
a. Provide flanged adaptors with kit, manufactured in accordance with ASTM D3261. The adaptor shall consist of the following:
1) Metallic back-up rings (Van-Stone style lap joint flanges), shall have a radius on the inside diameter of the bore so as to be compatible with HDPE Flanges. Back up rings shall have bolt pattern that will mate with AWWA C207 Class D (or B or E), ASME/ANSI B 16.5 Class 150, ASME/ANSI B 16.1 Class 125, or ASME/ANSI B16.47 Series A.

b. Flange adaptors shall meet the dimensional and material requirements of ASTM F2880.
c. Flange assemblies shall be assembled and torqued according to PPI TN-38, "Bolt Torque for Polyethylene Flanged Joints."
d. Fused flanged adaptors shall have a pressure rating equal to the pipe unless otherwise specified and be provided by:
1) GF Central Plastics
2) Plasson USA

D. Thrust Anchor:

a. Where shown on Drawings, connections to existing pipe shall use a thrust anchor.
b. Concrete thrust collar shall be attached to the HDPE pipe using an electro-fusion flex restraint device. Refer to concrete thrust collar detail.

E. HDPE FITTINGS THROUGH 12 INCH
1. Provide HDPE fittings made of HDPE material designation same as the mainline pipe and complying with NSF Standard 61 and AWWA C906.
2. Fittings shall be pressure class 200 rated.
3. Molded HDPE fittings
a. Fittings shall comply with the requirements of ASTM D3261.
b. Fitting is externally reinforced and maintains the same inside diameter as DR 11 main line.
4. The following are acceptable fitting manufacturers:
a. GF Central Plastics
b. Plasson USA
c. Or Approved Equal
d. Fittings shall comply with the requirements of ASTM F2206.
5. The following are acceptable fitting manufacturers:
a. GF Central Plastics
b. Plasson USA
c. Or Approved Equal

F. HDPE BRANCH SADDLE REDUCING TEE

1. Provide HDPE fittings made of HDPE material designation same as the mainline pipe and complying with NSF Standard 61 and AWWA C906.
2. Fittings shall be pressure class 200 rated.
3. Fabricated HDPE reducing tee:
   a. Fittings shall be equivalent diameter ratio 11 for full inside diameter (EDR-11). Fitting is externally reinforced and maintains the same inside diameter as adjacent main line. Fitting is fully pressure rated with full flow ID.
   b. Sidewall fusion performed by manufacturer.
   c. Fittings shall comply with the requirements of ASTM F2206.
4. The following are acceptable fitting manufacturers:
   a. GF Central Plastics
   b. Plasson USA
   c. Or Approved Equal

2.2 MARKING FOR IDENTIFICATION

A. Marking:
   1. Each standard and random length of pipe in compliance with this specification shall be clearly marked with the following information that will remain legible during normal handling and storage and per AWWA C901 and/or AWWA C906.
      a. ASTM or AWWA Standard Designation.
      b. Pipe Size.
      c. Class and Profile Number.
      d. Production Code.
      e. Standard Dimension Ratio (SDR).
      f. Standard Material Code Designation.

2.3 SOURCE QUALITY CONTROL

A. At a minimum, incoming polyethylene materials shall be inspected for density in accordance with ASTM D 1505 and melt flow rate in accordance with ASTM D 1238. All incoming polyethylene materials shall be certified by the Supplier. Certification shall be verified by Contractor and submitted to Engineer. Incoming materials shall be approved by Manufacturer's Quality Assurance Program before processing into finished goods.

B. Representative Samples of polyethylene materials shall be tested against the physical property requirements required herein. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production Samples and performing sustained pressure tests in accordance with ASTM D 1598.

C. Quality Assurance test for representative pipe and fitting Samples shall include:

Test	Standard	Pipe	Fittings
Ring ESCR	ASTM F 1248	Yes	Not Applicable

Sustained pressure at 176°F/725 psi hoop stress:
(fo>100 h) ASTM D 1598 Yes Yes

Sustained pressure at 73°F/1,600 psi hoop stress:
(fo>1000 h) ASTM D 1598 Yes Yes

D. The HDPE pipe and fitting manufacturer shall certify that Samples of their production pipe have undergone stress regression testing, evaluation, and validation in accordance with ASTM D 2837 and PPI TR-3. Under these procedures, the minimum hydrostatic design basis shall be certified by the pipe and fitting manufacturer to be 1,600 psi at 73.4°F and 800 psi at 140°F.

E. Material shall be listed in the name of the HDPE pipe and fitting manufacturer as required by the Plastics Pipe Institute (PPI) in PPI TR-4 with the following Standard Grade ratings:

	73.4°F	140°F
1. Hydrostatic Design Basis (HDB)	1,600 psi	800 psi
2. Hydrostatic Design Stress (HDS)	800 psi	400 psi

PPI material listing in the name of the resin Supplier is not acceptable in meeting this requirement.

F. Inspection Requirements:
1. Certification: As the basis of the acceptance of the material, the manufacturer will furnish a certificate of conformance of these Specifications upon request.
2. All outgoing materials shall be inspected for diameter, wall thickness, length, straightness, out-of-roundness, concentricity, toe-in, inside and outside surface finish, markings, and end cut. Manufacturer's Quality Control Program shall perform tests of density, melt flow rate, carbon content, and carbon dispersion. In addition, Samples of the pipe provided shall be tested for hoop tensile strength and ductility by either quick burst in accordance with ASTM D 1599 or ring tensile strength in accordance with ASTM D 2290. Molded fittings shall be subject to x-ray inspection for voids, and tests for knit line strength. All fabricated fittings shall be inspected for fusion quality and alignment.

G. Test Methods:
1. Flattening: Three specimens of pipe, a minimum of 12-inches long, shall be flattened between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the pipe. The rate of loading shall be uniform and such that the compression is completed within two to five minutes. Remove the load, and examine the specimens for splitting cracking or breaking.
2. Pipe Ring Stiffness Constant: The pipe ring stiffness constant shall be determined utilizing procedures similar to those outlined in ASTM D 2412. The stiffness of HDPE pipe is defined in terms of the load, applied between parallel plates, which causes one percent reduction of pipe diameter. Test specimens shall be a minimum of two pipe diameters or four feet in length, whichever is less.

H. Pipe may be rejected for failure to conform to these Contract Documents or the following:
1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of pipe which could be cut off and discarded. Pipes within one

shipment shall be rejected if defects exist in more than five percent of shipment or delivery.
2. Cracks sufficient to impair strength, durability or serviceability of pipe.
3. Defects indicating improper proportioning, mixing, and molding.
4. Damaged ends, where such damage prevents making satisfactory joint weld.
5. Gouges or scrapes exceeding ten percent of the specified wall thickness.

2.4 BURIED PIPING IDENTIFICATION

A. Provide piping tracing wire; refer to Section 33 31 00.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

B. Defective, damaged, or unsound pipe will be rejected. Cuts, punctures, or gouges that penetrate or reduce the wall thickness by 10-percent or more are not acceptable and must be removed and discarded.

C. Out of Round Pipe:
1. Re-round pipe with appropriate re-rounding tools as provided by the pipe manufacturer.
2. Squeeze tools are not acceptable for use on pipe.

3.2 PIPE HANDLING

A. Handle pipe in a manner to protect pipe from damage by dragging it over sharp and cutting objects. Do not drag pipe along gravel, asphalt or concrete pavement.

B. Protect pipe from damage during installation operations. Do not damage pipe with chains, cables, wire ropes, and hooks.

3.3 INSTALLATION

A. Buried Piping Installation
1. Refer to the applicable Division 33 piping installation section.

B. Horizontal Directional Drilling Installation
1. Refer to Section 33 05 23.13 Utility Horizontal Directional Drilling

C. Bedding and Backfill
1. Refer to Section 31 00 05 Trenching and Earthwork.

D. Contractor shall be responsible for verification of pipe loading during construction. Pipe design is based on final installation depth and required cover.

3.4 BURIED PIPING IDENTIFICATION INSTALLATION

A. Install piping tracing wire; refer to Section 33 31 00.

3.5 FIELD QUALITY CONTROL

A. Leakage Testing
   1. Complete pipe leakage testing; refer to Section 33 31 00, Sanitary Sewer Piping Installation.

+ + END OF SECTION + +

SECTION 33 31 00

SANITARY SEWER PIPING INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, and special items. The Work includes the following:
      a. All types and sizes of buried sanitary sewer piping, except where buried piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all buried sanitary sewer piping Work required, beginning at the outside face of structures or structure foundations.
      c. Work on or affecting existing buried piping.
      d. Installation of all jointing and gasket materials, special items, flexible couplings, mechanical couplings, and other Work required.
      e. Supports.
      f. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation.
      g. Field quality control, including testing.
      h. Cleaning.
      i. Incorporation of special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:
   1. Review installation procedures under this and other sections and coordinate installation of items to be installed with or before buried sanitary sewer piping Work.
   2. Coordinate with appropriate piping materials sections of Division 33.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 31 00 05, Trenching and Earthwork

1.2 MEASUREMENT AND PAYMENT

A. Pipe Installation:
   1. Pipe installation is to be included in the measurement and payment of each pipe material and associated appurtenances installed.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM International.
      a. ASTM C1103, Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.
      b. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
      c. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
      d. ASTM D3262, Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
      e. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
   2. American Water Works Association.
      a. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
      b. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
      c. AWWA M23, PVC Pipe - Design and Installation.
      d. AWWA M41, Ductile-Iron Pipe and Fittings.
      e. AWWA M45, Fiberglass Pipe Design.
      f. AWWA M55, PE Pipe - Design and Installation.
   3. American Society of Civil Engineers/Structural Engineering Institute
      a. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
   4. Indiana Administrative Code, Title 327 Water Pollution Control Board
      a. Indiana Administrative Code-327 IAC 3-6-12.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including.
      a. 327-IAC , Water Pollution Control Board
      b. Indiana Department of Environmental Management
      c. Indiana Department of Transportation
      d. Montgomery County Highway Department
   2. Obtain required permits for Work beneath roads, in rights-of-way, beneath railroads, and in other areas of the Work, as required by Authorities Having Jurisdiction listed above.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Field Quality Control Submittals:
      a. Results of each specified field quality control test.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Material delivery, storage and handling must conform to requirements in Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable sections of Division 33.

2.2 BURIED PIPING IDENTIFICATION FOR FORCE MAINS

A. Tracing Wire Requirements
   1. Provide - No.10 Extra High Strength Copper Clad Steel Reinforced with HDPE Insulation tracing wire. The following materials are acceptable:
      a. Soloshot Copperhead Industries, LLC
      b. Or approved equal
   2. Splice tracing wire together with the following material:
      a. DRYCONN Direct Bury Lug Aqua
      b. Or equal
   3. Tracer wire shall be required on:
      a. All mains 12-inch and larger, not exclusive to non-metal pipe.
      b. All non-metal main pipes, regardless of size.
   4. All wire utilized for tracing wire shall be designed for and approved by the manufacturer for use in buried low voltage applications and approved by the Engineer.
   5. For open trench installation of force main, the tracer wire shall be laid directly over the main and attached to the pipe at regular intervals not to exceed ten (10) feet. Wire shall be attached to the main with plastic "zip" strapping or wire.
   6. For horizontal directional drilling of force main, the tracer wire shall be pulled in with the main.

7. At valve structures, the tracing wire shall be drawn toward the surface inside the vault.

B. Marking Post Requirements
   1. The following marking posts, or approved equal, are acceptable for use in connection with sewer force main installation:
      a. Posts: Flexible Marking Post/Test Station (Glasforms or Carsonite)
      b. Decals: "Warning Sewer Pipeline" (USA Bluebook) or “Caution Sewer Pipeline” (Glasforms or Carsonite)
   2. The marking post/test station shall be made from a flexible impact resistant composite material. It shall contain reinforced hollowed ribs on each side where the test wire is protected. The tracing wire is extended at the bottom; so that it can be spliced to the pipe wire with a direct bury connector.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
   2. In the event of a conflict between manufacturer’s recommendations and the Contract Documents, request interpretation from Engineer before proceeding.
   3. Engineer will observe excavations and bedding prior to Contractor laying pipe. Notify Engineer in advance of excavating, bedding, pipe laying, and backfilling operations.
   4. Minimum cover over buried piping shall be 4 feet, unless otherwise shown or approved by Engineer.
   5. Earthwork is specified in Section 31 00 05 Trenching and Earthwork.
   6. The width of trenches shall be such as to provide a clearance of not less than 6 inches or not more than 15 inches on each side of the pipe. All pavements shall be cut with an abrasive saw. Concrete driveways, walks, alleys, etc., shall be cut to the nearest joint unless approved by Engineer.
   7. Excavation in excess of that required or shown, and that is not authorized by Engineer shall be filled at Contractor’s expense with granular material furnished, placed, and compacted in accordance with Section 31 00 05, Trenching and Earthwork.

B. Separation of Sewers and Potable Water Piping:
   1. Horizontal Separation:
      a. Where possible, proposed sanitary sewers shall be separated from existing potable water mains and service lines horizontally by a clear distance of at least 10 feet, measured edge to edge.
      b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in a separate trench or on an undistributed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above the crown of the sewer.

c. Exceptions:
    1) Where it is not possible to provide minimum horizontal separation, construct sewer pipe of pressure pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test newly installed pressure piping to a minimum of 125 psi, meeting the testing requirements in Field Quality Control of this specification.
    2) Sewer in water grade pipe shall extend from manhole to manhole.

2. Vertical Separation:
    a. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses above or below potable water main.
    b. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
    c. Provide adequate structural support where potable water main crosses above or below sewer. At minimum, provide compacted select backfill for 10 feet on each side of crossing.
    d. This deviation may allow installation of the sewer closer to the water main, provided that the water is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at horizontal separation of at least ten feet measured edge to edge.
    e. Exception:
        1) Where it is not possible to provide minimum horizontal separation described above, construct sewer pipe of pressure pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test newly installed pressure piping to a minimum of 125 psi, meeting the testing requirements in Field Quality Control of this specification.
        2) Sewer in water grade pipe shall extend from manhole to manhole.

C. Separation of Sewer Mains and Potable Water Structures:
    1. Maintain a 50 feet minimum distance from water supply wells or other water supply sources and structures.

D. Plugs (Bulkheads):
    1. Temporarily plug installed pipe at end of each day of Work or other interruption of pipe installation to prevent entry of animals, liquids, persons, and deleterious materials into pipe.
    2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
    3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
    4. Where plugging is required for phasing of the Work, abandonment of existing utilities, or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings:
    1. Trench excavation and backfill, and bedding materials shall conform to the Contract Documents.

2. Where over excavation is required by Engineer, due to unsuitable soil in trench or excavation subgrade, remove and replace unsuitable material with approved granular material furnished, placed, and compacted in accordance with the Contract Documents. Payment for removal and replacement of unsuitable soils is to be included in the unit price payment items included the Contract Documents. Separate payment for removal or hauling off of unsuitable soils will not be provided.
3. Bedding installation and materials shall be in accordance with the Drawings and as specified in Section 31 00 05 Trenching and Earthwork.
4. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
5. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

F. Alignment:
1. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by Engineer.
2. Slope piping uniformly as shown on the Drawings.
3. Maintain reference line and grade with laser equipment daily for adjustment and accuracy. Correct deficiencies in equipment, reference line and reference grade. Take precautions to prevent deflections in reference line and grade.
4. Contractor shall install sewer pipe in compliance with slope requirements shown on the Drawings. All sewer pipes shall have a maximum slope deviation no greater than the indicated percent for the following pipe sizes:

Pipe Diameter	Pipe Slope Deviation
8 inch	±15%
10 inch	±18%
12 inch	±20%

5. Contractor shall verify every other section of installed sewer pipe for compliance with design slope. In the event that the as-built slope exceeds the indicated deviation, notify Engineer in writing. Removal and replacement of pipe as directed by the Engineer shall be at no additional cost to the Owner.

G. Laying Pipe:
1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
   a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41.
   b. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.
   c. Sanitary and Storm Sewers: ASCE 37.
   d. Fiberglass Reinforced Pipe: ASTM D3262

2. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
3. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by Engineer.
4. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by Engineer.
5. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
6. For push-on jointed pipe, do not push past the manufacturer's specified home position.
7. Deflections at joints shall not exceed 50 percent of amount allowed by pipe manufacturer, unless otherwise approved by Engineer.
8. Carefully examine pipe, fittings, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
9. Inspect interior of all pipe, fittings, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be clean and dry immediately before pipe is laid.
10. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be tapered, and sharp edges shall be filed off smooth. Do not flame-cut pipe.
11. Do not place blocking under pipe, unless specifically approved by Engineer for special conditions.
12. Touch up protective coatings in manner satisfactory to Engineer prior to backfilling.
13. Notify Engineer in advance of backfilling operations.
14. On steep slopes, take measures acceptable to Engineer to prevent movement of pipe during installation.
15. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

H. Jointing Pipe:
1. Mechanical Coupling Joints:
    a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings specified.
    b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.
    c. For mechanical couplings that incorporate gaskets, after cleaning apply manufacture's recommended lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.
    d. For plasticized PVC couplings, loosen the stainless steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using manufacture's recommended lubricants. Place clamps

over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.

2. HDPE Pipe Joints:
   a. Bell and Spigot Joints:
      1) Remove all burrs and provide reference mark at correct distance from pipe end. Place mark such that no more than ½ inch of machined spigot surface will be visible outside of bell after pipe has been joined.
      2) Clean spigot end and bell thoroughly with soap and water before positioning gasket.
      3) Lubricate spigot groove with manufacturer's recommended lubricant. Thoroughly clean gasket and place in spigot groove starting at bottom, ensuring that gasket fins face backwards toward pipe.
      4) Thoroughly lubricate gasket with pipe manufacturer's recommended lubricant and equalize stretch in gasket by means of manufacturer's recommended procedure. Reposition gasket in groove after stretching.
      5) Thoroughly clean and lubricate receiving bell. Align pipe as straight as possible and insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.
      6) If mechanical means are used to insert spigot end, protect the end of pipe being pushed with wood, to provide even distribution of pressure.
   b. Butt Fusion Welded Joints:
      1) Install joints in accordance with manufacturer's instructions using hydraulic butt fusion machine or manual machine equipped with torque wrench. Equipment shall be able to achieve and maintain heating tool temperature range of 400 to 450 degrees F and an interface pressure of 60 to 90 psi.
      2) Clean interior and exterior of pipe and fitting ends with clean, dry, lint-free cloth.
      3) Align ends to be joined in the fusion machine without forcing ends into alignment. Adjust alignment as necessary and tighten clamps to prevent slippage.
      4) Place facing tool between ends to be joined and face them to provide clean, smooth, parallel mating surface. If stops are present, face ends down to the stops. Remove all shavings after facing without touching ends.
      5) Re-check alignment of ends and check for slippage against fusion pressure. There shall be no detectable gaps between ends. Align outside diameters.
      6) Heating tool shall maintain pipe manufacturer's recommended temperature range. Place the tool between ends to be joined. Move ends against heating tool to achieve full contact. Hold ends against heating tool without force until melt bead size is formed per manufacturer's recommendations.
      7) Upon forming proper melt bead size, quickly separate ends and remove heating tool. Quickly inspect melted ends and bring ends together applying joining force recommended by manufacturer, using 60 to 90 psi interfacial pressure to form double bead rolled over surface of pipe on both ends.
      8) Hold joining force against ends until joint is cool to the touch. Cooling period shall be 30 to 90 seconds per inch of pipe diameter. Heavier wall thicknesses may require longer cooling times as recommended by pipe manufacturer.

9) Upon completing joint, inspect to verify double bead has been formed on both sides, uniformly rounded and consistent in size all around joint. Remove faulty joints and re-joint.

3. Ductile Iron Push-On Joint Pipe:
   a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
   b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
   c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
   d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
   e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
   f. Maintain an adequate supply of gaskets and manufacture's recommended joint lubricant at the Site when pipe jointing operations are in progress.

4. Fusible PVC Joints
   a. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
   b. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
   c. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
   d. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
      1) Heat Plate - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
      2) Carriage – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.

3) General Machine - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
4) Data Logging Device – An approved datalogging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

e. Other equipment specifically required for the fusion process shall include the following:
1) Pipe rollers shall be used for support of pipe to either side of the machine
2) A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations.
3) An infrared (IR) pyrometer for checking pipe and heat plate temperatures.
4) Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
5) Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

I. Backfilling:
1. Conform to applicable requirements of the Contract Documents. Refer to Section 31 00 05, Trenching and Earthwork.
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered with at least one foot of backfill.

J. Transitions from One Type of Pipe to Another:
1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

K. Closures:
1. Provide closure pieces shown or required to complete the Work.

L. Service Connections:
1. Provide service connections in accordance with the requirements of the Contract Drawings.
2. The trench shall be fully backfilled in accordance with this specification and the Contract Drawings.
3. Prior to backfilling the service pipe, every building service shall be inspected by a representative of the Engineer. A minimum of 3 hours advanced notice shall be given to the Owner, for completing the inspection. The hours of operation for sewer tap inspections are from 8:00 am to 3:00 pm, 5 days a week, excluding holidays.

M. Concrete Cradle and Encasement:
1. Where subgrade conditions, in the opinion of the Engineer, warrant extra precautions for the bedding or encasement of pipe, the Engineer may order the construction of a concrete cradle and/or encasement to be installed in conformance with

the size and dimensions indicated on the plans. All concrete used in the concrete cradle shall be in accordance with Section 03 00 05, Concrete.

3.2 BURIED PIPING IDENTIFICATION INSTALLATION – FOR FORCE MAINS

A. Mainline Tracing Wire
   1. Tracing wire is required on all force mains, not exclusive to non-metal pipe.
   2. Tracing wire shall be laid directly over the water main and attached to the pipe at regular intervals not to exceed 10 feet.
   3. Attach the tracer wire to the pipe using plastic “zip” strapping or metal wire.
   4. The following technique shall be used to splice wires together:
      a. Use DryConn Direct Bury Lug and strip the wire to 5/8”.
      b. Place one stripped conductor into the lug.
      c. Tighten the set screw till it comes in contact with the solid conductor.
      d. Note the location of screwdriver and continue fighting the set screw ¾ turn for # 10 solid copper wire.
      e. Repeat the steps for the adjacent side.
      f. Remove sealant cover and discard. Close housing, aligning conductors until housing lid is fully latched.
   5. For valves in valve boxes, the wire shall be brought up the outside of the valve or curb box riser. Construct an opening in the lip of the valve box to allow the top of the tracer wire to be stored inside the valve box. Ensure that the opening is sized adequate so the cover will fit snug onto the valve box, once the tracer wire is installed. The wire should be installed with an excess length of 4-6 inches that is to be folded down in the valve box.
   6. Successful completion of conductivity test to be completed by the Contractor and in the presence of the Engineer. Successful completion of the test will be required prior to acceptance of force mains.

B. Marking Post Requirements
   1. Marking post will be required for all bores or as directed by Engineer.
   2. Marking post shall be buried at least 12 inches.
   3. The wire shall be brought up inside the marking post and attached at the top with 2 holes drilled in the marking posts so that the wire can be wrapped around an inserted eyebolt, or the wire can be feed through the hole and left extended on the exterior of the post.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.

B. Thrust restraint may be accomplished by using restrained pipe joints, or harnessing buried pipe. Thrust restraints shall be designed for axial thrust exerted by test pressure specified on Contract Drawings.

C. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:
   1. Locations of existing underground facilities shown on the Drawings should be considered approximate.
   2. Determine the true location of existing underground facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of underground facilities that could be disturbed prior to beginning of excavation and backfilling operations, or that may be affected by the Work.

3.5 FIELD QUALITY CONTROL

A. General:
   1. Groundwater infiltration into gravity pipe shall not exceed 100 gallons per inch of pipe diameter per day per mile of pipe.
   2. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
   3. Test all piping, except as exempted by the Engineer or Owner's representative in writing.
   4. When authorities having jurisdiction are to witness tests, notify Engineer and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   5. Conduct all tests in presence of Engineer or Owner's representative.
   6. Remove or protect pipeline-mounted devices that could be damaged by testing.
   7. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gauges, meters, test containers, valves, fittings, and temporary pumping systems required to maintain Owner's operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   8. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest structure. Piping not installed by Contractor and that fails the test shall be repaired upon authorization of Owner. Unless otherwise included in the Work, repair of existing piping or underground facilities will be paid as extra Work.

B. Test Schedule:
   1. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
   2. For all piping:
      a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig.
      b. Use exfiltration testing, infiltration testing, low-pressure air testing, or vacuum testing for other piping.

c. If test pressure is not listed, test pressure will be determined by Engineer based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
   1. Preparation for Testing:
      a. For PVC pressure pipe follow procedures described in Section 7 of AWWA C605.
         1) PVC pipe test pressure and duration: 125 psi for 6 hours
      b. For HDPE pipe, follow procedures described in ASTM F2164. If re-testing of a test section or pipeline is required, at least 8 hours shall elapse between tests.
         1) HDPE pipe test pressure and duration: 100 psi for 6 hours
      c. For Ductile Iron pipe, follow procedures described in AWWA M41.
         1) Ductile Iron pipe test pressure and duration: 125 psi for 6 hours
      d. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
      e. Prior to testing the Contractor shall ensure that the line is clean and free of dirt and debris.
   2. Test Procedure for DIP and PVC pressure pipe:
      a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
      b. Expel air from pipe as required. Obtain approval of Engineer prior to tapping pipe for expelling air.
      c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
      d. Add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
      e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
      f. Timed Test Period: After stabilization period, maintain test pressure for at least six hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
      g. Pump from test container to maintain test pressure. Measure volume of water pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
   3. Test Procedure for HDPE Pressure Pipe:
      a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
      b. Expel air from pipe as required. Obtain approval from Engineer prior to tapping pipe for expelling air.
      c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
      d. After filling pipeline, gradually pressurize pipe to test pressure and maintain required test pressure for three hours for pipe to expand. During expansion, add fluid to maintain required test pressure. Begin timed test period after expansion period and other requirements are met.

e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
f. Timed Test Period: After three hour expansion phase, reduce test pressure by ten psig and do not add liquid. Test pressure shall then remain steady for six hours, indicating no leakage.
g. If no visible leakage is observed and pressure remains within 5% of the original test pressure for one hour, a passing test is indicated.

4. Makeup Water Allowances:
   a. The allowable makeup water allowance is the maximum amount of water that is added into a pipeline undergoing hydrostatic pressure testing. The allowable leakage rates for the various pipe materials and joints are listed below.
   b. No Makeup Water: Pipe with flanged, welded, fused, threaded, soldered, or brazed joints.
   c. Rates based on formula or table in AWWA M41:
      1) DIP and PVC pipes joined with rubber gaskets as sealing members, including the following joint types:
         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved and shouldered couplings.
         e) Allowable leakage per 1,000 feet of pipeline at 125 psi test pressure:

Size (in)	Leakage (gph)
4	0.30
6	0.45
8	0.60
10	0.76
12	0.91
16	1.21
20	1.51

Size (in)	Leakage (gph)
24	1.81
30	2.27
36	2.72
42	3.17
48	3.63
54	4.08
60	4.53

   d. Makeup Water Allowances for Concrete Pressure Pipe shall conform to AWWA M9.

D. Sewer Testing with Low Pressure Air:
1. Plug and bulkhead ends of pipe segment to be tested.
   a. One plug shall have an orifice through which to pass air and a second orifice shall be continuously connected to a pressure gauge having a range from 0 to 10 psi, minimum divisions of 0.10 psi, and accuracy of plus or minus 0.04 psi.
2. The air supply line shall have a positive on-off valve and suitable means for readily disconnecting from the control panel.
3. The section of pipe shall be pressurized to approximately 4 psi.

4. The air shall be shut off and allowed to stabilize for a minimum of 2 min. If during this time the pressure drops below 3.5 psi, more air shall be added to raise pressure to a minimum of 3.5 psi.
5. After the air has stabilized, the air line shall be disconnected and testing will begin.
6. The time of test, in minutes, will be equivalent to one-half of the nominal diameter of the pipe being tested.
7. The maximum allowable pressure drop during the specified time period will be 1.0 psi.

E. Joint Acceptance Testing – Pipe Diameter Greater Than 36-inches
1. Conduct individual joint tests on each joint for 36-inch and larger precast concrete pipe, in accordance with ASTM C1103.
2. Prior to testing, clean the joint and interior surface to eliminate debris, and as necessary wet the pipe walls.
3. Conduct joint test as Work progresses, do not complete backfilling until joint has successfully passed testing.
4. The line for pressurizing the void volume shall include a 6 psi pressure relief device.
5. Position the testing apparatus over the joint and make sure the end element sealing tubes straddle both sides of the joint. For the water test the bleed-off petcock must be located at the top dead center.
6. Joint Air or Water Test
    a. Pressurize the void with air or water to 3.5 psi greater than the pressure exerted by ground water above the pipe. Allow the air pressure to stabilize before shutting of the air or water supply and start of test timing.
    b. If pressure holds, or drops less than 1 psi in 5 sec, the joint is acceptable.
    c. If the joint fails, it shall be retested, or repaired if necessary and retested.
    d. If the pressure required for the test is greater than 6 psi to meet the testing requirement in E.6.a above, the joint test shall not be used.

F. Vacuum Testing:
1. Manholes
    a. Temporarily plug pipe connections entering manhole to be tested.
    b. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
    c. Following set-up of test apparatus, draw vacuum of ten inches of mercury on manhole being tested. The time shall be measured for the vacuum to drop nine inches mercury.
    d. Start test upon reaching specified test vacuum. Test duration shall be in accordance with ASTM C1244.
        1) Minimum test times for various manhole diameters shall conform to the following table per ASTM C1244 or be 1 minute; whichever is longer:

Depth	**Diameter, in.**												
(ft)	48	54	60	66	72	78	84	90	96	102	108	114	120
Time, in seconds													

<4													
6													
8													
10											63	67	71
12								62	67	71	76	81	85
14						62	67	72	78	83	89	94	100
16					69	70	76	83	89	95	101	108	114
18				65	73	79	86	93	100	107	114	121	128
20			65	72	81	88	95	103	111	119	126	135	142
22		64	72	79	89	97	105	114	122	131	139	148	156
24		64	78	87	97	106	114	124	133	143	152	161	170
26	64	75	85	94	105	114	124	134	144	155	164	175	185
28	69	81	91	101	113	123	133	145	155	167	177	188	199
30	74	87	98	108	121	132	143	155	166	178	189	202	213

Note: Table per ASTM C1244

e. Record vacuum drop at end of test. If vacuum drop is greater than one inch of mercury, pipe segment or manhole fails the test and shall be repaired and retested. If vacuum drop is less than 1 inch of mercury, manhole passes the test.

G. Vertical Deflection Test for Flexible Pipe:
1. Conduct vertical deflection test at least thirty days after backfill has been placed.
2. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping, depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured.
3. Perform test without mechanical pulling devices.
4. Re-install and retest pipe segments that exceed deflection of 5 percent.

H. Infiltration/Exfiltration Testing
1. Contractor may test sanitary sewer piping, using the method specified in one of the following paragraphs: exfiltration testing and infiltration testing. Notify Engineer in writing in advance of the first test of method to be used for testing, and use the same test method for testing all piping in the Contract, unless otherwise accepted by Engineer."
2. Exfiltration Testing:
   a. Plug and bulkhead ends and lateral connections of pipe segment to be tested and admit fluid until the pipe is full. Admit fluid slowly to minimize air entrapment. Groundwater level shall be below the pipe during exfiltration test.
   b. Before measuring leakage, allow fluid to wet pipe interior for the following period:
      1) Concrete Pipe: 48 hours.
      2) Cement Mortar-lined Pipe: 24 hours.

3) Other Pipe: Wetting period not required.

c. Provide minimum hydrostatic head during test of two feet above crown of upstream end of pipe segment tested.

d. Add fluid from test container or from metered supply as required to maintain test water level within three inches of test head throughout the test.

e. Test duration shall be at least two hours.

f. Allowable Leakage Rates:

1) Leakage is defined as the quantity of fluid that must be supplied to pipe segment tested to maintain hydrostatic head within three inches of test head during the test after pipe has been filled and exposed to required wetting period, plus quantity required to refill to original head at end of test.

2) Leakage shall not exceed 100 gallons per inch of pipe diameter per day per mile of pipe.

3. Infiltration Testing

a. Conduct testing from manhole to manhole or between more than 2 manholes. The length of main tested shall not exceed 700 feet.

b. Stop all dewatering operations and allow the groundwater to return to its normal level.

c. Groundwater level shall be 2 feet above the crown of the pipe for the entire test section.

d. Plug all pipe outlets discharging in to the upstream manhole.

e. Measure the groundwater elevation and determine the average head over the test section.

f. Measure infiltration leakage at the outlet of the test section, using one of the following methods:

1) Fill a small container of known volume and record the time it takes to fill the container.

2) Install small weirs and record the flow over the weir.

3) Install an electronic flow monitoring device.

g. Allowable Infiltration Rate:

1) Leakage shall not exceed 100 gallons per inch of pipe diameter per day per mile of pipe.

h. If the test section fails, repair and retest until section passes infiltration test.

3.6 CLEANING

A. Cleaning, General: Clean pipe systems as follows:

1. Thoroughly clean all piping, in manner approved by Engineer, prior to placing in service.

+ + END OF SECTION + +

SECTION 33 32 19

PUBLIC UTILITY WASTEWATER PUMPING STATIONS

PART 1 GENERAL

1.1 GENERAL

A. The Contractor shall furnish and install one automatic pumping station complete with all needed equipment installed in a structure as shown on the Contract Drawings.

B. The principal items of equipment shall include two submersible, non-clog pumps; valves; piping; control panel with circuit breakers, and automatic pumping level controls, re-establishing existing telemetry and all wiring.

C. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
   1. ANSI - American National Standards Institute.
   2. ASTM - American Society for Testing & Materials.
   3. HI - Hydraulic Institute.
   4. NEMA - National Electric Manufacturer's Association.

1.2 MEASUREMENT AND PAYMENT

A. Lift Station (Mechanical)
   1. Work Item Number and Title
      33 32 19-A: Lift Station (Mechanical)

   2. Payment under this Item shall be on a lump sum basis.

1.3 QUALITY ASSURANCE

A. The pumps shall be heavy duty, electric submersible, centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater. The pumps shall be capable of operating in a liquid temperature up to 104 degrees F.

B. The pumps and motor shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged.

C. The pump, mechanical seals and motor units provided shall be from the same manufacturer.

D. The pumping unit manufacturer shall test each pump for mechanical and electrical correctness.

E. Perform field tests specified in this Section.

F. All control panels shall be designed and constructed to UL 508A standards. All control panels shall be UL 508A listed. Control panels shall be made available to the Owner and Engineer during factory testing.

1.4 SUBMITTALS

A. Standard submittal data for pump approval must consist of:
   1. Manufacturer's Certificate of compliance certifying compliance with the referenced specifications and standards.
   2. Shop drawings with performance data and physical characteristics.
      a. Certified performance total dynamic head, capacity, brake horse power, efficiency, and required net positive suction head curves for each pump supplied.
   3. Manufacturer's installation instructions.
   4. Manufacturer's operation and maintenance material and manuals.
   5. Certified copies of test reports.
   6. Pump outline drawing.
   7. Station drawing for accessories
   8. Warranty Information
   9. Electrical:
      a. Submit all electrical requirements for each piece of equipment including voltage, phase, and load data.
      b. Submit a drawing showing the electrical enclosure placement within the pump station. Placement must be approved by the Engineer prior to installation.
      c. Provide interior and exterior layouts of control panels where applicable. Layouts shall be to scale and a bill of material shall be included.
      d. Provide interior and exterior layouts of power panels where applicable. Layouts shall be to scale and a bill of material shall be included.
      e. Submit information on all pilot and control components. This includes but is not limited to: pilot lights, relays, push buttons, and timers.
      f. Provide wiring and interconnection diagrams for each piece of equipment. For example, submitting one diagram for all screening equipment is not acceptable. Differentiate between panel and field wiring.
      g. “Typical” diagrams are not acceptable. Manufacturer’s standard diagrams may be submitted if they are made specific for this project by:
         1) Showing all included options, special items, etcetera.
         2) Unused options or features shall be crossed out or deleted.
         3) Identify the drawing with project name, equipment name, and tag number.

B. Standard submittal data for plug and check valve approval must consist of:
   1. Shop Drawings
   2. Product Data

C. Operation and Maintenance Manuals
   1. The Contractor shall submit operation and maintenance manuals for the pump equipment furnished hereunder.
   2. The Contractor shall submit operation and maintenance manuals for the plug and check valves furnished hereunder.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in such a manner to prevent damage to products.

C. The pumps furnished shall be packaged in such a manner as to provide ample protection from damage during handling, shipment, and outdoor storage at the lift station site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.

D. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 PRODUCTS

2.1 PUMPS

A. Requirements: The Contractor shall furnish and install two submersible non-clog wastewater pumps at the pump station with each pump having the following criteria:

Capacity	230 gpm
Total Dynamic Head	167 feet
Model	N 3202 HT 3 Phase 4 Poles Smartrun
Impeller	273 mm
Horsepower	70 Hp
RPM	3565 rpm

B. Each pump shall be equipped with a submersible electric motor connected for operation on 240 volts, 3 phase, 60 hertz, with (15) feet of submersible cable suitable for submersible pump applications. Each pump shall be fitted with (15) feet of stainless steel chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

C. Pump Design - The pumps shall be automatically and firmly connected to the discharge connection, guided by 304 S.S. guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the sump floor.

D. Pump Construction- Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts and bolts shall be AISI type 316 stainless steel construction. All metal surfaces coming in contact with the pump, other than stainless steel or brass, shall be protected by a factory-applied spray

coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

E. Cable entry seal - The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by terminal board, which shall isolate the interior from foreign material gaining access through the pump top.

F. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 15 [30 for Premium Efficiency Motors] evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. The motor shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

G. Bearings - The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep grove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

H. Mechanical seal - Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively driven rotating tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The motor shall be able to operate dry without damage while pumping under load. Seal lubricant shall be FDA Approved, non-toxic.

I. Pump shaft - Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. The pump shaft shall be of 431 Stainless Steel.

J. Impeller (Type N) - The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, multi-vain, backswept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge. The impeller(s) vanes shall have screw-shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater. Impellers shall be locked to the shaft and held by an impeller bolt.

K. Volute Bottom/Insert Ring (Type – N) – The pump volute shall be of A48 Class 35B gray cast iron and shall have (an) integral spiral shaped cast groove(s) at the suction of the volute. The internal volute bottom or insert ring shall provide effective sealing between the pump volute and the multi-vane, semi-open impeller. The sharp spiral groove(s) shall provide the shearing edge(s) across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.

2.2 LEVEL INSTRUMENTATION

A. Level sensors: Provide a multi-point float stick and a submersible continuous level sensor to measure water depth in the wet well. Install as indicated on the drawings. The multi-point float stick shall serve as the primary level sensor.
   1. Continuous Level Sensors: MultiTrode® model MTPT with mounting bracket, 100 feet of cable, intrinsic safety barrier, and other items as required.
   2. Multi-point float stick: MultiTrode® probe, nominal 72 inches long (10 switch points), 100 feet of cable, mounting brackets, intrinsic safety barrier, and other items as required.
   3. Provide a Tension Clamp for each cable as manufactured by Rutenbeck part AKL-801.

B. Level transmitter: Provide a continuous monitoring level sensor to measure water depth in the wet well. Install as indicated on the drawings. The 4-20mA level transmitter shall serve as the secondary level sensor.

2.3 ELECTRICAL, CONTROL, AND CONTROL PANEL REQUIREMENTS

A. Enclosures
   1. The interior of the enclosure shall be provided with properly sized industrial grade corrosion inhibitors.
   2. The enclosure shall be provided with thermostatically controlled, properly sized condensate heater. The heater shall be mounted on the lower portion of the enclosure internal panel.
   3. Furnish a door limit switch actuated panel LED light.
   4. Include a door intrusion alarm.
   5. Integrate a red 30mm oil and water tight alarm light on the exterior hinge side of the enclosure.
   6. Wire duct shall be installed as a wire way. Wire way shall be min 4” (100mm) in height and be filled to max 50% capacity.
   7. Conduit entry into the enclosure originating from the wet well, shall be sealed with explosion-proof conduit seals to prevent moisture and gas vapors from entering the enclosure.
   8. Install all wiring within the enclosure plastic wiring ducts. Separate DC and AC signals with separate wire ducts or routing.
   9. Terminate all wiring at terminal blocks. Splices are not permitted.
   10. Include reference sheet in an archival quality acid-free sheet protector. It shall list initial pump set points, float stick set points, wet well elevations and Modbus slave address. Include level controller ‘zero’ elevation. All elevations are to be based on USGS NAVD1988 Datum.
   11. All telemetry equipment shall be included in the main control panel.
   12. Enclosure shall be NEMA 4X stainless steel, continuous hinge with 3-point latch. Manufactured by Hoffman, Saginaw, or Engineer approved equal.
   13. Provide adequately sized uninterruptable power supply (UPS) in control panel. UPS shall be din-rail mounted, designed to operate in temperatures down to -14° F, manufactured by Phoenix Contact or Engineer approved equal.
   14. Enclosure shall include appropriate heat shield for outdoor installations. Shield shall be provided by the enclosure manufacturer.

B. POWER

1. The incoming pump power wiring shall be terminated at distribution lugs and shall be provided with voltage surge arresters to protect all equipment mounted within the enclosure from switching surges and lightning induced surges.
    a. Locate surge arresters in such a manner as to facilitate inspection and future replacement of damaged units. Comply with UL 1449 and ANSI C62.41 Standards.
2. Power within the panel shall be distributed further through thermal magnetic circuit breakers and motor circuit protectors, which shall be accessible from the front of the swing-out panel without opening the swing-out panel. Provide the following:
    a. A motor circuit protector for each pump.
    b. A circuit breaker for control transformer
    c. Circuit breakers shall have minimum interrupting rating of 22kAIC
    d. Separate incoming terminals for control circuit panel control power, pressure transducer power supply and telemetry transceiver.
    e. Provide Mains voltage monitoring to the control panel.
3. Provide a transformer to obtain 120 Volts AC power.
    a. Transformer shall be high efficiency type, with 105 º C temperature class, extra regulation and low losses.
    b. Size transformer to feed all 120 Volts AC within the enclosure +20%. Minimum size of the transformer shall be 1.0 KVA.
4. Distribute 120 Volt AC power through single pole, circuit breakers as shown on the single line diagram, which shall have minimum interrupting rating of 10,000 Amperes. Provide a circuit breaker for each of the following items:
    a. Motor control circuit.
    b. Panel light and thermostatically controlled enclosure heater described above.
    c. Convenience GFI receptacle.
    d. Additional as specified on single line diagram.
5. Install a duplex convenience receptacle, which shall be accessible from the front of the swing out panel. Receptacles shall be 15 Ampere, GFI (Ground Fault Interrupting) types.
6. Protect each starter power with magnetic only motor circuit protector. Motor circuit protectors shall be as follows:
    a. Size, voltage and configuration shall be as required.
    b. Provided with adjustable instantaneous trips.
    c. Minimum rating: 22kAIC (Amperes Interrupting Capacity).
7. Provide each pump starter with the following:
    a. A minimum of two sets of normally open starter auxiliary contacts.
    b. A minimum of two sets of normally closed starter auxiliary contacts.
    c. One set of normally open auxiliary overload alarm contacts.
8. Provide for each pump starter circuit breaker tripped auxiliary contact.
9. For each pump provide the following
    a. Motor Thermal switch
    b. Leak sensor
    c. Current transformers for each phase
10. Provide terminal blocks, which shall be grouped together, for remote control and monitoring wiring.
11. Provide all electro mechanical relays as necessary to achieve the intended operation as described. Relays shall be plug-in ice-cube style, 3PDT or 4PDT, with manual operator and indicator light. Contacts shall be rated a minimum of 10 amps at 240 VAC.

12. Manufacturers shall be as listed below. Products of other manufacturers assembled to provide all specified functions, including reliability equal to or exceeding that of the manufacturers listed above may be submitted for approval.
    a. Circuit breakers and motor circuit protectors shall be Square D or Eaton.
    b. Pilot and control devices shall be as manufactured by Allen-Bradley, or Square D.

C. PUMP CONTROLLER
1. Microprocessor based, intelligent pump controller with pre-configured pump control logic and fault handling. Pump Control and Monitoring Equipment shall be MultiTrode®, Inc. MultiSmart model MSM3MP.
2. Provide pump control module and user interface model #IO-3PC (MultiTrode).
3. Provide motor protection module, model #IO-3MP (MultiTrode).
4. Standard functions: The pump controller shall be provided with pre-configured (default) parameters which are selectable via the user interface keypad, including:
    a. Set point adjustment for pump activation/deactivation and level alarms.
    b. Level device inputs: 4-20mA signal or (conductive) level probe.
    c. Redundant level device inputs.
    d. Selectable between charge (fill) & discharge (empty).
    e. Pump control of up to 3 pumps.
    f. Pump grouping and alternation.
    g. Station optimization including:
        1) Maximum off time for any pump.
        2) Maximum pumps to run simultaneously.
        3) Maximum pump starts per hour.
        4) Inter-pump start and stop delays.
        5) Maximum run time for any pump.
        6) Blocked pump detection.
    h. Well washer control functions.
    i. Well clean out (periodic pump down to off point).
    j. Alternate profiles of level set points (Conditional pump management).
    k. Data logger functions.
    l. 3-phase supply monitoring and supply protection including:
        1) Under-voltage.
        2) Over-voltage .
        3) Phase fail.
        4) Phase rotation.
        5) Monitoring of dc supply, battery voltage, and internal temperature.
    m. Additional Functions (Firmware Enabled):
        1) Over current and under current detection.
        2) Ground / earth fault.
        3) Insulation resistance testing for motor windings.
        4) KVA, kW and power factor measurement.
    n. Calculated flow function.
    o. Input/Output Description.
5. Available I/O types shall include:
    a. Digital inputs (voltage free, discrete input).
    b. Digital outputs (240V, 5A resistive).
    c. Analog inputs (10bit) (4-20ma).

d. Analog outputs (10bit) (4-20ma).
e. Standard (Configurable) Digital Inputs:
    1) Seal/Leakage sensor.
    2) PTC Thermistor or other over temp device.
    3) PT100.
    4) Xylem FLS Sensor.
    5) Conductive probe (for liquid level sensing).
f. Motor Protection & Monitoring Inputs:
    1) Insulation resistance test (IRT) to 1000v, 1 phase per pump.
    2) 3-phase current monitoring.
    3) 3-phase supply monitoring.
    4) Three (3) current transformers (CTs) shall be supplied and installed per pump. Each pump's full load amps (FLA) are to be taken into consideration to obtain correct CT ratio.

6. User Interface:
7. The field hardware shall include a user interface for operations and configuration. The display shall provide status of the pump station, control of pumps, resetting of faults and configuration of parameters.
    a. The following parameters shall be displayed on the main status screen:
        1) Level.
        2) Set points for alarms and pump start/stop.
        3) Pump Running/Stopped.
        4) Pump Available.
        5) 3-phase current for each motor Pump faults.
        6) 3-phase supply.
    b. Provide access to Faults, History, Information and Settings.
    c. The following information screens and parameters shall be available via the keypad:
        1) Elapsed Time accumulators for each pump & the pump station.
        2) Number of Starts accumulator for each pump & the pump station.
        3) Flow values, either derived from calculations or via a flow meter, including inflow, pump flow rate, total volume.
        4) Overflow information, including start time, duration, estimated volume.
        5) Insulation resistance value for each motor.
        6) Status of Inputs & Outputs.
    d. In addition to previously listed points to be indicated by the system the following conditions shall also be indicated:
        1) Communication Fail
        2) Inflow Rate
        3) Outflow Rate
        4) Pump Run Status (all pumps)
        5) Pump Failure (all pumps)
            a) High Alarm
            b) Medium Alarm
        6) Power Failure
        7) Control Power Failure
        8) UPS Failure
        9) Volume Today
        10) Volume Yesterday

11) Wet Well Level
12) Wet Well High Level

8. The following control functions/devices shall be industrial grade oil tight and watertight types. Each pump shall be provided with the following controls, which shall be visible from the front of the swing-out panel, with the enclosure door opened:
   a. Pump mode for each pump, (Hand/Off/Auto) – 22.5mm operator.
   b. Pump fault reset.
   c. Level alarm reset.
   d. An amber "FAIL" pilot light.
   e. An amber "SEAL FAILURE" pilot light.
   f. A red motor "RUN" pilot light.
   g. A green motor "OFF" pilot light.
   h. A "RESET" push button.
   i. A non-resettable elapsed time meter for each pump.
   j. A non-resettable elapsed time meter for when both pumps operate simultaneously.

2.3 ELECTRICAL, CONTROL, AND CONTROL PANEL REQUIREMENTS

A. Include reference sheet in an archival quality acid-free sheet protector. It shall list initial pump set points, float stick set points, wet well elevations and Modbus slave address. Include level controller 'zero' elevation. All elevations are to be based on USGS NAVD1988 Datum.

B. ENCLOSURES
   1. Conduit entry into the enclosure originating from the wet well, shall be sealed with explosion-proof conduit seals to prevent moisture and gas vapors from entering the enclosure.
   2. Terminate all wiring at terminal blocks. Splices are not permitted.
   3. Enclosures shall be NEMA 4X stainless steel.

C. POWER PANEL
   1. The incoming pump power wiring shall be terminated at distribution lugs and shall be provided with voltage surge arresters to protect all equipment mounted within the enclosure from switching surges and lightning induced surges.
      a. Locate surge arresters in such a manner as to facilitate inspection and future replacement of damaged units. Comply with UL 1449 and ANSI C62.41 Standards.
   2. Power within the panel shall be distributed further through thermal magnetic circuit breakers and motor circuit protectors, which shall be accessible from the front of the swing-out panel without opening the swing-out panel. Provide the following:
      a. A motor circuit protector for each pump.
      a. Circuit breakers shall have minimum interrupting rating of 22kAIC.
      b. Separate incoming terminals for control circuit panel control power, pressure transducer power supply and telemetry transceiver.
      c. Provide Mains voltage monitoring to the control panel.

   3. Provide a transformer to obtain 120 Volts AC power.
      a. Transformer shall be high efficiency type, with 105 º C temperature class, extra regulation and low losses.

b. Size transformer to feed all 120 Volts AC within the enclosure +20%. Minimum size of the transformer shall be 1.0 KVA.

4. Distribute 120 Volt AC power through single pole, circuit breakers as shown on the single line diagram, which shall have minimum interrupting rating of 10,000 Amperes.
5. Protect each starter power with magnetic only motor circuit protector. Motor circuit protectors shall be as follows:
   a. Size, voltage and configuration shall be as required.
   b. Provided with adjustable instantaneous trips.
   c. Minimum rating: 25,000 AIC (Amperes Interrupting Capacity).
6. Provide each pump starter with the following:
   a. A minimum of two sets of normally open starter auxiliary contacts.
   b. A minimum of two sets of normally closed starter auxiliary contacts.
   c. One set of normally open auxiliary overload alarm contacts.
7. Provide for each pump starter circuit breaker tripped auxiliary contact.
8. For each pump provide the following
   a. Motor Thermal switch
   b. Leak sensor
   c. Current transformers for each phase
9. Provide one set of normally closed circuit breaker tripped auxiliary contacts.
10. Circuit breakers and motor circuit protectors shall be Square D or Eaton.
11. Pilot indicator lights shall be LED and manufactured by Square D.

D. CONTROL PANEL
1. Provide and furnish the Lift Station Low Voltage Control Panel per prints and Bill of Materials.
2. Panel shall be built in a UL approved panel shop.

2.4 PIPE, VALVES, AND FITTINGS

A. Furnish complete station piping, valve pit, check valves and plug valves.

B. The discharge pipe and fittings shall be ductile iron Class 350. Inside pipe and fittings shall be flanged. Bell end pipes or fittings with mechanical joints shall be provided at or near the outside face of the station well. Piping shall be supported independent of the sewage flanges.

C. All plug valves shall be solid one piece, Cast Iron ASTM A126 Class B or Ductile Iron ASTM 536 Grade 65-45-12. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed. Spherical shaped plugs are not acceptable. One lever shall be provided for each plug valve. Bodies shall be Cast Iron ASTM A126 Class B. Ports shall be rectangular and 100% Port. The valve port area shall meet or exceed standard pipe area per ASME/ANSI B36. 10M. Round ports are not acceptable. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel, ASTM A743 Grade CF8M through 36” (900mm). In valves larger than 36” (900mm), the upper and lower plug journals shall be fitted with ASTM A240 type 316 stainless sleeves with body bearings of ASTM B30, Alloy C95400 aluminum bronze. Pressure ratings shall be 175 psi on valve sizes through 12” and 150 psi for 14” and larger.

Every valve shall be given a certified hydrostatic shell test and seat test, with test reports being available upon request.

D. Rubber Flapper Swing Check Valves to be APCO model CRF. All check valves shall be Ductile Iron ASTM A536 Grade 65-45-112 for sizes 2-24" and Cast Iron ASTM A126 Grade B for sized 30" and larger in body. Body Seat shall be on a 45 degree angle to the centerline of the pipe, permitting horizontal or vertical installation. The valve shall be rated to 175 psi cold working pressure.

E. All metal piping other than cast or ductile iron and copper tubing shall be galvanized steel pipe. Guide rails and all interior miscellaneous metals, including bolts, shall be stainless steel.

F. At joints, contractor shall use EBAA Iron Works Megalug Series 1100 mechanical joint restraint for ductile iron pipe.

PART 3 EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed in accordance with these specifications, construction drawings and the manufacturer's printed instructions.

B. Inspect all equipment and appurtenances prior to installation of the Work. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with new, undamaged and suitable products.

C. All electrical work shall be done by a qualified licensed electrician and shall conform to the National Electric Code.

3.2 TESTING

A. Each pump shall be fully tested in accordance with manufacturer's written instructions. Certified copies of the test results shall be furnished with each pumping unit. Record the test voltage and amperage measurements.

B. Refer to Section 01 75 11 "Checkout and Startup Procedures" for documentation requirements and checklists.

3.3 WARRANTY

A. The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of five years under normal use, operation, and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear or a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring, and ball bearings. The warranty shall be in published form and apply to all units.

B. The manufacturer shall provide as part of his bid price the services of a factory trained representative for two separate days at the lift station to perform initial start-up of the pumping station and demonstrate satisfactory performance of each piece of equipment and instruct operating personnel in the operation and maintenance of the equipment.
   1. The site visits shall be held on two separate days for the primary and sole purposes of the startup and O&M instruction.

C. All equipment supplied and installed under this item of the specifications shall meet the requirements of the Occupational Safety & Health Act of 1970.

+ + END OF SECTION + +

SECTION 33 39 13

SANITARY UTILITY SEWERAGE MANHOLES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all precast and cast-in-place structures.

B. General:
   1. Manholes and structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as directed by Engineer.
   2. Cast-iron frames, grates and covers shall be the standard frame and grate or cover unless otherwise shown and shall be as specified in Section 05 56 00, Metal Castings.
   3. Concrete for cast-in-place manholes and structures and for inverts in precast manholes and structures shall be Class "A", type II cement, and shall conform to the requirements specified under Section 03 00 05, Concrete.
   4. Manholes and structures shall be precast construction, unless otherwise shown.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 56 00, Metal Castings.
   3. Section 31 00 05, Trenching and Earthwork.
   4. Section 33 31 00, Sanitary Sewer Piping Installation.

1.2 MEASUREMENT AND PAYMENT

A. Concrete Manholes and Structures Various Sizes and Depths
   1. Work Item Number and Title
      33 39 13-A 48" Diameter Sanitary Utility Sewerage Manholes
   2. Payment for Concrete Manholes and Structures shall be on a unit price basis for each size and type.
   3. The pay quantity shall be the actual number of manholes and structures in each size and type actually furnished and installed.
   4. This Work will be at the unit price as listed on the submitted Bid schedule for size and type of the concrete manholes and structures and shall include the following: pavement removal, excavation, disposal of excess excavated material, base stabilization, dewatering, sheeting, riser rings, castings and lids, external wraps and seals, precast sections or cast in place concrete, channels, inverts, granular backfill material, connecting pipes, placing and compacting backfill, testing, utility adjustments, temporary pavement replacement if necessary, and any other requirements to complete the Work in accordance with the drawings and specifications, unless otherwise classified as a separate Work item.

1.3 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ASTM International.
      a. ASTM C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
      b. ASTM C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
      c. ASTM C990, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
   2. American Association of State Highway and Transportation Officials.
      a. AASHTO M198, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit manufacturer's Shop Drawings showing design and construction details for sanitary utility sewage manholes per type.
      b. Submit detailed Shop Drawings showing design and construction details for any special structures.

1.5 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer
      a. Sanitary Utility Sewerage Manholes shall be from a source listed in the INDOT List of Certified Precast Concrete Producers, in accordance with ITM 813.

B. Component Supply
   1. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, or on the Project Site, or at both places and the materials shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein. Material rejected after delivery to the Project Site shall be marked for identification and shall be removed from the Site immediately. All materials, which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.
   2. At the time of inspection, the materials shall be carefully examined for compliance with the ASTM standards specified in this specification section and with the approved manufacturer's Shop Drawings. All precast manhole sections shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. The surface shall be dense and close textured.

C. Imperfections in precast manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that a strong and permanent repair will result. Repairs shall be carefully inspected before final approval.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Any manhole section damaged in the process of transportation or handling, shall be rejected and immediately removed from the Site, and the damaged manhole sections shall be replaced at no increase in Contract Amount.

B. Material delivery, storage and handling must conform to requirements in Contract Documents. Refer to Section 01 65 00 Product Delivery Requirements and Section 01 66 00 Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES AND STRUCTURES

A. Precast manholes and structures shall conform to the details shown. Provide cast-in-place concrete bases where shown.

B. Except where otherwise specified, precast manhole components shall consist of reinforced concrete sections especially designed for manhole construction and manufactured in accordance with ASTM C478, except as modified herein.

C. Precast, reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods or dry cast methods, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.

D. Provide manhole with tongue and groove joints. Seal joints with the following method:
   1. Rubber Gasket in accordance with ASTM C443
      a. Manufactures: Provide rubber gasket from the following:
         1) O-Ring Gasket, by Press-Seal Gasket Corporation.
         2) Or equal.
   2. Preformed Flexible Joint Sealant in accordance with ASTM C990 and AASHTO- M198.
      a. Manufacturers: Provide joint sealant from the following:
         1) EZ Stik, by Press-Seal Gasket Corporation.
         2) Kent Seal #2, by Hamilton-Kent.
         3) RU 106 RUB'RNEK LTM, by Henry Co.
         4) or equal.
   3. Butyl Rubber Backplaster.
      a. Manufacturers: Provide joint sealant from the following:
         1) Trowelable EZ Stik #3, by Press-Seal Gasket Corporation
         2) or equal.
   4. Polyethylene Plastic Sheeting Film
      a. Manufacturers: Provide joint sealant as required to protect the joint from backfill operations:
         1) 6 mm polyethylene plastic sheeting film by Visqueen.
         2) or equal.

E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 120 pounds per cubic foot, an H-20 wheel loading, and an allowance of 30 percent impact.

F. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

G. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints.

H. Except as approved by Engineer for large pipes, openings in the barrel of the manholes for pipe connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

I. A precast or cast-in-place slab or precast eccentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the metal casting frame and cover.

2.2 MISCELLANEOUS METALS

A. Metal casting frames and covers and similar required items shall be provided as shown and in accordance with Section 05 56 00 Metal Castings.

2.3 RISER RINGS

A. Riser rings must conform to the requirements in the Contract Documents. Refer to Section 05 56 00 Metal Castings.

2.4 MANHOLE STEPS

A. Except where specifically listed on the Drawings, manholes and structures shall not be provided with steps.

2.5 DROP CONNECTIONS

A. Drop connections for manholes and structures shall be constructed where shown or directed by the Engineer and shall conform to the design and details shown.

B. Concrete for pipe encasement shall be Class “A” as specified under Section 03 00 05, Concrete. Concrete shall be bonded to manhole in the manner shown or otherwise approved by Engineer. Drop connection pipe encasement shall begin six (6) inches above the drop connection and continue to the bottom of the manhole.

C. Drop pipe shall be a minimum of 8 inch for 8 inch to 12 inch diameter mainline pipe and 12 inch for all larger mainline pipe, unless otherwise specified.

D. When increasing outlet pipe diameter by 6 inch or less, crown elevations shall match at the centerline of manhole. When increasing outlet pipe diameter by more than 6 inch, spring lines shall match at the centerline of the manhole.

PART 3 EXECUTION

3.1 PRECAST MANHOLE BASES

A. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.2 PRECAST MANHOLE SECTIONS

A. Install sections, joints and gaskets in accordance with these specifications and the manufacturer's recommendations.

B. Join riser cone, cone and flat top sections with preformed flexible joint sealant compound in accordance with manufacture's recommendations, except that install sufficient sealing compound so as to show a "squeeze-out" on the outside of the joint.

C. Apply trowelable grade butyl rubber backplaster material 1/4 inch minimum thickness, when dry, on the outside of the manhole at each joint, extending 6 inches above and below the joint. Next, apply shrink wrap or Visquene to the outside of each joint to protect the backplaster material.

D. Lifting holes, if used in manhole components, shall be repaired using a conical precast concrete plug, properly sealed into place using non-shrink cement or epoxy grout. The repair shall be clean and neat to ensure water tightness.

3.3 MANHOLE CHANNELS

A. Flow Channel
   1. All invert channels through manholes and structures shall be constructed of Class "A" concrete conforming to the requirements of Section 03 00 05, Concrete. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown or as ordered.
   2. For all manholes with equal diameter influent and effluent pipes in a straight through alignment, a minimum 0.10 foot drop between the inverts of the influent and effluent pipes shall be maintained.
   3. Flow channels through a manhole shall be made to conform in shape, and slope to that of the connecting sewers. The channel walls shall be shaped or formed to the full height of the springline of the outlet sewer so that maintenance, inspection, and flow in the manhole are not obstructed.

B. Bench
   1. Benches shall be provided on each side of the manhole channel when the pipe diameter(s) are less than the manhole diameters.
   2. Benches shall be built up to the heights shown, and shall be sloped no less than 1/2-inch per foot (4 percent), or as directed by the Engineer and given a uniform wood float finish.
   3. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.4 STUBS FOR FUTURE CONNECTIONS

A. When installing pipe stubs for future pipeline, installation of all stubs shall be properly restrained to prevent any movement. Where pipe stubs, sleeves or couplings for future connections are shown or directed by the Engineer, Contractor shall provide all materials and labor in order to complete the Work.

3.5 BEDDING AND BACKFILLING AT MANHOLES AND STRUCTURES

A. Conform to applicable requirements of the Contract Documents. Refer to Section 31 00 05, Trenching and Earthwork.

3.6 GRADING AT MANHOLES AND STRUCTURES

A. All manholes and structures in unpaved areas shall be built, as shown or directed by the Engineer, to an elevation higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown or directed by the Engineer. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth of grass is obtained.

B. Manholes and structures in paved areas shall be constructed to meet the final surface grade. In paved areas on state highways, all manholes and structures shall be 1/2-inch below final wearing surfaces. Manholes and structures shall not project above finished roadway pavements to prevent damage from snowplows.

C. Contractor shall be solely responsible for the proper height of all manholes and structures necessary to reach the final grade at all locations. Contractor is cautioned that Engineer's review of Shop Drawings for manhole components will be general in nature and Contractor shall have at its disposal an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.7 FLEXIBLE PIPE JOINT AT MANHOLE BASE

A. An approved flexible joint shall be provided between each pipe entering and exiting the manhole. Pipe to manhole connections shall conform to the details shown on Drawings. The joint into the manhole base shall be completely watertight.

B. Provide products manufactured as listed below and meeting requirements of ASTM C923:
   1. For pipes 36 inch diameter and smaller:
      a. Press-Seal PSX: Positive Seal
      b. NPC Kor-N-Seal II 306 Series
   2. For pipes larger than 36 inch diameter:
      a. A-Lok Premium
      b. Press-Seal WS 30 Waterstop Grouting Ring

3.8 FIELD QUALITY CONTROL

A. All manholes and structures shall be free of visible leakage and meet the testing requirements of the piping system, as specified in section 33 31 00 Sanitary Sewer Piping Installation.

B. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to Engineer's approval.

C. Each manhole may be tested with the piping, as a complete system, or individually. If tested individually, each manhole shall be vacuum tested in accordance with Section 33 31 00, Sanitary Sewer Piping Installation.

3.9 CLEANING

A. All new manholes shall be thoroughly cleaned of all silt, debris, and foreign matter of any kind, prior to final inspection.

+ + END OF SECTION + +

SECTION 40 63 00

PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.1 SCOPE

A. The CONTRACTOR and the Process Control and Instrumentation Systems (PCIS) sub-contractor shall provide a control panel for the Concertor Pumping System. This system includes, but is not limited to, the following:
   1. Communications gateway for each Concertor Pumping System (CPS)
   2. Pump station controller capable of controlling all CPS
   3. Remote monitoring equipment compatible with the manufacturer's remote monitoring system
   4. Surge protection
   5. Commissioning of the control panel
   6. Site acceptance testing (SAT)

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
   1. ANSI – American National Standards Institute.
   2. ASTM – American Society for Testing & Materials.
   3. HI – Hydraulic Institute.
   4. NEMA – National Electric Manufacturer's Association.

1.2 REFERENCES

A. UL 508A
B. UL 698A
C. NFPA 70 - NEC (2017)
D. NFPA 820
E. ISA 5.1
F. ISA 5.4

1.3 SUBMITTALS

A. Provide in accordance with Section 01 33 00. Submittals shall include but not be limited to the following:
   1. Manufacturer's Certificate of compliance certifying compliance with the referenced specifications and standards.
   2. Shop drawings with performance data and physical characteristics.
   3. Manufacturer's installation instructions
   4. Manufacturer's operation and maintenance material and manuals.
   5. Certified copies of test reports.
   6. Bill of Material (BOM).
   7. Wiring diagrams.
   8. Outline and dimension drawings.
   9. Enclosure mounting details.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall be responsible for the delivery, storage, and handling of products.
B. Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in such a manner to prevent damage to products.
C. The pumps furnished shall be packaged in such a manner as to provide ample protection from damage during handling, shipment, and outdoor storage at the lift station site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.
D. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.
E. Store in a clean, dry space.
F. Lift only with lugs provided for the purpose.
G. Handle carefully to avoid damage to internal components, enclosure and finish.

1.5 GENERAL REQUIREMENTS

A. The requirements of this section apply to the PCIS unless indicated otherwise.
B. The Concertor Pump System manufacturer shall design and build the control panel.

1.6 INSTALLATION

A. Installation shall be in accordance to manufacturer's instructions.
B. All electrical work performed shall be in full accordance to the requirements of the Electrical Specifications.

1.7 WARRANTY

A. When installed in accordance with all the provisions of this section and related sections, the warranty on the control panel shall be 7 years.
B. The warranty period shall start from the date of equipment delivery to the job site.

PART 2 PRODUCTS

2.1 PUMP STATION MANAGER

A. The station controller shall have the following features, at a minimum:
    1. Intelligent hand-off auto switch for each Concertor Pumping System (CPS)
    2. User configurable liquid level setpoints for CPS activation and deactivation.
    3. User configurable liquid level setpoints for high level, high-high level, low level and low-low level.
    4. Alternation options including but not limited to:
        a. Lead/lag
        b. Fixed
        c. Jockey/duty
        d. Most energy efficient as lead in an N to 1 ratio
        e. N to 1
        f. N to M
    5. Inputs and outputs
        a. Twenty (20) zero-volt digital inputs
        b. Seven (7) relay outputs rated at 240V, 5 amps with a resistive load and 2 amps with an inductive load.
        c. Two (2) analog inputs with 12 bit resolution.
        d. One (1) analog output with 12 bit resolution.
        e. Three phase voltage monitoring up to 600V

6. Six (6) unique setpoint profiles to allow for different modes of station operation. The profiles can be activated by digital input, SCADA command, timer, or user selection. At a minimum the followings items shall automatically change when a profile is changed:
    a. Pump activation setpoints
    b. Pump deactivation setpoints
    c. The maximum number of pumps allowed to run
7. The following station optimization features shall be pre-configured:
    a. Odor reduction feature that forces a pump start after an operator configurable timer runs out and there is sufficient fluid to start a CPS. The initial timer shall be set to 2 hours.
    b. Fat buildup minimization feature that uses a random lead pump start delay timer. The timer shall be initially set to 60 seconds.
    c. A sump cleaning function that will run the CPS to the snore point based on an operator configurable number of pump cycles and/or an operator configurable timer. The number of cycles shall be initially set to 12 and the timer shall be initially set to 9 hours.
    d. The CPS shall automatically detect a blockage and automatically clear the blockage. The station controller shall monitor the status and annunciate an alarm should one be reported by the CPS.
    e. The station controller shall have an energy minimizer function that minimizes the amount of energy used per pumping cycle.
8. Communications shall be setup to each CPS gateway to retrieve operating metrics and faults.
9. Inflow and out flow monitoring with any one of the following options:
    a. Calculate the inflow and outflow by liquid level draw down method.
    b. Analog input from a flow meter to monitor flow rate
    c. Pulsed signal from a flow meter to measure flow volume
    d. Simultaneous analog and pulsed signals from a flow meter
10. Integrated data logger with
    a. Capacity for recording up to 50,000 events
    b. Ability to download events to a USB storage device
    c. Ability to download events to an SD storage device
    d. Ability to log millions of events to a SD or USB storage device
11. Three phase voltage supply monitoring faults for
    a. Under voltage
    b. Over voltage
    c. Voltage phase imbalance
12. Monitoring and logging of DC power supply voltage
13. Monitoring and logging of controller internal temperature
14. Faults on the controller shall be configurable for
    a. Pump holdout
    b. Pump lockout with automatic reset
    c. Pump lockout with manual reset
    d. Hidden fault
    e. Automatically resetting fault

2.2 HUMAN MACHINE INTERFACE

A. A keypad display compatible with the pump station manager and shall have the following features at a minimum:

1. Home screen displayed parameters must include:
2. Information Screen that show the following information:
    a. Hours Run counter for each pump and the pump station to include:
        i. minutes run for last pump cycle
        ii. total minutes (hourly)
        iii. total hours today, total hours yesterday
        iv. total hours this week, total hours last week
        v. total accumulated hours
    b. Pump Start counter for each pump and the pump station including:
        i. pump starts this hour, pump starts last hour
        ii. pump starts today, pump starts yesterday
        iii. pump starts this week, pump starts last week
        iv. total accumulated pump starts
    c. Flow values (when enabled by software key)
        i. station inflow rate
        ii. pump flow rate
        iii. total station volume
        iv. overflow data (including overflow start time, duration, estimated volume)
    d. Power and Efficiency
        i. pump efficiency in gallons or liters per KWHr - or KVAh
        ii. power in kW, KVA
        iii. power factor
        iv. energy accumulators per pump in KWHr and KVAH
    e. Insulation resistance value for each pump motor in (Ohms)
    f. I/O Status
        i. Digital I/O status and accumulated values
        ii. Analog I/O status with a value in (mA) and a scaled value
        iii. 3-phase voltage, frequency, phase angle, power factor
    g. Database viewer function to review statistics and tag data information in real time
    h. Communications information and statistics
3. Context based help that explains each settings and information screen.
4. Ability to configure the controller without a laptop and configure the following parameters at a minimum:
    a. Set point programming of pump activation/deactivation values and level alarm values

b. Enable/Disable level alarms, faults and historical data recording
c. Configuration of Inputs and Outputs
d. Setup parameters for each type of fault available in the pump controller
e. Set alternation mode for pumps
f. Configure station optimization parameters
g. Configure voltage supply monitoring parameters
h. Configure motor monitoring parameters
i. Configure communications parameters
j. Configure data logging parameters
k. Enable level simulation session
l. Create or restore backup copies of the pump controller configuration settings
m. Restart the pump controller

B. A touchscreen display may be supplied, in lieu of, or in conjunction with the keypad display, and must have the following features at a minimum:
1. Option for 10", 12" or 15" touchscreen with the following minimum capabilities:
a. Built in web browser with kiosk mode
b. 5 wire resistive or projected capacitive multi-touch screen
c. Backlight life: 30,000 hours minimum
d. Quad core process @ 1.83GHz
e. 8GB DDR3L SDRAM
f. Fanless design
g. IP65 front panel
h. Power: 12-24VDC @16W
i. Resolution: 800x600
j. Operating temperature: 0-50C

2.3 CONCERTOR PUMPING SYSTEM GATEWAY
A. A Concertor DP gateway shall be supplied for each Concertor Pumping System (CPS) with the following features:
1. Pump communications interface port for communicating the following information to the CPS at a minimum:
a. Start and stop commands
b. Power consumption information
c. Operating speed
d. Running status
e. Fault information
2. Inputs and outputs:
a. Four (4) digital inputs
b. Four (4) relay outputs
c. One (1) analog input
d. One (1) analog output
3. Modbus TCP and RTU communications

2.4 SURGE SUPPRESSION
A. A 480VAC three phase surge suppression device shall be installed in line with the supply voltage with the following features:
1. Each input shall have a nominal AC operating voltage of 277VAC
2. Meet UL 1449 4th edition requirements
3. Meet IEC 61643-11 requirements
4. Response time <1ms

5. Nominal discharge current: 20kA 8/20 µs
6. Maximum discharge current: 50kA 8/20 µs
7. Maximum surge capacity: 60kA 8/20 µs
8. Voltage protection rating: 1500V
9. Voltage protection level: 1700V
10. Residual voltage at 10kA (8/20 µs): 1395V
11. Operating frequency range: 0-500Hz
12. Operating temperature: -40ºC to +85ºC

2.5 INTRINSICALLY SAFE BARRIERS

A. Provide intrinsically safe barriers for all IO that enters the wet well.

2.6 UPS

A. Provide a 24VDC power supply with battery backup capable of running al DC loads for a minimum of 1 hour.

2.7 ACCEPTABLE PUMP MANUFACTURERS

A. Pumps by the following manufacturers will be considered acceptable"
   1. Flygt Pumps, or approved equal

PART 3 EXECUTION

3.1 GENERAL

A. Perform installation in accordance with Contract Documents and manufacturers specifications.
B. Contractor shall provide field wiring terminations to the control panel.
C. Ground equipment as recommended by the control panel manufacturer.

3.2 EXAMINATION

A. A factory trained technician shall examine the work area prior to beginning work and check the following:
   1. The environment is safe to begin working in
   2. All surfaces are ready to receive work
   3. All tools are in the proper location and are in good condition
   4. Grounding of the system

3.3 FIELD QUALITY CONTROL

A. The follow field tests shall be performed by a factory trained technician
   1. Point to point wiring verification
   2. Utility power verification
   3. Site acceptance testing
   4. System demonstration
B. Point to Point I/O Verification
   1. After installation of the Concertor Pumping System control panel, a factory trained technician shall prepare the I/O checklist. The checklist shall include the following:
      a. All inputs and outputs connected to the control panel
      b. All alarms that can be generated by the control panel
   2. The technician shall follow a test procedure to test all I/O and alarms.
      a. All digital inputs shall be tested from point of origin unless it is unsafe.

b. All digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.
c. All analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.
d. All analog outputs shall be tested by running a simulation program or by forcing the output to a value.

3. The technician shall follow a test procedure to insure the system operation parameters are met.

C. Configuration Verification

1. The factory trained technician shall document the settings using a factory provided configuration checklist. Each parameter shall be verified prior to the beginning of testing and then again after testing is completed.
2. The configuration of the pump station manager as well as the CPS gateways shall be documented.
3. The pump station manager configuration shall be saved to a factory provided SD card after testing is completed.

3.4 FACTORY TRAINED SUPERVISION

A. The contractor shall procure a factory trained technician to check over equipment prior to putting the equipment into operation.
B. Point to point test of all wiring
C. Functional test of all equipment, alarms and controls.

3.5 CERTIFICATION OF TESTING

A. All test shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.
B. Written notice of all test shall be given two weeks in advance.

3.6 TEST EQUIPMENT

A. All test equipment shall be provided by the Contractor.

3.7 TRAINING

A. Training shall be a minimum of four (4) hours and cover the Concertor Pumping System and related controls.
B. Instruction material shall be provided for four (4) trainees.