

**SECTION 00 01 00
CONTRACT DOCUMENTS**

EUREKA ROAD CORRIDOR AND FRANK & POET DRAIN IMPROVEMENTS

City of Taylor
23555 Goddard Rd
Taylor, MI 48180

December 2024



25251 Northline Rd, Taylor, MI 48180

TAY323302T

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July 29, 2020

Draft Michigan EGLE Permit No. WRP043022 v.1, For information only

END OF SECTION 00 01 10

SECTION 00 01 15
LIST OF DRAWING SHEETS

The Plans bearing the general title of Eureka Road Corridor and Frank & Poet Drain Improvements and dated December 2024 are included with and form a part of the Contract Documents for this Project.

GENERAL SHEETS	SHEET NUMBER
COVER SHEET	G-0.01
GENERAL NOTES	G-0.02
LEGEND & NOTES	G-0.03
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PARDEE ROAD SOUTH - PHASE 2 REMOVAL	TS-1.04
PARDREE ROAD SOUTH - FINAL CONSTRUCTION	TS-1.05

PARDREE ROAD SOUTH - PHASE 2 CONSTRUCTION/FINAL	TS-1.06
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CITY OF TAYLOR DETAILS	
STANDARD MISCELLANEOUS DETAILS	MD-1
STANDARD SOIL EROSION & SEDIMENTATION CONTROL DETAILS	SE-1
STANDARD STORM SEWER DETAILS	ST-1

The Plans bearing the general title of Frank & Poet Stream Mitigation Improvements and dated Project Manual Date are included with and form a part of the Contract Documents for this Project.

GENERAL SHEETS	SHEET NUMBER
COVER SHEET	G-1.0
LEGEND & NOTES	G-1.1
LONG TERM MAINTENANCE EXHIBITS	G-1.2
FRANK & POET STREAM MITIGATION SHEETS	
TOPOGRAPHIC SURVEY AND DEMOLITION PLAN	C-1.0
SITE, GRADING & SESC PLAN	C-2.0
STREAM CHANNEL PLAN & PROFILE	C-2.1 TO C-2.3
CROSS-SECTIONS	C-2.4
DETAILS	C-3.0 TO C-3.1
SESC DETAILS	C-3.2
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SECTION 00 11 13
ADVERTISEMENT FOR BIDS

Eureka Road Corridor and Frank & Poet Drain Improvements

City of Taylor has implemented online project bidding using the Quest Construction Data Network (QuestCDN). Only electronic bids submitted through www.questcdn.com will be accepted for this Project.

Sealed Bids will be received by the City of Taylor through QuestCDN until 10:00 AM, Local Time, Tuesday, January 28, 2025. Shortly after the bid closing time a bid tabulation will be prepared and posted online.

Bids will be received for the following Work:

This Project includes enclosing approximately 700 LF of the Frank & Poet Drain on Eureka Road east of Telegraph Road by placing a 700 – ft long by 8-ft long by 22-foot concrete box culvert, improving approximately 3,910 LF of the Drain to create a low flow channel and floodplain terrace within the existing drain channel alignment (with the exception of the realignment at the upstream end of the Project). Drain improvements further include excavation and fill material including rip rap, fabric wrapped soil lifts and plantings in the Drain to construct grade control and the floodplain terrace. The existing Racho Road culvert is to be replaced with a 135-foot long by 8-foot by 22-foot concrete box culvert.

New headwalls at each of the existing culvert crossings throughout the open channel enhancement limits are proposed.

Streetscape improvements throughout the Eureka Road corridor include sidewalk replacements and enhancements, trees and plantings, elevated sidewalks at two overpasses, lighting upgrades (to be completed by DTE) and all related appurtenances.

Three additive alternates are included in the Proposal for construction of new connecting sidewalk adjacent to Meijer and the construction of a new Pergola and related appurtenances in front of Southland Mall.

Off-site mitigation for the Frank & Poet Drain activities includes approximately 400 lineal feet of stream channel restoration, culvert replacement and associated restoration activities at the Lakes of Taylor Golf Course. Coordination with the Lakes of Taylor Golf Course and construction during the off-season will be required.

Communication, schedule, coordination of construction activities and minimization of impact to area businesses and residents are paramount to the Project's success.

Coordination is required with Panhandle Eastern to facilitate construction of a concrete collar protective measure within the Racho Road culvert replacement area. Further coordination is required with the City of Taylor Fire Station No. 3 relative to maintaining emergency access. Access to all businesses must be maintained at all times throughout the entire Project.

The Contract Documents for bidding purposes are only available from QuestCDN starting Thursday, December 19, 2024. Contract Documents can be viewed and downloaded by registering for free with QuestCDN online (www.questcdn.com) or by calling 952-233-1632. The QuestCDN Project Number for this project is 9470865 and may be used to look up the project. There is a Twenty Two Dollar (\$22.00) nonrefundable fee for downloading the Contract Documents in pdf format. Bidders must download the Documents from QuestCDN to be included on the Plan Holders List and to receive any Addenda posted for the project.

Plans and specifications are also available for viewing at no cost (**not to be used for bidding purposes**) online at www.wadetrим.com/resources/bid-tab/

- A. Bids will be received electronically through QuestCDN as outlined in Section 00 21 13 - Instructions to Bidders. There is a Forty Two Dollar (\$42.00) non-refundable fee for submitting a Bid.

Each Bid will be accompanied by a bid bond, in the amount of at least **five (5)** percent of the amount bid, drawn payable to City of Taylor as security for the proper execution of the Agreement.

A non-mandatory pre-bid conference will be held on Monday, January 13, 2025 at 2:00 PM, Local Time at the office of Wade Trim, 25251 Northline Road, Taylor, Michigan, 48180. Representatives of the Owner and the Engineer will be present to discuss the project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference.

An additional consideration will be given to City of Taylor based Contractors as explained in the Contract Documents.

City of Taylor reserves the right to accept or reject any or all bids and to waive any informality in any bids should it consider same to be in its best interest. City of Taylor further reserves the right to award all or part of the bid as budget allows.

Bids may not be withdrawn for the period of 90 days after date of receiving bids.

Inquiries will be directed to Kelly McRobb-Ackland, PE, at Phone: (734) 947-2627 or email: kackland@WadeTrim.com.

SECTION 00 21 13 INSTRUCTIONS TO BIDDERS

PART 1 GENERAL

1.01 DEFINED TERMS

- A. Terms used in these Instructions to Bidders have the meanings assigned to them in the General Conditions.
- B. The term "Bidder" means one who submits a Bid to Owner as distinct from a subbidder who submits a Bid to a Bidder.
- C. The term "Successful Bidder" means the lowest, qualified, responsible Bidder to whom the Owner makes an award.
- D. The term "Owner" means City of Taylor, 23555 Goddard Rd, a Municipal Corporation and being a party of the first part of this Contract.
- E. The term "Engineer" means Wade Trim Associates, Inc., 25251 Northline Rd, Taylor, MI 48180 , or a duly authorized representative.

1.02 BIDDERS QUALIFICATIONS

- A. No Bid will be considered from any Bidder unless known to be skilled and regularly engaged in work of a character similar to that covered by the Contract Documents. In order to aid the Owner in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by the Owner to do so, must furnish evidence, satisfactory to the Owner, of the Bidder's experience and familiarity with Work of the character specified, and Bidder's financial ability to properly prosecute the proposed Work to completion within the specified time. The evidence requested may include the following:
 - 1. Address and description of the Bidder's plant or permanent place of business.
 - 2. Bidder's performance records for all Work awarded to or started by Bidder within the past three years.
 - 3. An itemized list of the Bidder's equipment available for use on the proposed Contract.
 - 4. Bidder's financial statement, including statement of ownership of equipment necessary to be used in executing Work under Contract.
 - 5. Evidence that the Bidder is authorized to do business in the state in which the project is located, in case of a corporation organized under the laws of any other state; and,
 - 6. Such additional information as will satisfy the Owner that the Bidder is adequately prepared to fulfill the Contract.

1.03 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- A. It is the responsibility of each Bidder before submitting a Bid, to:
 - 1. Examine the Contract Documents thoroughly,
 - 2. Visit the site to familiarize himself with local conditions that may in any manner affect cost, progress or performance of the Work,
 - 3. Consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work; and
 - 4. Study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and
 - 5. Promptly notify the Engineer in writing of conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

6. Purchase official Procurement Documents from the Engineer in order to be included on the project Plan Holder List and be considered eligible for bidding.
- B. Reference is made to the Supplementary Conditions for the identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which have been relied upon by the Engineer in preparing the Contract Documents.
1. If such reports are not included as appendices to the Contract Documents, the Owner will make copies available to any Bidder requesting them. These reports are included for reference only and are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents.
 2. Bidder may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for bidding or construction purposes.
 3. Before submitting their Bid each Bidder will, at Bidder's own expense, make such additional investigations and tests as the Bidder may deem necessary to determine Bidder's Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.
- C. On request, the Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of their Bid. Bidder must fill all holes and clean up and restore the site to its former conditions upon completion of such investigations and tests.
- D. The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by the Contractor in performing the Work are identified in Section 01 11 00 - Summary of Work, or on the Plans.
- E. The locations of utilities as shown on the Plans are taken from sources believed to be reliable. Neither the Owner nor the Engineer will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.
1. The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, that without exception the Bid is based upon performing and furnishing the Work required by the Contract Documents and applying the specific means, methods, techniques, sequences or procedures of construction (if any) that may be shown, indicated or required by the Contract Documents, that Bidder has given the Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in Contract Documents and the resolution by the Engineer is acceptable to Bidder, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the Work, and that the time stated in the Proposal is sufficient to complete the project.

1.04 PRE-BID CONFERENCE

- A. An in-person, non-mandatory pre-bid conference will be held, and representatives of the Owner and the Engineer will be present to discuss the Project.
- B. Bidders are not required to attend and participate in the conference to be considered responsive.
- C. Engineer will transmit to prospective Bidders a record of such Addenda as the Engineer considers necessary in response to questions arising at the meeting. Oral statements made during the meeting may not be relied upon and will not be binding or legally effective.

1.05 INTERPRETATIONS AND ADDENDA

- A. Should any prospective bidder find discrepancies in, or omissions from the Plans, Specifications or other parts of the Contract Documents, the prospective bidder may submit a written request to the Engineer for an interpretation thereof. The person submitting the request will be held responsible for its prompt delivery at least seven (7) days prior to the date for opening of Bids. Questions received less than seven (7) days prior to the date for opening of bids will not be answered. Any interpretation of inquiry will be made by Addendum duly issued to all prospective bidders.
- B. Any change in or addition to the Contract Documents deemed necessary by the Owner must be made in the form of an Addendum issued to all prospective bidders who have taken out Contract Documents and all such Addenda will become a part of the Contract Documents as though same were incorporated into same originally. Oral explanations and information do not constitute official notification and are not binding.

1.06 BID SECURITY

- A. Bid Security must be made payable to the Owner, in an amount of five (5) percent of the Bidder's maximum Bid price and in a form as indicated in Section 00 11 13 - Advertisement for Bids. Bid Bonds, if indicated as acceptable in Section 00 11 13, will be issued on the form included in the Contract Documents by a Surety meeting the requirements of paragraph 5.01 of Section 00 72 00 - General Conditions.
- B. The Bid Security of the Successful Bidder will be retained until such Bidder has executed Section 00 52 00 - Agreement and furnished the required Contract Security, whereupon it will be returned; if the successful Bidder fails to execute and deliver the Agreement and furnish the required Contract Security within 15 days of the Notice of Award, the Owner may annul the Notice of Award and the Bid Security of that Bidder will be forfeited.
- C. The Bid Security of any Bidder whom the Owner believes to have a reasonable chance of receiving the award may be retained by the Owner until the earliest of the seventh day after the "Effective Date of Agreement" (which term is defined in the General Conditions) or the expiration of the hold period on the Bids. Bid Security of other Bidders will be returned within 14 days of the Bid opening, unless indicated otherwise in the Advertisement.

1.07 CONTRACT TIME

- A. The number of days within which, or the date by which, the Work is to be Substantially Completed, if applicable, and also completed and ready for final payment (the Contract Time) are set forth in the Agreement.

1.08 SUBSTITUTE AND "OR-EQUAL" ITEMS

- A. The Contract, if awarded, will be on the basis of materials and equipment described in the Plans or specified in the Specifications without consideration of possible substitute or "or-equal" items.
- B. Whenever it is indicated in the Plans or specified in the Specifications that a substitute or an "or-equal" item of material or equipment may be furnished or used by the Contractor if acceptable to the Engineer, application for such acceptance will not be considered by the Engineer until after the effective date of the Agreement.
- C. In addition, in no case will the Engineer's denial of the Contractor's application give rise to any claim for additional cost, it being understood by the Contractor that acceptance of substitute or an "or equal" item of material is at the sole discretion of the Engineer.

1.09 RECEIPT AND FORM OF BID

- A. Bids must be submitted at the time and place indicated in the Advertisement for Bids and must be accompanied by the Bid Security and other required documents.
 - 1. Bids must be submitted electronically as specified herein.

- B. Bids received after the scheduled time and place indicated in the Advertisement for Bids will be returned unopened.
- C. Owner invites bids on the Proposal and any other form(s) attached thereto.
- D. The complete set of Contract Documents must be used in preparing Bids; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.
- E. Bidder must acknowledge of receipt of all Addenda as provided for in the electronic bidding platform. Failure to acknowledge Addenda will be cause for rejection of bid.
- F. The Legal Status of Bidder Form, located in Section 00 43 45 - Legal Status of Bidder, must be submitted with each Bid and must clearly state the legal position of a Bidder. In the case of a corporation, the home address, name and title of all officers must be given. In the case of a partnership, show names and home addresses of all partners. If an individual, so state. Any individual bid not signed by the individual must have attached, thereto, a power of attorney evidencing authority to sign.
- G. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal.
- H. A tabulation of the amounts of the base bids and any alternates will be made available after the opening of Bids.
- I. To obtain Contract Documents and submit a Bid, Bidders:
 - 1. Must proceed to the QuestCDN website at www.questcdn.com and download the Contract Documents.

1.10 MODIFICATIONS AND WITHDRAWAL OF BIDS

- A. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.
- B. If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with the Owner and promptly thereafter demonstrates to the reasonable satisfaction of the Owner that there was a material and substantial mistake in the preparation of their Bid, that Bidder may withdraw their Bid and the Bid Security will be returned.
 - 1. Thereafter, at the sole option of the Owner, that Bidder will be disqualified from further Bidding on the Work to be provided under the Contract Documents.

1.11 AWARD OF CONTRACT

- A. Owner reserves the right to reject any and all Bids for any reason, to waive any and all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, non-responsive, unbalanced, or conditional Bids.
- B. Discrepancies between words and figures will be resolved in favor of words. Discrepancies in the multiplication of units of work and unit prices, will be resolved in favor of unit price.
- C. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.
- D. In evaluating Bids, the Owner will consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data if requested in the Bid forms. It is the Owner's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid form but the Owner may accept them in any order or combination.

- E. Subject to the approval of the Owner, the Contract will be awarded to the lowest responsive and responsible Bidder. Responsibility of Bidder will be determined on basis of past performance and Work of similar character, equipment and labor available to do the Work and financial status.
- F. The Contract will be considered to have been awarded after the approval of the Owner has been duly obtained and a formal Notice of Award duly served on the successful Bidder by the Owner.
- G. If the Contract is to be awarded, the Owner will give the successful Bidder a Notice of Award within 60 days after the day of the Bid opening, unless such other time is specified in the Advertisement for Bids.
- H. The Contract will not be binding upon the Owner until the Agreement has been duly executed by the Bidder and the duly authorized officials of the Owner.

1.12 SIGNING OF AGREEMENT

- A. Within fifteen (15) days after the Owner gives a Notice of Award to the successful Bidder, the Contractor must sign and deliver the specified number of counterparts of the Agreement to the Owner with all other Contract Documents attached.
- B. Within ten (10) thereafter, the Owner will deliver two (2) fully signed counterparts to the Contractor. Engineer will identify, date or correct those portions of the Contract Documents not fully signed, dated or executed by the Owner and the Contractor and such identification, dating or correction will be binding on all parties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 21 13

Section 00 22 13 Supplementary Instructions to Bidders

Part 1 General

1.01 Modifications

These Supplementary Instructions to Bidders amend or supplement the Instructions to Bidders as indicated below. All provisions which are not amended or supplemented remain in full force and effect.

The terms used in these Supplementary Instructions to Bidders have the meanings assigned to them in the Instructions to Bidders, General Conditions, and as follows:

- A. OWNER -- City of Taylor, 23555 Goddard Road, Taylor, MI 48180, a Municipal Corporation, and being a party of the first part of this Contract.
- B. ENGINEER -- Wade Trim Associates, Inc., 25251 Northline Road, Taylor, Michigan 48180, or his duly authorized representative.

SIB-1.09 Receipt and Form of Bid

Supplement Article 1.09 of the Instructions to Bidders with the following:

1.09 Receipt and Form of Bid

- A. Bids shall be submitted electronically only at the time and place indicated in the Advertisement for Bids and shall be accompanied by the Bid Security and other required documents.
- D. The quantities as shown in the Proposal are approximate only and will be used as a basis of comparison of Bids, and award of Contract(s). Payment will be made on basis of actual quantities of Work performed in accordance with the Contract Documents. The Unit Prices bid, shall include such amounts as the Bidder deems proper for overhead, profit, taxes, General Conditions and such other incidentals as noted in the Contract Documents.
- I. To obtain Contract Documents and submit a Bid:
 - 1. Proceed to QuestCDN website at www.questcdn.com.
 - 2. Select the project as listed in the Advertisement for Bids from the list of projects. Prospective Bidders To submit a Bid, you must register for a free membership on QuestCDN and download the Contract Documents in digital form under "Download Bid Documents". There is a non-refundable fee as stated in the Advertisement for Bids to download the documents and bid the project.
 - 3. You will be asked to sign into your account or create a free QuestCDN account by clicking the "Join" link. Contact QuestCDN at (952) 233-1632 or info@questcdn.com for assistance in membership registration, downloading the project, and VBid online bid submittal.
 - 4. The QUESTCDN Project Number for this project is listed in the Advertisement for Bids.
 - 5. To access the Bid Form, click the online bidding button at the top of bid advertisement. The on-line bid button will be available when the project is published and open for bidding.

- 6. All addendums will be issued through the QuestCDN electronic bidding site. You must download the bid documents to be a plan holder to receive any addenda notices. It is the sole responsibility of the Bidder to obtain and review all addenda.
- J. The CONTRACTOR shall submit a Certificate of Insurance with his Bid showing the current insurers and limits of liability being carried. In instances where the current insurer or limits of liability do not meet the OWNER's requirements but can be revised if the Bidder is awarded the Contract, this must be so stated in a separate letter attached to the Certificate of Insurance. It shall be further stated that a revised Certificate of Insurance meeting all of the OWNER's requirements shall be provided within five (5) days of award of this Bid to the Bidder.
- K. The Bidder shall execute the Non-Collusion Affidavit as contained in these Specifications. This form must be completed and signed prior to the Bidder submitting his Proposal to the OWNER.
- L. The Bidder certifies the price bid in this Proposal is correct and complete as intended by the Bidder for Work covered by this Proposal, further, that all information given in or furnished with this Proposal, is correct, complete and submitted as intended by the Bidder, and the Bidder does hereby waive any right or claim he may now have or which may hereafter accrue to him, by reason of errors, mistakes, or omissions made by the Bidder in this Proposal, to refuse to execute the Contract if awarded to him, or to demand the return of the Bid deposit or to be relieved from any of his obligations as set forth in said Bid deposit required with this Proposal.
- M. The Bidder certifies that no officer or employee of the City of Taylor is personally or financially interested, directly or indirectly, in this Proposal, or in any Contract which may be made under it, or in the purchase or sale of any materials or supplies for the Work to which it relates, or any portion of any expected profits thereto.
- N. The Bidder certifies that, as of the date of this Proposal, he is not in arrears to the City of Taylor for debt or Contract.

SIB-1.11.C.

Add the following to Article 1.11.C. of the Instruction to:

- 1.11.C. When one or more of the bidders is based in the City of Taylor, then the City will give an additional consideration to all Taylor-based firms in determining the lowest Bidder. This additional consideration shall be as follows:

<u>Amount of Bid</u>	<u>Percent Consideration</u>
\$0 to \$30,000	3%
\$30,001 to \$100,000	2%
\$101,000 on up	1%

When the amount of the Bid minus the applicable consideration makes a Taylor-based firm the lowest responsive and responsible Bidder, the Contract will be awarded to such Taylor-based firm for the original Bid amount.

SIB-1.11.E.

Add the following to Article 1.11.C. of the Instruction to:

Add a new paragraph 1.11.E to the Instructions to Bidders, which is to read as follows:

- 1.11.E The lowest responsive and responsible Bidder will be determined based upon the total of the Base Bid and any selected Alternates.

SIB-1.13

Insert the following language as Article 1.13 of the Instructions to Bidders:

- 1.13 The Bidder declares that if awarded the Contract, he is prepared to and will start the Work and complete the entire Project in accordance with the provisions set forth in the Contract Documents.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

**SECTION 00 42 43
PROPOSAL**

Owner: City of Taylor, 23555 Goddard Road, Taylor, MI 48180

Project: Eureka Road Corridor and Frank & Poet Drain Improvements

Project Location: Eureka Rd between Telegraph Rd and Allen Rd, Taylor, Michigan and Lakes of Taylor Golf Course located at 25505 Northline Road, Taylor, MI 48180

BIDDER INFORMATION

Bidder Name: _____

By (Printed Name): _____

Signature: _____

Address: _____

Phone. No.: _____

Email: _____

Bidder proposes and agrees, if their Bid is accepted, to enter into an Agreement with the City of Taylor in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in the Agreement, and in accordance with the Contract Documents.

In submitting their bid, Bidder represents, as more fully set forth in the Agreement, that:

1. Bidder has examined copies of Contract Documents, (consisting of Plans dated December 2024 and Project Manual dated December 2024 understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which has been acknowledged.
 - A. Addendum _____ Acknowledged by: _____ Date: _____
 - B. Addendum _____ Acknowledged by: _____ Date: _____
 - C. Addendum _____ Acknowledged by: _____ Date: _____
2. Bidder has examined the surface and subsurface conditions where the Work is to be performed, the legal requirements and local conditions affecting cost, progress, furnishing or performance of the Work, and has made such independent investigations as Bidder deems necessary.
3. Bidder, by submitting a Bid, agrees that their Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any Agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over the Owner.
4. Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

BASE BID - EUREKA ROAD CORRIDOR

Item	Description	Quantity	Unit	Unit Price	Amount
	BASE BID – EUREKA ROAD CORRIDOR				
1	Mobilization (5%)	1	LS	\$ _____	\$ _____
2	Bypass Pumping	1	LS	\$ _____	\$ _____
3	Traffic Maintenance and Control	1	LS	\$ _____	\$ _____

4	Soil Erosion Sedimentation Control, Complete	1	LS	\$ _____	\$ _____
5	Culvert, Remove Racho Rd	135	LF	\$ _____	\$ _____
6	Concrete Curb & Gutter, Remove, Racho Rd	200	LF	\$ _____	\$ _____
7	Concrete, Remove, Curb & Gutter	1,980	LF		
8	Concrete, Remove, Pavement	6,000	SY	\$ _____	\$ _____
9	Remove Bituminous Pavement	433	SY		
10	Tree and Stump, Remove	69	EA	\$ _____	\$ _____
11	Stump, Remove	1	EA	\$ _____	\$ _____
12	Guardrail, Remove	739	LF	\$ _____	\$ _____
13	Irrigation System, Remove and Replace, Southland Mall	1	LS	\$ _____	\$ _____
14	Allowance, Irrigation System Replacements, Other Areas	1	AL	\$20,000.00	\$20,000.00
15	Tree Protection Fencing	4,572	LF	\$ _____	\$ _____
16	Streetscape Lighting Modifications and Replacements, Contractor to coordinate with DTE	1	AL	\$200,000.00	\$200,000.00
17	Remove and Replace Split Rail Fence	1,165	LF	\$ _____	\$ _____
18	Clearing and Grubbing	21	AC	\$ _____	\$ _____
19	Excavation, Site	3,100	CY	\$ _____	\$ _____
20	Excavation, Culvert	4,550	CY	\$ _____	\$ _____
21	Excavation Culvert, Racho Rd	531	CY	\$ _____	\$ _____
22	Excavation, Open Channel	17,000	CY	\$ _____	\$ _____
23	Structural Backfill, Culvert	3,700	CY	\$ _____	\$ _____
24	MDOT Plain Rip Rap	655	CY	\$ _____	\$ _____
25	Substrate/Channel Fill (Pool Bottom Areas, 8" Depth)	350	CY	\$ _____	\$ _____
26	Rock Channel Lining, Complete	3,560	SY	\$ _____	\$ _____
27	Rock Grade Control Structure, Complete	215	SY	\$ _____	\$ _____
28	Fabric-Wrapped Low Flow Channel Bank	1180	SY	\$ _____	\$ _____
29	Bituminous Patch to Match Existing Conditions	433	SY	\$ _____	\$ _____
30	Road Reconstruction, Racho Rd	685	SY	\$ _____	\$ _____
31	Pavement, Concrete (4")	9,651	SY	\$ _____	\$ _____
32	Pavement, Concrete (6-8" at drives)	1,054	SY	\$ _____	\$ _____
33	Concrete, Straight Curb	87	SF		
34	Concrete, Standard Curb & Gutter	54	LF	\$ _____	\$ _____
35	Concrete, Standard Curb & Gutter, Racho Rd	200	LF	\$ _____	\$ _____
36	Crosswalk Restriping	1	EA	\$ _____	\$ _____
37	Sidewalk Ramp, Concrete	4,130	SF	\$ _____	\$ _____
38	Fire Hydrant, Salvage, Remove and	1	EA	\$ _____	\$ _____

	Replace				
39	Railing, Ameristar/Assa Abloy, 4' Ht.	1,293	LF	\$ _____	\$ _____
40	Railing, Ameristar/Assa Abloy, 6' Ht.	328	LF	\$ _____	\$ _____
41	Bench, Gillette Series, Model B82	13	EA	\$ _____	\$ _____
42	Trash Receptacle, Steel Strap Model CN-R/SS2-36	13	EA	\$ _____	\$ _____
43	Culvert Bedding, 12" Depth, Complete	725	CY	\$ _____	\$ _____
44	Box Culvert, 20' x 6', Complete	805	LF	\$ _____	\$ _____
45	6" Side Culvert Connection to Box	1	EA	\$ _____	\$ _____
46	12" Side Culvert Connection to Box	9	EA	\$ _____	\$ _____
47	Storm Sewer, 6 inch, Trench A	33	EA	\$ _____	\$ _____
48	Storm Sewer, 10 inch, Trench A	19	EA	\$ _____	\$ _____
49	Storm Sewer, 12 inch, Trench A	327	EA	\$ _____	\$ _____
50	Storm Sewer, 18 inch, Trench A	18	EA	\$ _____	\$ _____
51	Storm Sewer, 24 inch, Trench A	5	EA	\$ _____	\$ _____
52	Storm Sewer, 30 inch, Trench A	43	EA	\$ _____	\$ _____
53	Storm Sewer, 36" x 54" Ellip, Trench A	5	EA	\$ _____	\$ _____
54	Manhole Access on Box Culvert	3	EA	\$ _____	\$ _____
55	Manhole Structure, 36" Diameter, Concrete	21	EA	\$ _____	\$ _____
56	Manhole Structure, 48" Diameter, Concrete	21	EA	\$ _____	\$ _____
57	Manhole Structure, 60" Diameter, Concrete	3	EA	\$ _____	\$ _____
58	Manhole Structure, Elliptical 108" Diameter, Concrete	1	EA	\$ _____	\$ _____
59	Standard, Catch Basin Structure, 36" Diameter, Concrete	1	EA	\$ _____	\$ _____
60	Connection to Existing Culvert with Concrete Collar	7	EA	\$ _____	\$ _____
61	Removal of Existing Headwalls	10	EA	\$ _____	\$ _____
62	Removal of Existing Wingwalls	14	EA	\$ _____	\$ _____
63	Headwall for 20' x 6' Box Culvert	3	EA	\$ _____	\$ _____
64	Wingwalls for 20' x 6' Box Culvert	6	EA	\$ _____	\$ _____
65	Headwall for Ex Culverts, Concrete	5	EA	\$ _____	\$ _____
66	Wingwalls For Ex Culverts, Concrete	10	EA	\$ _____	\$ _____
67	Headwalls for Storm Structures, Concrete	10	EA	\$ _____	\$ _____
68	Sheet Pile Improvements for Existing Headwall & Wingwalls	10	EA	\$ _____	\$ _____
69	Lower Existing Water Main (8")	90	LF	\$ _____	\$ _____
70	Road Sign, Salvage, Remove and Relocate	15	EA	\$ _____	\$ _____
71	Segmental Retaining Wall	1,200	SF	\$ _____	\$ _____
72	Restoration, Coir Fiber Matting, Complete	18,400	SY	\$ _____	\$ _____

73	Restoration, Floodplain Terrace, Complete	11,000	SY	\$ _____	\$ _____
74	Restoration, Riparian Bank, Complete	7,400	SY	\$ _____	\$ _____
75	Restoration, Low Profile Prairie, Complete	4,600	SY	\$ _____	\$ _____
76	Restoration, Lawn (MDOT Roadside Seeding), Complete	1	LS	\$ _____	\$ _____
77	Tree, Acer rubrum (2.5")	37	EA	\$ _____	\$ _____
78	Tree, Acer saccharum (2.5")	29	EA	\$ _____	\$ _____
79	Tree, Carpinus betulus (2.5")	14	EA	\$ _____	\$ _____
80	Tree, Carpinus caroliniana (2.5")	12	EA	\$ _____	\$ _____
81	Tree, Cornus florida (2")	10	EA	\$ _____	\$ _____
82	Tree, Cercis canadensis (6')	12	EA	\$ _____	\$ _____
83	Tree, Celtis occidentalis (2.5")	18	EA	\$ _____	\$ _____
84	Tree, Crataegus viridis 'Winter King' (2")	30	EA	\$ _____	\$ _____
85	Tree, Fagus grandiflora (2.5")	11	EA	\$ _____	\$ _____
86	Tree, Ginkgo biloba (2.5")	11	EA	\$ _____	\$ _____
87	Tree, Gymnocladus dioicus 'Espresso' (2.5")	24	EA	\$ _____	\$ _____
88	Tree, Gleditsia triacanthos var. Inermis (2.5")	7	EA	\$ _____	\$ _____
89	Tree, Liquidambar styraciflua 'Cherokee' (2.5")	18	EA	\$ _____	\$ _____
90	Tree, Liriodendron tulipifera (2.5")	7	EA	\$ _____	\$ _____
91	Tree, Platanus acerifolia (2.5")	12	EA	\$ _____	\$ _____
92	Tree, Quercus alba (2.5")	27	EA	\$ _____	\$ _____
93	Tree, Quercus macrocarpa (2.5")	33	EA	\$ _____	\$ _____
94	Tree, Quercus palustris (2.5")	23	EA	\$ _____	\$ _____
95	Tree, Tilia americana (2.5")	9	EA	\$ _____	\$ _____
96	Tree, Tilia cordata (2.5")	22	EA	\$ _____	\$ _____
97	Tree, Ulmus americana 'Princeton Valley' (2.5")	14	EA	\$ _____	\$ _____
98	Tree, Zelkova serrata 'Village Green' (2.5")	19	EA	\$ _____	\$ _____
99	Underpass Structural Repairs	1	LS	\$ _____	\$ _____
100	Underpass Retaining Wall	1,260	LF	\$ _____	\$ _____
101	Soil Evaluation	1	LS	\$ _____	\$ _____
102	Easement Acquisition	1	AL	\$175,000	\$175,500
103	1 Year Maintenance Contract	1	LS	\$ _____	\$ _____
104	Permit Fees, Eureka Road Corridor	1	AL	\$40,000	\$40,000
105	Allowance, Contingency (7.5% of Total Contract)	1	AL	\$ _____	\$ _____

Total Base Bid Contract Price (Items 1 through 105)

\$ _____

ADDITIVE ALTERNATE NO. 1

In the event the Owner elects to do the following Work, the Bidder agrees to complete the Work, in accordance with the Contract documents for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1	Meijer Sidewalk-East Connection	1	LS	\$ _____	\$ _____

Total Additive Alternate Contract Price (Items 1 through 1)

\$ _____

ADDITIVE ALTERNATE NO. 2

In the event the Owner elects to do the following Work, the Bidder agrees to complete the Work, in accordance with the Contract documents for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1	Meijer Sidewalk-West Connection	1	LS	\$ _____	\$ _____

Total Additive Alternate Contract Price (Items 1 through 1)

\$ _____

ADDITIVE ALTERNATE NO. 3

In the event the Owner elects to do the following Work, the Bidder agrees to complete the Work, in accordance with the Contract documents for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1	Pergola and Related Appurtenances, Southland Mall	1	LS	\$ _____	\$ _____

Total Additive Alternate Contract Price (Items 1 through 1)

\$ _____

BASE BID - OFF-SITE MITIGATION (LAKES OF TAYLOR)

In the event the Owner elects to do the following Work, the Bidder agrees to complete the Work, in accordance with the Contract documents for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1	Off-Site Mitigation (Lakes of Taylor)	1	LS	\$ _____	\$ _____
2	Allowance, Permit Fees, Off-Site Mitigation, Lakes of Taylor	1	AL	\$15,000	\$15,000

Total Base Bid - Off - Site Mitigation (Lakes of Taylor) Contract Price (Items 1 through 2)

\$ _____

5. Bidder, by submitting a Bid, thereby certifies that Bidder or a qualified designated person in Bidder's employ has examined the Contract Documents provided by the Owner for bidding purposes. Further, they certify that Bidder or Bidder's qualified employee has reviewed the Bidder's proposed construction methods and finds them compatible with the conditions which Bidder anticipates from the information provided for Bidding.
6. Bidder, by submitting a Bid, agrees to complete the Work under any job circumstances or field conditions present and/or ascertainable prior to bidding. In addition, Bidder agrees to complete the Work under whatever conditions Bidder may create by Bidder's own sequence of construction, construction methods, or other conditions he may create, at no additional cost to the Owner.
7. Bidder, by submitting a Bid, declares that Bidder has familiarized them self with the location of the proposed Work and the conditions under which it must be constructed. Also, Bidder has carefully examined the Plans, the Specifications, and the Contract Documents, which Bidder understands and accepts as sufficient for the purpose, and agrees that Bidder will Contract with the Owner to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.
8. Bidder will provide a bid bond, in the amount of at least **five (5)** percent of the amount Bid, drawn payable to City of Taylor as security for the proper execution of the Agreement.
9. Bidder, by submitting a Bid, agrees that if awarded Contract, to sign the Agreement and submit satisfactory bonds and certificates of insurance coverage and other evidence of insurance required by the Contract Documents within 15 days after the date of Owner's Notice of Award.
10. Bidder, by submitting a Bid, agrees that time is of the essence and, if awarded Contract, that the Work will be Completed on or before the dates/days as specified in the Agreement.
11. Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, will also apply to the Substantial Completion date.
12. Engineering and inspection costs incurred after the final completion date will be paid by the Contractor to the Owner as specified in the Conditions of the Contract and Agreement.
13. Proposals may not be withdrawn for a period of 90 days after bid opening.
14. The following documents are made a condition of this Proposal:
 - A. Required Bid Security
 - B. Legal Status of Bidder
 - C. Non-Collusion Affidavit
 - D. Current Certificate of Insurance

**SECTION 00 43 13
BID BOND FORM**

KNOW ALL BY THESE PRESENT, that we, the undersigned, _____ as Principal, hereinafter called the Principal, a corporation duly organized under the laws of the State of _____, and duly authorized to transact business in the state of Michigan, as Surety, _____, hereinafter called the Surety, are held and firmly bound unto the Owner, hereinafter called Owner, in the sum of _____ Dollars (\$_____) for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid for Eureka Road Corridor and Frank & Poet Drain Improvements.

NOW, THEREFORE, if the Owner accepts the Bid of the Principal and the Principal will enter into a Contract with the Owner in accordance with the terms of such Bid, and give such Bond or Bonds as may be specified in the Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such Bond or Bonds, if the Principal pays to the Owner the difference not-to-exceed the penalty hereof between the amount specified in said Bid and such larger amount for which the Owner may in good faith contract with another party to perform the Work covered by said Bid, then this obligation will be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, 20__.

(Witness)

(Principal)

(Title)

(Witness)

(Surety)

(Title)

**SECTION 00 43 45
LEGAL STATUS OF BIDDER**

(The Bidder should check the appropriate box and complete the information requested therein)

A corporation, duly authorized and doing business under the laws of the State of Michigan, for whom _____ whose signature is affixed to this Bid, is duly authorized to execute contracts.

A limited liability company, duly authorized and doing business under the laws of the State of Michigan, for whom _____, whose signature is affixed to this Bid, is duly authorized to execute contracts.

A partnership, all partners with their addresses are:

An individual, whose signature is affixed to this Bid.

**SECTION 00 45 13
STATEMENT OF BIDDER'S QUALIFICATIONS**

This Proposal is submitted in the name of:

(Print) _____

The undersigned hereby designates the following business address to which all notices, directions or other communications may be served or mailed:

Street: _____ City: _____

State: _____ Zip Code: _____

The undersigned hereby declares their legal status as checked below:

- Sole Proprietor
- Sole Proprietor doing business under an assumed name
- Co-partnership

The Assumed Name of the Co-Partnership is registered in the County of _____,

- Corporation incorporated under the laws of the State of _____.

The Corporation is:

- authorized to conduct business in the State of _____
- not now authorized to conduct business in the State of _____
- possess all required licenses for the work being bid
- limited liability corporation

The name, titles, and home addresses of all persons who are officers or partners in the organization are as follows:

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Signed this _____ day of _____, 20_____

By: _____

Printed Name: _____

Title: _____

**SECTION 00 45 19
NON-COLLUSION AFFIDAVIT OF PRIME BIDDER**

State of _____)

) ss:

County of _____)

_____, being first duly sworn, deposes and says that:

1. They are the of _____ (Position) of _____ (Firm), the Bidder that has submitted the attached Bid;
2. They are fully informed with respect to the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham bid;
4. Neither the Bidder nor any of its officers, partners, members, managers, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, entity or person to submit a collusive or sham bid in connection with the Contract Documents for which the attached Bid has been submitted or to refrain from bidding in connection with the Contract Documents or has in any manner, directly or indirectly, sought by agreement, collusion, communication or conference with any other Bidder, entity or person to fix the price or prices in the attached Bid or that of any other Bidder or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against City of Taylor, or any person or other entity interested in the proposed Contract Documents; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees or parties having interest, including this affiant.

Name of Bidder: _____

Signed By: _____

Title: _____

Subscribed and sworn to me this _____ day of _____, 20_____.

_____ Notary Public

_____ County, Michigan

Acting in the County of: _____

My Commission Expires: _____

Notary Seal

**SECTION 00 51 00
NOTICE OF AWARD**

Attention: _____

Date: _____

Project: Eureka Road Corridor and Frank & Poet Drain Improvements

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders, you are hereby notified that the _____ (Owner) during a _____ Meeting held on _____, _____, 20__ has directed the acceptance of your Bid for the above referenced Project in the amount of _____ Dollars (\$_____).

This Project consists of: Improvements include enclosing a segment of the Frank & Poet Drain and creating a new open channel cross-section downstream. Further improvements include a culvert replacement, headwalls widened and repaired sidewalk, improved bus stops, lighting/landscaping, elevated sidewalks at underpasses, off-site drain mitigation improvements and all related appurtenances. as delineated in your Bid submitted to City of Taylor on 01-28-2025.

Please comply with the following conditions within 15 days of the date of this Notice of Award; that is by _____, 20_____.

1. Deliver to Engineer _____ (_____) fully executed counterparts of the Agreement including all the Contract Documents.
2. Deliver with the executed Agreement the Contract Security (Bonds), on the form included in the Contract Documents, as specified in the General Conditions (Article 5).
3. Deliver with the executed Agreement the Insurance Certificates (and other evidence of insurance) as specified in the General Conditions (Article 5).
4. Please do not date Agreement and Contract Security (Bonds), as these will be dated by the Owner when executed by them.

It is important to comply with these conditions and time limits as failure to comply with these conditions within the time specified will entitle Owner to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within 10 days after you comply with those conditions, Owner will return to you two (2) fully signed counterparts of the Agreement with the Contract Documents attached.

In accordance with paragraph 2.05 of the General Conditions, please submit to Engineer the required schedules prior to the scheduling of a Pre-Construction Meeting.

Owner: _____

Authorized Signature: _____

Copy to Wade Trim Associates, Inc.

**SECTION 00 52 00
AGREEMENT**

This Agreement, made and entered into this _____ day of _____ in the year 20____, by and between City of Taylor hereinafter called Owner, and _____ hereinafter called Contractor, in consideration of the mutual covenants hereinafter sent forth, agree as follows:

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

Improvements include enclosing a segment of the Frank & Poet Drain and creating a new open channel cross-section downstream. Further improvements include a culvert replacement, headwalls, widened and repaired sidewalk, improved bus stops, lighting/landscaping, elevated sidewalks at underpasses, off-site drain mitigation improvements and all related appurtenances.

\$4.25 million of Act 51 eligible pay items must be substantially completed by August 15, 2026. \$4.25 million of Act 51 eligible pay items must be ready for final payment in accordance with paragraph 14.11 of Section 00 72 00 – General Conditions on or before September 15, 2026. The Project in its entirety must be substantially completed by June 15, 2027. The Project in its entirety must be ready for final payment in accordance with paragraph 14.11 of section 00 72 00- General Conditions on or before July 15, 2027.

Engineering and inspection costs incurred after the specified final completion date will be paid by the Contractor to the Owner prior to final payment authorization.

1. Charges will be made at such times and in such amounts as the Engineer will invoice the Owner, provided however said charges will be in accordance with the Engineer's current rate schedule at the time the costs are incurred.
2. The costs of the Engineer incurred after the specified final completion date will be deducted from the Contractor's progress payments.

Owner and Contractor recognize that time is of the essence of this Agreement and that the Owner will suffer financial loss if the Work is not Substantially Complete within the time specified in paragraph 1.03.A above, plus any extensions thereof allowed in accordance with Article 12 of Section 00 72 00. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by the Owner if the Work is not Substantially Complete on time. Accordingly, instead of requiring any such proof, the Owner and the Contractor agree that as liquidated damages for delay (but not as penalty) the Contractor will pay the Owner One Thousand (\$1000.00) for each day that expires after the time specified in paragraph 1.03.A above for Substantial Completion until the Work is Substantially Complete.

1. Liquidated damages charged will be deducted from the Contractor's progress payment.

Owner will pay Contractor as provided in the attached Proposal for performance of the Work in accordance with the Contract Documents.

Progress payments and retainage under this Contract are governed by the provisions of PA 1980, No. 524 (MCLA 125.1561 et seq.). That Act is incorporated herein by reference and made a part of this Contract. Without excluding any provisions of the Act from this Contract, but in order to comply therewith and summarize certain provisions, the following will apply:

1. The person representing the Contractor who will submit written requests for progress payments will be: _____
2. The person representing the Owner to whom requests for progress payments are to be submitted will be: _____
3. Contractor's representative, listed above, will submit Applications for Payment on the form provided in the Contract Documents in accordance with Article 14 of Section 00 72 00. Applications for Payment will be processed as provided in Section 00 72 00.

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

1. Contractor has considered the nature and extent of the Contract Documents, Work, locality, and all local conditions and federal, state and local laws, and regulations that may affect cost, progress, performance, or furnishing of the Work.
2. Contractor has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon in the preparation of the Plans and Specifications and which have been identified in the Supplementary Conditions.
3. Contractor has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to above as the Contractor deems necessary for the performance of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required by the Contractor for such purposes.
4. Contractor has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.
5. Contractor has given Engineer written notice of all conflicts, errors or discrepancies that he has discovered in the Contract documents and the written resolution thereof by Engineer is acceptable to the Contractor.

The Contract Documents which comprise the entire Contract between the Owner and the Contractor are attached to this Agreement, made a part hereof, and consists of the following:

1. Procurement Requirements (including the Advertisement for Bids, Instructions to Bidders, Proposal, Legal Status of Bidder, and other Documents listed in the Table of Contents thereof).
2. This Agreement
3. Performance and other Bonds
4. Notice of Award
5. Notice to Proceed (if issued)
6. Conditions of the Contract (including Section 00 72 00 - General Conditions and Section 00 73 00 - Supplementary Conditions, if any)
7. Specifications contained within Division 01 through 49 of the Project Manual
8. Plans bearing the following general title: Eureka Road Corridor and Frank & Poet Drain Improvements
9. Addenda numbers _____ to _____, inclusive
10. Documentation submitted by the Contractor prior to Notice of Award
11. Any Modification, including Change Orders, duly delivered after execution of Agreement.

Terms used in this Agreement which are defined in Article 1 of Section 00 72 00 will have the meanings indicated in Section 00 72 00.

No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on any other party without the written consent of the party sought to be bound; and specifically but without limitation, monies that may become due and monies 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.

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

Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon the Owner and the Contractor, who agree that the Contract Documents will 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.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in three counterparts. One counterpart each has been delivered to Owner and Contractor, and one counterpart has been delivered to the Engineer. The Contract Documents have been signed or identified by Owner and Contractor.

This Agreement will be effective on _____, 20____.

Owner: City of Taylor

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

Contractor: _____

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

License No. _____

Agent for service of process: _____

**SECTION 00 55 00
NOTICE TO PROCEED**

To: _____

Date: _____, 20____

Attention: _____

Project: Eureka Road Corridor and Frank & Poet Drain Improvements

Please note that the Contract Time under the above Contract will commence to run on _____, 20____. Within **ten (10)** days of this date you are to start performing the Work. The dates of Substantial Completion and Final Completion are set forth in the Agreement: they are _____, and _____, respectively.

In accordance with Article 2.05 of Section 00 72 00 - General Conditions, please submit to the Engineer the required schedules prior to the scheduling of a Pre-Construction Meeting.

Also, in accordance with Article 2.05 of Section 00 72 00 - General Conditions, please request a Pre-Construction Meeting from the Engineer prior to delivery of any materials or start of any construction. A minimum of three (3) full working days' notice is required to set up the Pre-Construction Meeting. Also, please notify the Engineer three (3) full working days in advance of any staking requirements or other activity on the Project.

Work at the site must be started by _____, 20____.

Owner: _____

Authorized Signature: _____

COPY TO Wade Trim Associates, Inc.

**SECTION 00 61 12.13
LABOR AND MATERIAL PAYMENT BOND FORM**

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars (\$ _____) lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the day of _____, 20____, for _____

_____.

Herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND WHEREAS, this Bond is given in compliance with and subject to the provisions of Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, including all notices, time limitation provisions and other requirements set forth therein, which are incorporated herein by reference.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work to be performed thereunder or the Contract Documents accompanying the same will in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, the condition of this obligation is such that if all claimants as defined in Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, are timely paid for all labor and material used or reasonably required for use in the performance of the contract, then this obligation will be void; otherwise, it will remain in full force and effect.

Signed and sealed this day of _____, 20_____.

Signed, sealed and delivered in the presence of:

Witness for Contractor: _____

_____ (Principal)

_____ (Title)

By: _____

Witness for Surety: _____

_____ (Surety)

_____ (Title)

By: _____

_____ (Attorney-in-Fact)

Seal

Address of Surety: _____

Telephone: _____

**SECTION 00 61 13.13
PERFORMANCE BOND FORM**

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars (\$ _____) lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the day of _____, 20____, for _____

_____.

Herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the work to be performed thereunder or the Contract Documents accompanying the same will in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, if the above Principal will in all respects comply with the terms and conditions of said contract, and their obligations thereunder, including the Contract Documents therein referred to and made a part thereof, and such alteration as may be made in such contract or Contract Documents, as herein or therein provided for, then this obligation will be void; otherwise, this bond and obligation will be and remain in full force and effect.

Signed and sealed this day of _____, 20_____.

Signed, sealed and delivered in the presence of:

Witness for Contractor: _____

_____ (Principal)

_____ (Title)

By: _____

Witness for Surety: _____

_____ (Surety)

_____ (Title)

By: _____

_____ (Attorney-in-Fact)

Seal

Address of Surety: _____

Telephone: _____

**SECTION 00 61 19.13
MAINTENANCE AND GUARANTEE BOND FORM**

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Owner State, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars (\$ _____) lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the day of _____, 20____, for _____

Herein referred to and made part hereof as fully and to the same extent as if the same were entirely written herein, and

NOW THEREFORE, the condition of this obligation is that under the Contract Documents, Contractor has agreed with Owner that for a period of one (1) year from the date of payment of the Final Estimate, Contractor will keep in good order and repair any defect in the Work, either by Contractor or its Subcontractors that may develop or be discovered during said one (1) year period due to improper materials, defective equipment, workmanship, or arrangements and any other work affected in making good such imperfections. Contractor also agreed to promptly make such repairs as directed by Owner for replacement of the Work, without cost to Owner, except for such parts of the Work as may have been disturbed without the consent of Contractor after the final acceptance of the Work, whenever directed so to do by notice from Owner. If Contractor fails to make such repair within one (1) week from the date of receipt of such notice, then Owner will have the right to purchase such materials and employ such labor and equipment as may be necessary for the purpose and to undertake, to and make such repairs and charge the cost thereof to Contractor and receive payment for the same promptly from the Contractor or Surety.

If any repair is necessary to be immediately made to protect persons or property then, and in such event, Owner may, but will not be required to, take immediate steps to repair such defects without notice to Contractor. In such event, Owner will not be required to obtain the lowest bid for the performance of the Work or any part thereof, and all sums actually paid therefore will be charged to the Contractor or Surety. In this regard, the judgment of Owner will be final and conclusive. Contractor will, for a period of one (1) year from the date of payment of the Final Estimate, keep the Work in good order and repair, except for such parts of the Work which may have been disturbed without the consent of Contractor after the final acceptance of the Work. Contractor will further, whenever notice is given as hereinbefore specified, promptly proceed to make the repair as in said notice directed or reimburse Owner for any cost incurred by Owner in making such repairs.

If Contractor or Surety fail to do as hereinbefore specified, they will jointly and severally indemnify, defend, and hold harmless Owner from and against all and any losses, costs, suits, and actions for damages of every kind and description brought or claimed against Owner for or on account of any injury or damage to persons or property received or sustained by any party or parties by or from any of the acts of omissions or through the negligence of Contractor, its Subcontractors, Suppliers, servants, agents, or employees in connection with the Work and then from any and all claims arising under the Workmen's Compensation Act of the State of Michigan.

IN WITNESS WHEREOF, the parties hereto have caused this Maintenance and Guarantee Bond to be executed by their respective authorized officers this _____, 20_____.

Signed, sealed and delivered in the presence of:

Witness for Contractor: _____

(PPrincipal)

(TTitle)

By: _____

Witness for Surety: _____

(SSurety)

(TTitle)

By: _____

(Attorney-in-Fact) Seal

Address of Surety: _____

Telephone: _____

**SECTION 00 62 75
ENGINEER'S CERTIFICATE FOR PAYMENT**

Job Number: _____ Certificate Number: _____ Date: _____
Owner: _____ Contractor: _____
Project: _____
Contract Date: _____
Substantial Completion: _____ Extended To: _____
Final Completion: _____ Extended To: _____

Original Contract Price: _____ Total Earned To Date: _____
Adjustments to Quantities: _____ Retention: _____
Extras: _____ Deductions: _____
Total Change Orders: _____ Total Withheld: _____
Amended Contract Price: _____ Total Net Due: _____
Less Total Net Due: _____ Less Previous Certificates: _____
Balance on Contract: _____ Balance Due this Certificate: _____

ENGINEER'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on the data comprising the above application, the Engineer to the best of Engineer's knowledge, information, and belief and subject to the limitations stated in the Contract Documents certifies to the Owner that: (1) Work has progressed to the point indicated, (2) that the quality of the Work is in accordance with the Contract Documents, and (3) Contractor is entitled to payment of the Total Balance Due This Certificate.

Certified By: _____ Date: _____

**SECTION 00 62 76
CONTRACTOR'S APPLICATION FOR PAYMENT**

Job Number: _____ Application No: _____ Date: _____
Owner: _____ Contractor: _____
Project: _____
Contract Date: _____
Period of this Application: _____ to _____

Total Earned To Date: _____ Less Total Earned to Due: _____
Previous Certificate: _____ Total Earned this Application: _____

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that to the best of Contractor's knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by Contractor for Work for which previous Certificates for Payment were issued and payments received from Owner, and that current payment shows herein is now due.

By: _____ Title: _____

CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period covered by this Application, performed any work, furnished any material, sustained any loss, damage, or delay for any reason, including soil conditions encountered or created, or otherwise done anything for which I will ask, demand, sue for, or claim compensation from the Owner or its agents, and the Engineer or its agents, in addition to the regular items set forth in the Contract as dated above executed between myself and the Owner and in the Change Orders for Work issued by the Owner in writing as provided thereunder, except as I hereby make claim for additional compensation and/or extension of time, as set forth on the itemized statement attached hereto.

By: _____ Title: _____

**SECTION 00 62 77
PAYMENT SCHEDULE**

Application No.: _____ Date: _____ Period: _____

Item of Work	Unit	Original Estimated Quantity	Unit Price	Period Quantity	Period Amount	Total Quantity to Date	Total Amount to Date

--	--	--	--	--	--	--	--

**SECTION 00 63 25
SUBSTITUTION REQUEST FORM**

Specification Section: _____

Specified Product: _____

Proposed Substitution: _____

Does specified product exceed, in any respect proposed substitution? Y N

Does substitution affect dimensions shown on Plans? Y N

Does substitution affect other trades more than original product? Y N

Does warranty differ from that specified? Y N

Does substitution affect cost to Owner? Y N

Does substitution result in any license fee or royalty? Y N

If you indicated "Yes" to any of the items above, attach thorough explanation on your Company letterhead, as follows:

1. Explain any differences between proposed substitution and specified product.
2. Summarize experience with product and manufacturer in Project area.
3. Attach complete technical data and literature.

The undersigned states that the function, appearance, and quality of the proposed substitution is equivalent or superior to the specified item, and that all information above and attached is true and correct.

Submitted By: _____

Signature: _____ Date: _____

Position: _____ Company: _____

Address: _____

Telephone: _____ Email: _____

**SECTION 00 63 70
CHANGE PROPOSAL FORM**

Project: Eureka Road Corridor and Frank & Poet Drain
Improvements Date: _____

Contractor: _____

Owner: _____

This Change Proposal is submitted in accordance with paragraph 10.06 of Section 00 72 00 - General Conditions. If this Change Proposal is accepted, either in whole or in part, a Change Order will be issued to modify the Contract Documents accordingly.

Detailed Description of Proposed Change	

Attachments (List documents attached supporting requested change)	

Change in Contract Price	Change in Contract Time
Original Contract Price:\$_____	Original Contract Time: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Increase or Decrease from previously approved Change Order(s): \$_____	Increase or Decrease from previously approved Change Order(s): Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Contract Price prior to this Change Proposal: \$_____	Contract Time prior to this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Increase or Decrease of this Change Proposal: \$_____	Increase or Decrease of this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion (days): MM-DD-YYYY
Contract Price incorporating this Change Proposal: \$_____	Contract Time incorporating this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Engineer's Decision on Change Proposal	

Contractor: _____	Engineer: _____	Owner: _____
By: _____	By: _____	By: _____
Date: _____	Date: _____	Date: _____

**SECTION 00 65 16
CERTIFICATE OF SUBSTANTIAL COMPLETION**

Project: Eureka Road Corridor and Frank & Poet Drain Improvements

Owner: City of Taylor

Contractor: _____

Contract Date: _____ Project No.: _____

Date of Issuance: _____

Project or Designated Portion will include: _____

The Work performed under this Contract has been reviewed and found to be Substantially Complete. The _____ which is also the date of commencement of applicable warranties required by the Contract Documents except as stated below. date of Substantial Completion of the Project or portion thereof designated above is hereby established as: _____

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The date of Substantial Completion of the Work or designated portion thereof, is the date certified by the Engineer when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the Engineer is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. The date of commencement of warranties for items on the attached list will be the date of final payment unless otherwise agreed to in writing.

The responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance will be as follows:

Owner will have **45** calendar days after receipt of this certificate during which Owner may make written objection to Engineer and Contractor as to any provisions of the certificate or attached list. Such objection may be cause for this Certificate of Substantial Completion to be null and void.

Engineer: _____

By: _____

Date: _____

**SECTION 00 65 20
SWORN STATEMENT**

State of Michigan

County of _____ }

being duly sworn, deposes and says:

That _____ is the (Contractor) (Subcontractor) for an improvement to the following described real property situated in _____ County, Michigan described as follows:

Insert Legal Description of Property

That the following is a statement of each Subcontractor and Supplier and laborer, for which the payment of wages or fringe benefits and withholdings is due but unpaid, with whom the (Contractor) (Subcontractor) has (contracted) (subcontracted) for performance under the contract with the Owner or lessee thereof, and that the amounts due to the persons as of the date hereof are correctly and fully set forth opposite their names, as follows:

Name of Subcontractor/ Supplier/ Laborer	Type of Improvement Furnished	Total Contract Price	Amount Already Paid	Amount Currently Owing	Balance to Complete (optional)	Amount of Laborer Wages Due but Unpaid	Amount of Laborer Fringe Benefits and Withholdings Due But Unpaid
TOTALS:							

(Some columns are not applicable to all persons listed)

Contractor has not procured material from, or subcontracted with, any person other than those set forth on the reverse side and owes no money for the improvement other than the sums set forth on the reverse side.

Deponent further says that they make the foregoing statement as the (Contractor) (Subcontractor) or as _____ of the (Contractor) (Subcontractor) for the purpose of representing to the Owner or lessee of the described on the reverse side premises and their agents that the property described on the reverse side is free from claims of construction liens, or the possibility of construction liens, except as specifically set forth on the reverse side and except for claims of construction liens by laborers which may be provided pursuant to Section 109 of the Construction Lien Act, Act No. 497 of the Public Acts of 1980, as amended, being section 570.1109 of the Michigan Compiled Laws.

Warning to Owner: Owner or Lessee of the property described herein may not rely on this Sworn Statement to avoid claim of a Subcontractor, supplier or laborer who has provided a Notice of Furnishing pursuant to Section 109 of the Construction Lien Act to the Designee or to the Owner or Lessee if the Designee is not named or has died.

Warning to Deponent: A person, who with intent to defraud, gives a false Sworn Statement, is subject to criminal penalties as provided in Section 110 of the Construction Lien Act, Act No. 497 of the Public Acts of 1980, as amended, being Section 570.1110 of the Michigan Compiled Laws.

_____ day of _____, 20_____.

Notary Public: _____

_____ County, Michigan

My Commission Expires: _____

INSTRUCTIONS

A Sworn Statement in the preceding form must be provided before any Contractor or Subcontractor can file a Complaint, Cross-Claim, or Counter-Claim to enforce a construction lien.

An Owner or lessee may withhold payment to a Contractor or Subcontractor who has not provided a Sworn Statement. Owner or lessee may withhold from a Contractor or Subcontractor who has provided a Sworn Statement the amount sufficient to pay all sums shown on the statement as owing Subcontractors, Suppliers, and laborers, or the amount shown to be due to lien claimants who have provided Notices of Furnishing pursuant to the Construction Lien Act of 1980.

Owner or lessee may rely on a Sworn Statement to avoid a lien claim unless the lien claimant has provided the Owner or lessee with a Notice of Furnishing pursuant to the Construction Lien Act of 1980.

If the contract provides for payments by the Owner to the Contractor, if any, in the normal course of construction, but the Owner elects to pay lien claimants directly, the first time the Owner elects to make payment directly to a lien claimant they will provide at least 5 business days' notice to the Contractor of the intention to make direct payment. Subsequent direct disbursements to lien claimants need not be preceded by the 5-day notice provided in this section unless the Owner first returns to the practice of paying all sums to the Contractor.

SECTION 00 72 00 GENERAL CONDITIONS

ARTICLE 1 DEFINITIONS

1.01 DEFINED TERMS

- A. Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:
1. Addenda -- Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Contract Documents.
 2. Agreement -- The written Agreement between Owner and Contractor covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.
 3. Application and Certificate for Payment -- The form included in the Contract Documents which is to be used by Contractor in requesting progress or final payment and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. Bid -- The offer or proposal of the bidder submitted on the prescribed form setting forth the price(s) for the Work to be performed.
 5. Bidding Requirements -- The Advertisement for Bids, Instructions to Bidders, Supplementary Instructions to Bidders, Proposal, Legal Status of Bidder, Bid Bond, and any other documents identified in the Proposal, to be submitted with the Bid.
 6. Bonds -- Bid, Performance and Payment bonds and other instruments of security.
 7. Change Order -- A written order to Contractor, reviewed by Engineer and signed by Owner, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Price or the Contract Time. The Contract Price and Contract Time may be changed only by Change Order. A Change Order signed by Contractor indicates his agreement therewith, including that the Change Order constitutes a final adjustment in the Contract Price or Contract Time for all issues addressed or described in the Change Order.
 8. Change Proposal -- A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 9. Claims --
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.
 - b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, arising after Engineer has issued a recommendation of final payment.

- d. A demand for money or services by a third party is not a Claim.
10. Constituents of Concern -- Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
 11. Contract -- The entire and integrated written contract between Owner and Contractor concerning the Work.
 12. Contract Documents -- Those items so designated in the Agreement, and which together comprise the Contract.
 13. Contract Price -- The monies or other considerations payable by Owner to Contractor for completion of acceptable Work in accordance with the Contract Documents as stated in the Agreement.
 14. Contract Time -- The number of days or the date stated in the Agreement:
 - a. to achieve Substantial Completion of all or any specified portions of the Work, and;
 - b. to complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.11.
 15. Contractor -- The person, firm or corporation with whom Owner has entered into the Agreement.
 16. Cost of the Work -- The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined in paragraph 12.01.
 17. Day -- A calendar day of 24 hours measured from midnight to the next midnight.
 18. Defective -- An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to Engineer's recommendation of final payment.
 19. Drawings -- See Plans.
 20. Effective Date of 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.
 21. Electronic Document -- Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 22. Electronic Means -- Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow:
 - a. the transmission or communication of Electronic Documents;
 - b. the documentation of transmissions, including sending and receipt;
 - c. printing of the transmitted Electronic Document by the recipient;
 - d. the storage and archiving of the Electronic Document by sender and recipient; and
 - e. the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

23. Engineer -- The person, firm, or corporation identified in the Supplementary Instructions to Bidders hired by Owner to prepare Plans and Specifications for the Project and to assist Owner in interpreting Plans and Specifications during the performance of the Work. Engineer's authority and responsibility are set forth in the Contract between Owner and Engineer. Contractor acknowledges and agrees that Engineer's obligations and duties under Engineer's contract with Owner are obligations and duties to Owner only, and Engineer has no independent obligation to Contractor of any kind, including but not limited to providing services, or to take any action or to refrain from taking action on behalf of Contractor or any Subcontractor, Sub-Subcontractor or Supplier.
24. Field Order -- A written order issued by Engineer which clarifies or interprets the Contract Documents or orders minor changes in the Work in accordance with paragraph 9.04 and paragraph 9.05 but which does not involve a change in the Contract Price or the Contract Time.
25. Hazardous Environmental Conditions -- The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
26. 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.
27. Lump Sum -- Construction Work where Owner pays a single stipulate price (Lump Sum) for the entire scope of Work; plus or minus alternates and/or allowances. However, unit prices may be required for individual items of Work for the purposes of changes, additions, or deletions.
28. Milestone -- A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of the Work.
29. Notice of Award -- The written notice by Owner to the apparent successful Bidder stating that, upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, Owner will sign and deliver the Agreement.
30. Notice to Proceed -- A written notice given by Owner to Contractor (with a copy to Engineer) fixing the date on which the Contract Time will commence to run and on which Contractor will start to perform Contractor's obligation under the Contract Documents.
31. Owner -- The public body or authority, corporation, limited liability company, association, partnership, or individual with whom Contractor has entered into the Agreement and for whom the Work is to be provided and as identified in the Supplementary Instructions to Bidders.
32. Partial Utilization -- Use by Owner of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.
33. Plans -- The part of the Contract Documents which graphically show the extent, character and Scope of the Work to be furnished and performed by Contractor and which have been prepared or approved by Engineer or Owner; sometimes also referred to as Drawings.

34. Progress Schedule -- A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
35. Project -- The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.
36. Project Manual -- The volume assembled for the Project which may include, among other parts, Procurement Requirements, Contracting Requirements and Specifications.
37. Proposal -- The offer or bid of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
38. Radioactive Material -- Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 as amended.
39. Resident Project Representative -- The authorized representative of Engineer who may be assigned to the Site or any part thereof.
40. 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.
41. Schedule of Submittals -- A schedule, prepared and maintained by Contractor, of required Submittals and the time requirements for Engineer's review of the Submittals.
42. 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.
43. Shop Drawings -- All drawings, diagrams, illustrations, schedules and other data or information required by the Contract Documents which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate material or equipment for some portion of the Work.
44. 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, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
45. Specifications -- That part of the Contract Documents which consist of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.
 - a. Project Specifications are those portions of the Contract Documents which have been prepared specifically for this Project and which are identified by the job number in the lower right-hand corner of each page.
 - b. Standard Specifications are Specification sections that are the same from Project to Project as of the revision date shown in the lower left-hand corner of the page.
46. Subcontractor -- An individual, firm or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
47. Submittal -- A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by

Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

48. Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.11. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
49. Supplementary Conditions -- The part of the Contract Documents which amends or supplements these General Conditions.
50. Supplementary Instructions to Bidders -- The part of the Contract Documents which amends or supplements the Instructions to Bidders.
51. Supplier -- A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with Contractor, or with any Subcontractor, or with Owner, to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
52. Unit Price -- Construction Work where Owner pays a fixed sum (Unit Price) per each completed unit of Work. Units are listed on the Proposal Form.
53. Utilities -- Underground or above ground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any structures or encasements containing such facilities, which have been installed to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, water or other liquids or chemicals.
54. Work -- The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.
55. Work Change Directive -- A written directive to Contractor, issued on or after the Effective Date of the Agreement and signed by Owner and reviewed by Engineer, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.03 or to emergencies under paragraph 6.18. A Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed 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 Time as provided in paragraph 10.01.

1.02 TERMINOLOGY

- A. The following words, terms, or phrases are not defined but, when used in the Contract Documents, have the following meaning:
 1. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used; or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of Engineer as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the technical requirements of and information in the Contract Documents and conformance with the design concept of the

completed 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 will not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

2. The word “furnish,” when used in connection with services, materials, or equipment, will 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.
 3. The word “install,” when used in connection with services, materials, or equipment, will mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 4. The words “perform” or “provide,” when used in connection with services, materials, or equipment, will mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 5. 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.
- B. Unless stated otherwise in the Contract Documents, words or phrases which 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 INSURANCE

- A. When Contractor delivers the executed Agreement to Owner, Contractor will also deliver to Owner such Bonds and Insurance Certificates and other evidence of Insurance requested as Contractor may be required to furnish in accordance with Article 5. No Work at the site may begin or progress payments made to Contractor until all Bonds and Insurance Certificates in the form and substance required in Article 5 have been submitted and approved by Owner.

2.02 COPIES OF DOCUMENTS

- A. Owner will furnish to Contractor up to five (5) copies of the Contract Documents (including at least one fully signed counterpart of the Agreement) as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.03 COMMENCEMENT OF CONTRACT TIME; NOTICE TO PROCEED

- A. Time is of the essence in the performance of the Work. The Contract Time will commence to run on the 30th 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 Time commence to run later than the 30th day after the effective date of the Agreement. Time limits stated in the Contract Documents are of the essence of the Agreement.

2.04 STARTING THE PROJECT

- A. Contractor will start to perform the Work within 10 days of when the Contract Time commences to run, but no Work shall be done at the Site prior to the date on which the Contract Time commences to run. Contractor will notify Engineer at least 3 working days in advance of the time he intends to start Work.

2.05 PRECONSTRUCTION MEETING

- A. Within 10 days of the Effective Date of the Agreement and prior to the delivery of materials or the start of any construction, Contractor will request a Preconstruction Meeting from Engineer. A minimum of 3 full working days' notice will be required.
- B. Prior to the scheduling of the Preconstruction Meeting, Contractor will submit to Engineer for review:
 - 1. A preliminary Progress Schedule indicating the starting and completion dates of the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. A preliminary Schedule of Submittals which will list each required Submittal and the times for submitting, reviewing and processing such Submittal;
 - 3. An estimated monthly payment schedule, and a preliminary Schedule of Values for all of the Work.
- C. The Preconstruction Meeting will be held for review and acceptance of the schedules, to establish procedures for handling Shop Drawings and other Submittals, for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

2.06 ELECTRONIC TRANSMITTALS

- A. Except as otherwise stated elsewhere in the Contract, Owner, Engineer, and Contractor may send, and will accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor will jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3 CONTRACT DOCUMENTS INTENT AND REUSE

3.01 INTENT

- A. The Contract Documents are complementary; what is required by one Contract Document 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.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.
- G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations; or
3. any obligation on the part of Engineer to Contractor.

3.02 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, will mean the latest standard, specification, manual, 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.
- 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 Work, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not it is specifically called for.
- C. No provision of any standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of Owner, Contractor or Engineer, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Owner, Engineer or any of Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.10 or any other provision of the Contract Documents.

3.03 REPORTING AND RESOLVING DISCREPANCIES

- A. 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 has a duty to and shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor should reasonably have discovered and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
- B. 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 any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall report it to Engineer in writing at once, and, Contractor shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.18) until receiving written instruction or clarification from Engineer or Owner. However, Contractor shall not be liable to Owner or Engineer for failure to report any such conflict, error, ambiguity or discrepancy unless Contractor knew or reasonably should have known thereof.
- C. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement issued by one of the methods indicated in paragraph 3.05, 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;
 1. the provisions of any standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. 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 REQUIREMENTS OF CONTRACT DOCUMENTS

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation - RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve
 1. the performance or acceptability of the Work under the Contract Documents,
 2. the design (as set forth in the Drawings, Specifications, or otherwise), or
 3. other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in paragraph 11.01.

3.05 ORDER OF PRECEDENCE

- A. In resolving conflicts, errors or discrepancies between Plans and Specifications,
 1. figured dimensions shall govern over scaled dimensions;
 2. Plans shall govern over Standard Specifications;
 3. and Project Specifications shall govern over Standard Specifications and Plans.

3.06 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 in one or more of the following ways:
 1. a Field Order (pursuant to paragraph 9.05), or,
 2. a Change Order (pursuant to paragraph 10.01.A.1), or
 3. a Work Change Directive Order (pursuant to paragraph 10.01.A.2)
- B. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:
 1. a Field Order (pursuant to paragraph 9.05),
 2. Engineer's review of a Shop Drawing or Sample (pursuant to paragraph 6.21), or
 3. Engineer's written interpretation or clarification (pursuant to paragraph 9.04).

3.07 REUSE OF DOCUMENTS

- A. Neither Contractor nor any Subcontractor, manufacturer, fabricator, Supplier, distributor, or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Owner:

1. shall have or acquire any title to or ownership rights in any of the Plans, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's Consultant, and
2. they shall not reuse any of such Plans, Specification, other documents or copies on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

3.08 ELECTRONIC DATA

- A. Except as otherwise stated elsewhere in the Contract Documents, Owner, Engineer and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information and graphics, including but not limited to Shop Drawings and other Submittals, in electronic media or digital format, either directly or through access to a secure Project website.
- B. 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; REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

- A. Owner shall furnish, as indicated in the Contract Documents and not later than the established date for beginning Work on the Contract, the lands upon which the Work is to be performed, rights of way and easements for access thereto, and such other lands which are designated for the use of Contractor. Owner shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which Contractor will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by Owner, unless otherwise provided in the Contract Documents. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment unless otherwise provided in the Contract Documents.

4.02 SUBSURFACE AND PHYSICAL CONDITIONS; INVESTIGATIONS AND REPORTS

- A. Reference is made to the Supplementary Conditions for identification of those reports of investigations and tests of subsurface and physical conditions at the Site or otherwise affecting cost, progress or performance of the Work which have been reviewed in preparation of the Contract Documents. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.
- B. The locations of utilities or other physical conditions relating to existing surface or subsurface structures at or contiguous to the Site as shown on the Plans are taken from drawings from sources believed to be reliable. Neither Owner nor Engineer will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.
- C. Contractor shall draw its own conclusions as to the general accuracy of the "technical data" contained in such reports and drawings, and confirms such reports and drawings are not Contract Documents. Contractor may not rely upon or make any Claim against Owner, Engineer or any of Engineer's Consultants 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 data, interpretations, opinions or information.
- D. The cost of all the following will be included in the Contract Price and Contractor shall have full responsibility for:
1. reviewing and checking all such information and data,
 2. locating all Utilities during construction,
 3. coordination of the Work with the owners of such Utilities, and
 4. the safety and protection of all such Utilities as provided in paragraph 6.15 and repairing any damage thereto resulting from the Work.

4.03 UNFORESEEN PHYSICAL CONDITIONS

- A. If Contractor discovers one or both of the following physical conditions of surface or subsurface at the Project or improvement Site, before disturbing the physical condition, Contractor shall immediately notify Owner and Engineer of the physical condition; and follow up within 48 hours in writing:
1. A subsurface or a physical condition at the Site differing materially from those indicated in the Contract Documents, or
 2. An unknown physical condition at the Site of a nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for the improvement project.
- B. Engineer's Review. After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in paragraph 4.03.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. Owner's Statement to Contractor Regarding Site Condition. After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. Possible Price and Times Adjustments:
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, 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 fall within any one or more of the categories described in paragraph 4.03.A;
 - 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 paragraph 12.03; and

- c. 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 pursuant to paragraph 10.05.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a 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 otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by paragraph 4.03.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order or Work Change Directive.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of Owner's written statement to Contractor regarding the subsurface or physical condition in question.

4.04 UTILITIES

- A. Contractor's Responsibilities. The information and data shown or indicated in the Contract Documents with respect to existing Utilities at or adjacent to the Site, if any, is based on information and data furnished to Owner or Engineer by the owners of such Utilities, including Owner, or by others.
 1. Owner and Engineer do not warrant or guarantee 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 information and data regarding existing Utilities at the Site;
 - b. locating all Utilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Utilities, during construction; and
 - d. the safety and protection of all existing Utilities at the Site, and repairing any damage thereto resulting from the Work.
- B. Notice by Contractor. If Contractor believes that an Utilities that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then 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 6.18), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
- C. Engineer's Review. Engineer will:
 1. promptly review the Utilities and conclude whether such Utilities was not shown or indicated in the Contract Documents,
 2. or was not shown or indicated with reasonable accuracy;

3. obtain any pertinent cost or schedule information from Contractor;
 4. prepare recommendations to Owner regarding Contractor's resumption of Work in connection with the Utilities in question;
 5. determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Utilities;
 6. and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- D. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- E. Owner's Statement to Contractor Regarding Utilities. After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Utilities in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- F. Possible Price and Times Adjustments:
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Utilities at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Utilities in question;
 - 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 paragraph 12.03;
 - c. 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; and
 - d. Contractor gave the notice required in paragraph 4.04.B.
 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of Owner's written statement to Contractor regarding the Underground Facility in question.

4.05 REFERENCE POINTS

- A. Owner shall provide engineering surveys for construction to establish property corners, monuments, bench marks and similar reference points which in his judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for the preservation of established reference points and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. Reference points destroyed by negligence of Contractor will be replaced by Owner at the expense of Contractor. Construction Staking will be furnished by Owner as provided in Division 01 of the Specifications.

4.06 CONSTITUENTS OF CONCERN

- A. Owner shall be responsible for any Constituents of Concern uncovered or revealed at the Site which was not shown or indicated in Plans or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. Owner shall not be responsible for any such materials brought to the Site by Contractor, Subcontractor, Suppliers or anyone else for whom Contractor is responsible.
- B. Upon discovering any such material, Contractor shall immediately:
 - 1. stop all Work in connection with such Hazardous Environmental Condition and in any area affected thereby (except in emergency as required by paragraph 6.18), and
 - 2. notify Owner and Engineer (and 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 Hazardous Environmental Condition or take corrective action, if any.
- C. Contractor shall not be required to resume Work in connection with such Hazardous Environmental Condition or in any such affected areas until after Owner has obtained any required permits related thereto and delivered to Contractor special written notice:
 - 1. specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or
 - 2. specifying any special conditions under which such Work may be resumed safely.
- D. If Owner and Contractor cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Terms as a result of such Work stoppage or such special conditions under which Work is agreed by Contractor to be resumed, either party may make a Claim therefor as provided in paragraph 11.01.
- E. If after receipt of such special 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 such portion of the Work that is in connection with such condition, or in such affected area, to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Time as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 11.01. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with paragraph 7.01.
- F. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, Engineer, Engineer's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from such condition per this paragraph 4.06, provided that:
 - 1. 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, and
 - 2. nothing in this paragraph 4.06 shall obligate Owner to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.
- G. The provisions of paragraph 4.03 are not intended to apply to the presence of Constituents of Concern or Hazardous Environmental Conditions uncovered or revealed at the Site.

ARTICLE 5 BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

- A. Contractor shall furnish performance and payment Bonds, on the form included in the Contract Documents, 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 at least until 1 year after the date when final payment becomes due, except as otherwise provided by Laws and Regulations or as specified in the Contract Documents or Bond. Contractor shall also furnish such other Bonds as are required by the Supplementary Conditions.
- B. All Bonds shall be in the forms prescribed by the Contract Documents and be executed by such Sureties as
 - 1. are licensed to conduct business in the state where the Project is located, and
 - 2. are named in the current 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 U.S. Department of Treasury, Financial Management Service, Surety Bond Branch.
- C. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- D. If Surety on any Bond furnished by Contractor is declared as 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 clauses (1) and (2) of paragraph 5.01, Contractor shall within 5 days thereafter substitute another Bond and Surety, both of which shall be acceptable to Owner.

5.02 LICENSED INSURERS AND SURETIES

- A. 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.

5.03 INSURANCE

- A. Contractor shall purchase and maintain during the term of the Project such insurance as will protect him, Owner(s) and Engineer(s) from Claims arising out of the Work described in this Contract and performed by Contractor, Subcontractor(s) or Sub subcontractor(s) consisting of:
 - 1. Workers' Compensation Insurance including Employer's Liability to cover employee injuries or disease compensable under the Workers' Compensation Statutes of the states in which Work is conducted under this Contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Workers', Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which Work on this Project is performed are acceptable.
 - 2. An occurrence form Commercial General Liability policy to cover bodily injury to persons other than employees and for damage to tangible property, including loss of use thereof, plus appropriate endorsements to protect Owner and Engineer against Claims, demands, and lawsuits from employees of Contractor and Subcontractors, including the following exposures:
 - a. All premises and operations.
 - b. Explosion, collapse and underground damage.
 - c. Contractor's Protective coverage for independent contractors or Subcontractors employed by him.

- d. Broad form blanket, contractual liability for the obligation assumed in the Indemnification or Hold Harmless agreement found in the General Conditions or Supplementary Conditions of this Contract.
 - e. Personal Injury Liability endorsement with no exclusions pertaining to employment.
 - f. Products and Completed Operations coverage. Coverage shall extend through the Contract guarantee period.
 - g. Broad form property damage.
 - h. Cross liability endorsement.
 - i. For design professional additional insureds, ISO Endorsement CG 20 32 04 13, "Additional Insured-Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
3. Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. Comprehensive General Liability and the Comprehensive Auto Liability shall be written by the same insurance carrier, though not necessarily in one policy.
 4. Contractor shall purchase for Owner an Owner's Protective Liability policy to protect Owner, Engineer, their consultants, agents, employees and such public corporations in whose jurisdiction the Work is located for their liability for Work performed by Contractor, the Subcontractor(s) or the Sub subcontractor(s) under this Contract.
 5. When a limit of liability is identified in the Supplementary Conditions, Contractor shall purchase a Builder's Risk Installation Floater in a form acceptable to Owner covering property of the Project for the full cost of replacement as of the time of any loss which shall include, as named insureds,
 - a. Contractor,
 - b. all Subcontractors,
 - c. all Sub subcontractors,
 - d. Owner, and Engineer(s) or Architect(s), as their respective interests may prove to be at the time of loss, covering insurable property which is the subject of this Contract, whether in place, stored at the Site, stored elsewhere, or in transit at the risk of the insured(s).
 - e. Coverage shall be effected on an "All Risk" form including, but not limited to, the perils of fire, wind, vandalism, collapse, theft, flood and earthquake, with removal of passive design error exclusion. Except as may otherwise be required by Owner, Contractor may arrange for such deductibles as Contractor deems to be within Contractor's ability to self-assume, but Contractor will be held solely responsible for the amount of such deductible and for any co-insurance penalties. Any insured loss shall be adjusted with Owner and Contractor and paid to Owner and Contractor as Trustee for the other insureds.
 6. Umbrella or Excess Liability:
 - a. Contractor is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested. Umbrella or Excess policy wording shall be at least as broad as the primary or underlying policy(ies) and shall apply both to Contractor's General Liability and Automobile Liability Insurance and shall be written on an occurrence basis.
 7. Railroad Protective Liability:

- a. Where any of the Work is within a railroad right-of-way or where a limit of liability is identified in the Supplementary Conditions, Contractor will provide coverage in the name of each railroad company having jurisdiction over rights of way across which Work under the Contract is to be performed. The form of policy and the limits of liability shall be determined by the railroad company(ies) involved. See Section 00 73 00 - Supplementary Conditions for limits and coverage requested.
8. Contractor's Professional Liability Insurance:
- a. If Contractor will provide or furnish professional services under this Contract through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against Claims arising out of performance of professional design or related services caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- B. Owner's responsibilities in respect of purchasing and maintaining insurance are set forth below:
- 1. Owner shall assume responsibility for such boiler and machinery insurance as may be required or considered to be necessary by Owner in the course of construction, testing or after completion.
 - a. Owner shall assume responsibility for such insurance as will protect Owner against any loss of use of Owner's property due to those perils insured pursuant to paragraph 1 above.

5.04 LIMITS OF LIABILITY

- A. The required limits of liability for insurance coverages required in paragraphs 5.03 shall be not less than those specified in Section 00 73 00 - Supplementary Conditions .

5.05 NOTICE OF CANCELLATION OR INTENT NOT TO RENEW

- A. Policies will be endorsed to provide that at least 30 days written notice shall be given to Owner and to Engineer of cancellation, intent not to renew, or material modification of the coverage.

5.06 EVIDENCE OF COVERAGE

- A. Prior to commencement of the Work, Contractor shall furnish to Owner and Engineer, Certificates of Insurance in force on current Accord® Certificate of Insurance form. Other forms of Certificate are acceptable only if;
 - 1. they include all of the items prescribed in the current Accord® Certificate of Insurance form, including agreement to cancellation provisions outlined in paragraph 5.05 above; and
 - 2. they have approval of Owner and Engineer.
- B. Prior to the commencement of the Work, Contractor shall furnish to Owner complete "originally signed" copies of the Owner's Protective Liability Policy. The number of copies shall be the same as the number of counterparts of the Agreement. Owner reserves the right to request complete copies of other policies if deemed necessary to ascertain details of coverage not provided by the certificates. Such policy copies shall be "Originally Signed Copies," and so designated.

5.07 QUALIFICATION OF INSURERS

- A. In order to determine financial strength and reputation of insurance carriers, all companies providing the coverages required shall be licensed or approved by the Insurance Bureau of the state in which the Project is located and shall have a financial rating not lower than XI and a policyholder's service rating no lower than B+ as listed in A.M. Best's Key Rating Guide, current

edition. Companies with ratings lower than B+:XI will be acceptable only upon written consent of Owner.

5.08 DAMAGE CLAIMS - ACKNOWLEDGMENT AND REPORTS

- A. Contractor shall furnish to Owner an acknowledgment receipt from the insurance carrier for each damage claim against the Project. The receipt shall include the insurance carrier's assigned claim number.
- B. Upon request, Contractor or his insurance carrier shall also furnish to Owner a status report on all damage claims. This report shall include inspections made, the disposition of claims, and what action has been taken towards settlement of each claim.
- C. Failure of Contractor to comply with this paragraph 5.08 may result in the amount of such damage claims being withheld from Contractor's monthly pay estimate. Such withholding shall be reimbursed in the monthly pay estimate following compliance with this paragraph.

5.09 COST OF INSURANCE

- A. The unit cost of the insurance herein specified will not be a specific bid item, but the cost of such insurance will be included by Contractor in the various prices bid.

5.10 WAIVER OF RIGHTS

- A. Owner and Contractor intend that all policies purchased in accordance with paragraph 5.03 will protect Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants (and all other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds in such policies) and will provide primary coverage for all losses and damages caused by the perils covered thereby. Such policies shall contain provisions to
- B. 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 additional insureds thereunder.
- C. Owner and Contractor waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and in addition, waive all such rights against Subcontractors, Engineer, Engineer's Consultants and any other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds under such policies for loss 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.

5.11 RECEIPT AND APPLICATION OF INSURANCE PROCEEDS

- A. Any insured loss under the policies of insurance required by paragraph 5.03.A.5 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. If no other special agreement is reached the damaged Work shall be repaired or replaced, the monies so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order, Field Order or Work Change Directive.
- B. Owner as fiduciary shall have power to adjust and settle any loss under the policies required by paragraph 5.03.A.5 with the insurers unless one of the parties in interest shall object in writing within fifteen 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.

ARTICLE 6 CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

- A. Contractor shall supervise 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 be responsible to see that the finished Work complies with the Contract Documents. However, if specific means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications, Contractor shall be responsible to comply therewith, but may implement such prescribed Work in a manner of Contractor's choosing so long as the Work complies with the requirements of the Plans and Specifications.
- B. At all times during the progress of the Work, Contractor shall assign and maintain a competent superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. Any superintendent or foreman who neglects to have Work done in accordance with the Plans and Specifications shall be removed from the Project. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to the superintendent shall be as binding as if given to Contractor.

6.02 LABOR AND WORKING HOURS

- A. Contractor shall provide competent, suitably qualified personnel in their various duties. Contractor shall at all times maintain good discipline and order at the Site. Except as otherwise required for the safety or protection of persons, the Work, property at the Site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the Site shall be performed during regular working hours (7:00 a.m. to 7:00 p.m.), and Contractor will not permit the performance of Work on Sunday or any legal holiday without Owner's written consent given after prior written notice to Engineer.

6.03 SERVICES, MATERIALS AND EQUIPMENT

- A. Unless otherwise specified in the Contract Documents, Contractor shall furnish 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 furnishing, performance, testing, start up and completion of the Work.
- B. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents 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 kind and quality of materials and equipment to be incorporated in the Work. Contractor shall not use material in the Work until Shop Drawing or Submittals have been reviewed by Engineer. All materials which do not meet the requirements of the Specifications at the time they are to be used will be rejected, and unless otherwise permitted by Engineer, shall be plainly marked and removed immediately from the Work.
- C. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, Supplier or distributor, except as otherwise provided in the Contract Documents.

6.04 SUBSTITUTES AND "OR-EQUALS"

- A. Whenever an item of materials or equipment is specified or described in the Contract Documents for installation in the Work by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier or distributor; or means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications; the specification or description is intended to establish the type, function and quality required or the

means, methods, techniques, sequences and procedures of construction required. Unless the specification or description contains or is followed by words indicating that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or materials or equipment of other manufacturers, fabricators, suppliers or distributors; or other means, methods, techniques, sequences and procedures of construction may be accepted by Engineer under the following circumstances:

1. "Or-Equal": 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 acceptance of proposed substitute items.
 2. Substitute Items: 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 6.04.A; or a proposed means, methods, techniques, sequences and procedures of construction are different from what is prescribed in the Plans or Specifications, it will be considered a proposed substitute item.
- B. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment or means, methods, techniques, sequences and/or procedures proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by Engineer will include the following, as supplemented in the Specifications, and as Engineer may decide is appropriate under the circumstances. Requests for review of substitute items of material and equipment will not be accepted by Engineer from anyone other than Contractor.
- C. If Contractor wishes to furnish or use a substitute, Contractor shall make written application to Engineer on the Substitution Request Form provided for acceptance thereof, certifying that the proposed substitute will:
1. perform adequately the functions and achieve the results called for by the general design,
 2. be similar in substance to that specified,
 3. and be suited to the same use and capable of performing the same function as that specified.
 4. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor's achievement of Substantial Completion on time, whether or not acceptance of the proposed substitute for use in the Work will require a change in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the Project) to adapt the design to the proposed substitute, and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.
- D. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.
- E. All data to be provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's expense. Engineer will be the sole judge of acceptability, and Engineer's determination shall be final and binding, may not be reversed through an appeal under any provisions of the Contract Documents, and no "or-equal" or substitute shall be ordered, installed or utilized without Engineer's prior written acceptance. Owner may require Contractor to furnish

at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute which has been approved by Engineer.

- F. Engineer will record time required by Engineer and Engineer's consultants in evaluating substitutions proposed by Contractor and in making changes in the Contract Documents occasioned thereby. Whether or not Engineer accepts a proposed substitute, Contractor shall reimburse Owner for the charges of Engineer and Engineer's consultants for evaluating any proposed substitute and in making any changes in the Contract Documents resulting therefrom.

6.05 CONCERNING SUBCONTRACTORS

- A. Contractor shall not employ any Subcontractor, Supplier or other person or organizations, including those who are to furnish the principal items of materials or equipment, whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall furnish Engineer a complete list of any Subcontractor, Supplier or other person or organization furnishing principal items of material or equipment within 4 days of request. Failure to object to any Subcontractor, Supplier, other person or organization by Owner or Engineer shall not constitute a waiver of any right of Owner or Engineer to reject defective Work.
- B. If Owner or Engineer, after due investigation, has reasonable objection to any Subcontractor, Supplier, other person or organization proposed by Contractor after the Notice of Award, Contractor shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order shall be issued. Contractor shall not be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.
- C. Contractor shall not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of Owner.
- D. Contractor shall be fully responsible for all acts and omissions of his Subcontractors, Suppliers and of persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier or other person or organization any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any Subcontractor, Supplier or other person or organization. Owner or Engineer may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, evidence of amounts paid to Contractor on account of specific Work done.
- E. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor. Contractor shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. If the amount of the subcontract or the nature of the Work to be performed thereunder warrants, Owner may require Subcontractor to furnish, for the benefit of Owner and Contractor jointly, Bonds in an amount proportioned to the amount of his subcontract, and for the same purpose and under the same specifications as those of the general Contract. The Surety on the general Contract shall not be eligible to furnish such Subcontract Bonds.
- 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 and additional insured on the property insurance provided in paragraph 5.03.A.5, the agreement between Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, Engineer's Consultants and all other additional insureds for all

losses and damages caused by, arising out of or resulting from any of the perils 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. Contractor shall file a true copy of such agreement with Owner.

6.06 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 Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Contractor shall defend, indemnify and hold harmless Owner and Engineer and anyone directly or indirectly employed by either of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from 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, and shall defend all such claims in connection with any alleged infringement of such rights.

6.07 PERMITS AND LICENSES

- A. 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, permit, review, 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. Contractor shall pay all charges of utility owners for connections to the Work.

6.08 LAWS AND REGULATIONS

- A. Contractor shall give all notices and comply with all laws, ordinances, rules, and regulations applicable to furnishing and performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws, ordinances, rules, and Regulations.
- B. If Contractor performs any Work that is contrary to such laws, ordinances, rules and regulations, Contractor shall bear all claims, costs, losses, damages and expenses caused by, arising out of, or resulting therefrom. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Plans are in accordance with such laws, ordinances, rules, and regulations, but this shall not relieve Contractor of Contractor's obligations under paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated Contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to, or on the amount, or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

6.09 TAXES

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

6.10 USE OF PREMISES

- A. Contractor shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights of way, permits and easements, and shall not unreasonably encumber the premises 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. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with any such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. Contractor's continuing obligations under paragraph 6.24 shall be applicable to any claim hereunder.

6.11 REMOVAL OF DEBRIS AND CLEANING

- A. During the progress of the Work, Contractor shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work Contractor shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the Site clean and ready for occupancy by Owner at Substantial Completion of the Work. Contractor shall restore to their original condition all property not designated for alteration by the Contract Documents. If Contractor shall fail to keep the above noted areas cleaned of dust or debris resulting from Contractor's operations, Contractor shall be so notified in writing by Engineer. If within 24 hours after receipt of such notice Contractor shall fail to clean such areas satisfactorily, Owner may have such other agency as he shall designate, perform the work and all costs of such cleaning shall be paid for by Contractor.

6.12 LOADING STRUCTURES

- A. 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.

6.13 PROTECTION OF UTILITIES

- A. When it is possible for construction operations to endanger any public or private utility, conduit, or structure, Contractor shall notify the utility owner of this possibility, and safeguard and support such utilities, conduits, or structures. Where it is the policy of any utility owner to make its own repairs to damaged conduit or other structures, Contractor shall cooperate to the fullest extent with the utility, and he shall see that his operations interfere as little as possible with these operations, and Contractor shall assume the cost of any charge against Owner therefor. In cases where existing Utilities or Utility service connections are encountered, Contractor shall perform his operations in such a manner that service will be uninterrupted, and the cost thereof shall be at Contractor's expense, unless otherwise provided.

6.14 RECORD DOCUMENTS

- A. Contractor shall maintain in a safe place at the Site 1 record copy of all Specifications, Plans, Addenda, Change Orders, Work Change Directives, and Field Orders, in good order and annotated to show all changes made during construction. These record documents together with all Samples and all Shop Drawings shall be available to Engineer for examination and shall be delivered to Engineer for Owner upon completion of the Work.

6.15 SAFETY AND PROTECTION

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. 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 Work Site or who may be affected by the Work,

2. all the Work and materials or 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, and Utilities and not designated for removal, relocation or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them 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, Utilities, and utility owners when prosecution of the Work may affect them.
 - C. Contractor shall restore, at his own expense, any public or private property damaged or injured in consequence of any act or omission on his part, or on the part of his employees or agents, to a condition equal or better than that existing before such injury or damage was done. If Contractor neglects to restore or make good such damages or injury, Owner may, upon 48 hours' notice, proceed to restore or make good such damage or injury and to order the cost thereof deducted from any monies that are due, or may become due, to Contractor for this Work.
 - D. Contractor's duties and responsibilities for the safety and 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 14.11 that the Work is Acceptable.
 - E. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
 - F. 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.
 - G. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with paragraph 14.11 that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
 - H. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

6.16 SAFETY REPRESENTATIVE

- A. Contractor shall be responsible to designate for itself and its employees, and its Subcontractors 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.

6.17 HAZARD COMMUNICATION PROGRAM

- A. Contractor shall be responsible for coordinating any exchange of 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 applicable Laws or Regulations.

6.18 EMERGENCIES

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor, without special instruction or authorization from Owner or Engineer, 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. 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 to document the consequences of such action.

6.19 SHOP DRAWINGS AND SAMPLES

- A. Contractor shall submit Shop Drawings required by the Contract Documents to Engineer for review, in accordance with an accepted schedule. All Submittals will be identified as Engineer may require and in the number of copies specified in the Specifications. The 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 materials and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by paragraph 6.21.
- B. Contractor shall also submit all samples required by the Contract Documents to Engineer for review in accordance with an accepted schedule. Each Sample will be identified clearly 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 6.21. The number of each sample to be submitted will be as specified in the Specifications.

6.20 SUBMITTAL PROCEDURES

- A. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:
 - 1. all field measurements, quantities, dimension, specified performance criteria, installation requirements, manufacturer's recommendations, material, catalog numbers and similar information with respect thereto,
 - 2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and
 - 3. all information relative to Contractor's responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.
- B. Contractor shall have 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.
- C. Each Submittal will bear a stamp or specific written indication that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to review and approval of that Submittal.
- D. At the time of each submission, Contractor shall in writing call Engineer's attention to any deviations that the Shop Drawings or Samples may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review of each such variation.
- E. 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. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
- F. Contractor shall furnish required Submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- G. If Contractor requests a change of a previously approved Submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-

off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

6.21 ENGINEER'S REVIEW

- A. Engineer will review Shop Drawings and Samples in accordance with the Schedule of Submittals accepted by Engineer as required by paragraph 2.05. Engineer's review shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions.
- B. Engineer's review of Shop Drawings or samples shall not relieve Contractor from responsibility for any variations from the Contract Documents unless Contractor has in writing called Engineer's attention to such variation at the time of submission and Engineer has given written concurrence to the specific variation, nor shall any concurrence by Engineer relieve Contractor from responsibility for errors or omissions in the Shop Drawings. Engineer's review shall not relieve Contractor from responsibility for complying with the requirements of paragraph 6.20.
- C. Where a Shop Drawing or sample is required by the Contract Documents or the Schedule of Submittals accepted by Engineer per paragraph 2.05, no related Work shall be commenced until the Submittal has been reviewed by Engineer.

6.22 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 Contractor and Owner may otherwise agree in writing.

6.23 CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

- A. Contractor warrants and guarantees to Owner, Engineer, and Engineer's Consultants that all work will be in accordance with the Contract Documents and will not be defective. Contractor's warranty and guarantee excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or their employees, agents, or representatives, or any person or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- B. 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 of any progress or final payment by Engineer;
 - 3. the issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;
 - 4. use or occupancy of any part of the Work by Owner;
 - 5. any acceptance by Owner or failure to do so;
 - 6. any review or approval of a Shop Drawing or Sample Submittal or the issuance of a notice of acceptability by Engineer per paragraph 14.11;
 - 7. any inspection, test or approval by others; or
 - 8. any correction of defective Work by Owner.

- C. If Contract requires Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned Contract.
- D. Contractor shall assign to Owner all warranties extended to Contractor by material Suppliers and Subcontractors. If an assignment of warranty requires the material Supplier or Subcontractor to consent to same, then Contractor shall secure the material Supplier's or Subcontractor's consent to assign said warranties to Owner.
- E. The warranties provided in this section shall be in addition to, and not in limitation of, any other warranty or remedy required by law.

6.24 INDEMNIFICATION

- A. To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel acceptable to Owner) and hold harmless Owner, Engineer and any additional indemnitees identified in the Supplementary Conditions and their respective directors, officers, members, partners, affiliates, employees, agents and successors, from and against any and all liabilities, claims, causes of action, lawsuits, liens, injuries, damages, losses and expenses (collectively "Demands") to the extent caused by, arising out of, resulting from or occurring in connection with:
 - 1. Contractor's breach of, or failure to comply with, the Agreement, the Contract Documents, or any other contract that it enters into regarding the Work, including any default in performance; or
 - 2. Personal injury or death to any person (including, but not limited to, Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, and material Suppliers) or injury to or destruction of property (including claims for loss of use) caused by, arising out of, resulting from, or in any way connected with
 - a. the Work,
 - b. any activity associated with the Work, or
 - c. the operations or acts of commission or omission of Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, material suppliers, or anyone for whom Contractor is legally liable in the performance of Work, whether arising before or after completion of the Work.
- B. To the extent caused by, arising out of, resulting from, or occurring in connection with the provisions of the above paragraph 6.24.A, Contractor's indemnity obligations under this Agreement shall include, but are not limited to:
 - 1. Indemnity for all damages and judgment interest, all costs and fees, including, but not limited to, all defense costs, expenses and actual attorneys' fees, and all settlement payments relating to, arising out of, resulting from or in any way connected with any demand requiring indemnity by this Agreement;
 - 2. All expenses, including but not limited to, costs, expenses and actual attorneys' fees, incurred in securing and enforcing indemnity from Contractor if Contractor fails or refuses promptly to fulfill any of the indemnity obligations under this Agreement;
 - 3. All indemnification obligations imposed upon Owner or Engineer, or both, arising out of or in connection with the Work; and
 - 4. Indemnification for any penalties and/or fines arising or resulting from Contractor's or any Subcontractor's failure to comply with laws and/or regulations applicable to its/their Work.
- C. Contractor's duty to indemnify under subpart A.2. of paragraph 6.24 is limited to the negligence of Contractor, Contractor's employees, Subcontractors, Subcontractor's employees, material

Suppliers, or anyone for whom Contractor is legally liable in the performance of the Work, whether arising before or after the completion of the Work.

- D. The indemnification rights under this Agreement shall not be construed to negate, abridge, or otherwise reduce any other right or obligations of indemnity which would otherwise exist.
- E. Owner, at its option, may select counsel to defend any demand brought against it without impairing any obligation of Contractor to provide indemnification.
- F. The indemnification provisions under this Agreement shall survive the completion or termination of this Agreement.
- G. In the case of claims by any employee of Contractor, anyone directly or indirectly employed by Contractor, or anyone for whose acts Contractor may be liable, the indemnification obligations under this Agreement 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 under workers' compensation acts. Such obligations shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Agreement.
- H. Indemnification, additional insured and hold harmless obligations of Contractor and Subcontractor under the Contract Documents shall survive the termination of this Agreement.
- I. Contractor and Subcontractors will compel their insurance company to waive subrogation against Owner, Engineer and Contractor and Subcontractors identified as additional insureds in the Contract Documents, including any municipal entity now existing or newly created during the term of the Contract Documents.

6.25 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 or procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, equipment, structures, means, methods, techniques or sequences of construction 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 professional properly licensed in the state in which the project is located, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, 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.
- D. Pursuant to this paragraph 6.25, Engineer's review or 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 or approval of Shop Drawings and other Submittals (except design calculations and design drawings) will be only for the purpose stated in paragraph 6.21.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 7 WORK BY OTHERS

7.01 RELATED WORK AT SITE

- A. In addition to and apart from the Work under the Contract Documents, Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If any part of Contractor's Work depends on proper execution or results upon the work of any such other contractor or utility owner, Contractor shall inspect and promptly report to Engineer in writing any delays, defects or deficiencies in such other work that render it unavailable, or unsuitable for such proper execution and results of Contractor's Work. Contractor's failure to so report shall constitute an acceptance of the other work as fit and proper for integration with Contractor's Work except for latent or non-apparent defects and deficiencies in the other work.
- C. Contractor shall afford each contractor who is party to such a direct contract, and each utility owner, (and Owner, if Owner is performing the additional work with Owner's employees), proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, Contractor shall do all cutting, fitting and patching of Contractor's Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected.
- D. If the performance of additional work by other contractors, utility owner, or Owner was not noted in the Contract Documents, written notice thereof shall be given to Contractor prior to starting any such additional work. If Contractor believes that the performance of such additional work by Owner or others involves additional expense to Contractor, or requires an extension of the Contract Time, Contractor may make a Claim therefor as provided in paragraph 11.01. Claims for delay or inconveniences due to operations of such other parties for work noted in the Contract Documents will not be allowed.

ARTICLE 8 OWNER'S RESPONSIBILITIES

8.01 COMMUNICATION 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 against whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 FURNISHING DATA

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

8.04 PAY WHEN DUE

- A. Owner shall make payments to Contractor promptly after they are due as provided in paragraphs 14.05 and 14.11.

8.05 LANDS AND EASEMENTS; REPORTS AND TESTS

- A. Owner's duties in 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 investigations and tests of subsurface and latent physical conditions at the Site.

8.06 CHANGE ORDERS

- A. In connection with Owner's rights to request changes in the Work in accordance with Article 10, Owner (especially in certain instances as provided in paragraph 10.01) is obligated to execute Change Orders.

8.07 INSPECTIONS, TESTS, AND APPROVALS

- A. Owner's responsibility in respect to certain inspections, tests and approvals is set forth in paragraph 13.02.

8.08 LIMITATION ON OWNER'S RESPONSIBILITY

- A. 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 furnishing or performance of the Work. Owner will not be responsible for Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

8.09 UNDISCLOSED HAZARDOUS MATERIALS

- A. Owner's responsibility in respect of undisclosed Constituents of Concern uncovered or revealed at the Site is set forth in Paragraph 4.06.

8.10 OWNER'S DESIGNATED REPRESENTATIVE

- A. Owner shall designate a person to act as its representatives during the performance of the Work. Owner's designated representative will attend meetings and perform on behalf of Owner all obligations required of Owner under the provisions of the Contract Documents.

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 shall be as set forth in the Contract Documents.

9.02 VISITS TO SITE

- A. Engineer may make visits to the Site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work, and to determine solely for the benefit of Owner, in general, if the Work is proceeding in accordance with the technical requirements of the Contract Documents. It will not be the responsibility of Engineer to make exhaustive or continuous on Site inspections to check the quality or quantity of the Work.

9.03 RESIDENT PROJECT REPRESENTATIVE

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more continuous observation of the Work. A Resident Project Representative will act as directed by and under the supervision of Engineer and will confer with Engineer regarding his actions. Resident Project Representative's dealings in matters pertaining to the on Site Work shall in general be only with Engineer and Contractor, and dealings with Subcontractors shall only be through or with the full knowledge of Contractor. The Resident Project Representative's duties and responsibilities include:
 - 1. Schedules:
 - a. Review the Progress Schedule, Schedule of Submittals and Schedule of Values prepared by Contractor.

2. Conferences:
 - a. Arrange a schedule of progress meetings and other job conferences as required in consultation with Engineer and Owner, and notify those expected to attend in advance.
3. Liaison:
 - a. Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist him in understanding the intent of the technical aspects of the Contract Documents. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on Site operations.
4. Shop Drawings and Samples:
 - a. Advise Engineer and Contractor, or Contractor's superintendent, immediately of the commencement of any Work requiring a Shop Drawing or Sample submission if the submission was identified on the schedule and has not been reviewed by Engineer.
5. Review of Work, Rejection of Defective Work, Inspections, and Tests:
 - a. Conduct on Site observations of the Work and report to Engineer whenever Resident Project Representative believes that technical aspects of any executed Work is unsatisfactory, faulty or defective or does not meet the requirements of any inspections, tests or approval required to be made or has been damaged prior to final payment; and advise Engineer when Resident Project Representative believes that any partially completed portion of the Work should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
 - b. Observe, record and report to Engineer appropriate details relative to test procedures and startups.
 - c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the outcome of these inspections and report to Engineer.
6. Modifications:
 - a. Consider Contractor's suggestions for modifications in Plans or Specifications and report them to Engineer.
7. Reports:
 - a. Prepare periodic reports as required of progress of the Work and Contractor's compliance with the approved Progress Schedule and Schedule of Submittals.
8. Completion:
 - a. Verify that all items on final list of items requiring completion or correction have been completed or corrected and make recommendations to Engineer concerning acceptance.
9. Exceptions:
 - a. Resident Project Representative:
 - 1) Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.
 - 2) Shall not approve or accept any portion of the completed Work.
 - 3) Shall not undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work.
 - 4) Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents.

- 5) Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.
- 6) Shall not advise on or issue directions regarding Contractor's failure to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

9.04 CLARIFICATIONS AND INTERPRETATIONS

- A. Engineer will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents as Engineer may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK - FIELD ORDER

- A. Engineer may authorize minor adjustments in the Work to avoid obstructions or interferences which do not involve an adjustment in the Contract Price or the Contract Time, and which are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and shall be binding on Owner, and also on Contractor who shall perform the change 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 request for a Change Proposal may be made therefore as provided in paragraph 10.06 or a Claim may be submitted as set forth in paragraph 11.01.

9.06 REJECTING DEFECTIVE WORK

- A. Engineer will have authority to disapprove or reject completed portions of the Work which Engineer believes to be defective and 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.

9.07 SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS

- A. Engineer's responsibility for Shop Drawings and samples are set forth in paragraphs 6.19 through 6.21 inclusive.
- B. Engineer's responsibilities as to Change Orders are set forth in Articles 10, 11, and 12.
- C. Engineer's responsibilities in respect of Applications for Payment are set forth in Article 14.

9.08 DETERMINATIONS FOR UNIT PRICE WORK

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review Engineer's preliminary determinations with Contractor 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 10.06.

9.09 DECISIONS ON DISAGREEMENTS, CLAIMS

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work performed thereunder. Claims, disputes and other matters relating to the acceptability of the Work, or the interpretation of the requirements of the Contract Documents pertaining to the execution and progress of the Work, shall be referred initially to Engineer in writing with a request for a formal decision in accordance with this paragraph 9.09.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe 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 11.01.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of paragraph 11.01.

- D. In this capacity 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.

9.10 LIMITATIONS ON ENGINEERS RESPONSIBILITIES

- A. Neither Engineer's authority to act under this Article 9 or elsewhere in the Contract Documents, nor any decision made by Engineer in good faith either to exercise or not exercise such authority, shall give rise to any duty or responsibility of Engineer to Owner or Contractor, any Subcontractor, any manufacturer, fabricator, Supplier, distributor, surety, or any other person, 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 furnishing or performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents. These limitations on authority and responsibility shall also apply to Engineer's Consultant's, Resident Project Representative and assistants.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer will not be responsible to Contractor or any Subcontractor, or Supplier, or to their agents or employees for injuries, damages, claims, losses, or expenses (including attorney's fees) of whatsoever kind resulting from or caused by any act or omission of Engineer in preparation for, arising from, relating to, or concerning the Project. Such acts or omissions include, but are not limited to, Engineer's negligence, tortuous conduct, errors, omissions, strict liability, breach of contract, or breach of warranty. Engineer makes no representations to Contractor, Subcontractors, Suppliers or their agents or employees regarding or respecting any work performed by Engineer in preparation for, arising from, relating to, or concerning the Project.
- E. Neither Contractor, its agents or employees, nor any Subcontractors or Suppliers or their agents or employees, are intended beneficiaries of Engineer's agreement with Owner, nor are such parties intended beneficiaries of Engineer's duties or responsibilities arising therefrom. Engineer disclaims all duties to Contractor, Subcontractors, Suppliers or their agents or employees arising from, relating to, or concerning Engineer's involvement in the Project. Owner and Contractor further agree to notify all Contractor's, Subcontractors or Suppliers of this disclaimer of Engineer's liability and require them to abide by this disclaimer.

ARTICLE 10 AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

10.01 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
1. Change Orders:
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve;
 - 1) the performance or acceptability of the Work,
 - 2) the design (as set forth in the Drawings, Specifications, or otherwise), or

- 3) other engineering or technical matters, without the recommendation of Engineer. Such an amendment shall be set forth in a Change Order.
2. Work Change Directives:
 - a. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including paragraph 10.04 regarding change of Contract Price.
 - b. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the issuance of the Work Change Directive.
 - c. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.
 3. Field Orders:
 - a. Engineer may authorize minor changes in the Work if the changes 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. Such changes will be accomplished by a Field Order and will be binding on Owner and Contractor, which shall perform the Work involved promptly.
 - b. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

10.02 OWNER-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. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive.
- B. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph 10.02 shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

10.03 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, except in the case of an emergency as provided in paragraph 6.18 or in the case of uncovering Work as provided in paragraph 13.03.

10.04 CHANGE OF CONTRACT PRICE

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of paragraph 11.01.

- B. 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, then by application of such Unit Prices to the quantities of the items involved (subject to the provisions of paragraph 12.03); or
 2. where the Work involved is not covered by Unit Prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 10.04.C.2); or
 3. where the Work involved is not covered by Unit Prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in paragraph 12.01) plus a Contractor's fee for overhead and profit (determined as provided in paragraph 10.04.C).
- C. Contractor's Fee: When applicable, 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 paragraph 12.01.B.1 and 12.01.B.2, Contractor's fee shall be 15 percent;
 - b. for costs incurred under paragraph 12.01.B.3, 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 10.04.C.2.a and 10.04.C.2.b is that Contractor's fee shall be based on:
 - 1) a fee of 15 percent of the costs incurred under paragraphs 12.01.B.1 and 12.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and
 - 2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor;
 - 3) provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. no fee shall be payable on the basis of costs itemized under paragraphs 12.01.B.4, 12.01.B.5, and 12.01.C;
 - 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 5 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 10.04.C.2.a through 10.04.C.2.e, inclusive.

10.05 CHANGE OF CONTRACT TIMES

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of paragraph 11.01.

- B. An adjustment of the Contract Times shall be subject to the limitations set forth in paragraph 12.04, concerning delays in Contractor's progress.

10.06 CHANGE PROPOSALS

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seeking other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.
1. Procedures: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 5 days) after the start of the event giving rise thereto, or after such initial decision. Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any) to Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal and consider any comments or response from Owner regarding the Change Proposal.
 2. Engineer's Action: Engineer will review each Change Proposal and, within 30 days after receipt of Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under paragraph 11.01.
 3. Binding Decision: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under paragraph 11.01.
- B. Resolution of Certain Change Proposals: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of paragraph 11.01.

10.07 EXECUTION OF CHANGE ORDERS

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. 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;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are:
 - a. ordered by Owner pursuant to paragraph 10.02,
 - b. required because of Owner's acceptance of defective Work under paragraph 13.08 or Owner's correction of defective Work under paragraph 13.09, or

- c. agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 - 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under paragraph 10.06, or Article 16.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this paragraph 10.07, it shall be deemed to be of full force and effect, as if fully executed.

10.08 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.

ARTICLE 11 CLAIMS

11.01 CLAIMS

- A. Claims Process: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
- 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 10 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. Mediation:
- 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and

decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 16 for final resolution of disputes.
- F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 16 for final resolution of disputes.
- G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 12 COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

12.01 COST OF WORK

- A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this paragraph 12.01 are used to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work 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 12.01.C, 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, and 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. Costs 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 12.01.
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. 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.
 - b. 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.
 - 1) The rental rate established for each piece of Contractor owned equipment, including appurtenances and attachments to the equipment, used will be determined by use of the Rental Rate Blue Book for Construction Equipment, Volume 1, 2 or 3, as applicable; the edition which is current at the time the Work was started will apply. The established rental rate will be equal to the "Monthly" rate divided by 176; modified by the rate adjustment factor and the applicable map adjustment factor, plus the "Estimated Operating Costs per Hour."
 - 2) For equipment not listed in the Rental Rate Blue Book, Volume 1, 2 or 3, the rental rate will be determined by using the rate listed for a similar piece of equipment or by proportioning a rate listed so that the capacity, size, horsepower, and age are properly considered.
 - 3) For equipment for which there are no comparables in the Rental Rate Blue Book, Volume 1, 2 or 3, the monthly rate shall be reasonable, but not more than 5 percent of the current list price, or invoice, of the equipment. The base hourly rate shall then be determined by dividing the monthly rate by 176 to which 20 percent will be added to the sum which will account for adjustments and operating costs.
 - c. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by laws and regulations.
 - d. 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.
 - e. 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 5.03), 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:

- 1) The cost of utilities, fuel, and sanitary facilities at the Site.
- 2) The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. 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, expeditors, 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 12.01.B.1 or specifically covered by paragraph 12.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by 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 paragraph 12.01.B.

D. Contractor's Fee: When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other 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 10.04.C.

E. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 12, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer on a daily basis, an itemized cost breakdown together with supporting data.

12.02 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: Contractor agrees that:
 1. 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
 2. Contractor's costs for unloading and handling of 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: 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.

12.03 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 Proposal.
- 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. Payments to Contractor for Unit Price Work will be based on actual quantities.
- 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. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review Engineer's preliminary determinations with Contractor 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 the following paragraph 12.03.E.
- E. Within 30 days of Engineer's written decision under the preceding paragraph 12.03.D, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking and adjustment in the Contract Price if:
 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimate quantity of such item indicated in the Proposal (in no event will any change in quantities of less than 25% be considered a material or significant change from the estimated quantities); and
 2. there is no corresponding adjustment with respect to any other item of Work.

12.04 DELAYS IN CONTRACTOR'S PROGRESS

- A. If Owner, Engineer, 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 request an equitable adjustment in the Contract Times and Contract Price. However, Contractor's entitlement to an adjustment of the Contract Times or Contract Price is expressly conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. 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. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include only the following:
 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. acts or failures to act of utility owners (other than those performing other works at or adjacent to the Site by arrangement with Owner, as specified in paragraph 7.01); and
 3. acts of war or terrorism.
- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 10.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of paragraph 10.04.
- F. Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised Progress Schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- G. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by paragraphs 4.03 and 4.06.
- H. Paragraph 7.01 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- I. Contractor shall not be entitled to any adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- J. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 5 days of the commencement of the delaying, disrupting, or interfering event.
- K. Where Contractor is prevented from completing any part of the Work within the Contract Time (or Milestones) due to delay beyond the control of both Owner and Contractor, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be Contractor's sole and exclusive remedy for such delay. In no event shall Owner or Engineer be liable to Contractor, any Subcontractor, any Supplier, or any other person or organization, or to any surety or employee or any agent of them, for 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 resulting from:

1. delays caused by or within the control of Contractor (or Subcontractor or Supplier);
 2. delays beyond the control of both Owner and Contractor, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts of neglect by utility owners or other contractors performing other work;
- L. Nor shall Owner or Engineer or each of them be liable to Contractor for any claims, costs, losses or damages sustained by Contractor on or in connection with any other project or anticipated project.
- M. Nothing in this paragraph 12.04 bars a change in Contract Price to compensate Contractor due to delay, interference, or disruption directly attributable to actions or inactions of Owner or anyone for whom Owner is responsible. Except for an adjustment to the Contract Times and Contract Price, Contractor shall not be entitled to and hereby waives any and all damages that it may suffer by reason of such delay or for any Act of God, including but not limited to lost profits, overhead, and other consequential damages.

ARTICLE 13 TESTS AND INSPECTION; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 ACCESS TO WORK

- A. Owner, Engineer and Engineer's representatives, other representatives of Owner, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspection and testing. Contractor shall provide proper and safe conditions for such access and advise Owner and Engineer of Contractor's Site safety procedures and programs so that Owner and Engineer may comply therewith as applicable.

13.02 TESTS AND INSPECTIONS

- A. Contractor shall give Engineer and testing agency at least 24-hour notice, unless otherwise specified, 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. If any Law and Regulation, code, or order of any public body having jurisdiction requires any Work or part thereof to specifically be inspected, tested or approved, Contractor shall assume full responsibility therefor, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval.
- C. Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner's or Engineer's acceptance of a manufacturer, fabricator, Supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.
- D. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by Owner unless otherwise specified.
- E. All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to Owner and Contractor or by Engineer if so specified.
- F. Cost of materials to be used in inspection and transportation costs shall be paid for by Contractor.
- G. Neither observations by Engineer nor inspections, tests or approvals by others shall relieve Contractor from his obligations to perform the Work in accordance with the Contract Documents.

13.03 UNCOVERING WORK

- A. If any Work that is to be tested, inspected or approved is covered without written concurrence of Engineer, or contrary to the written request of Engineer, it shall, if requested by Engineer, be uncovered by Contractor for Engineer's observation. Such uncovering shall be at Contractor's expense unless Contractor has given Engineer timely written notice of his intention to cover such Work and Engineer has not acted with reasonable promptness in response to such notice.
- 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. Except as otherwise specified in paragraph 13.04, the cost of Work shall be paid for as follows:
 - 1. If it is found that such Work is defective, Contractor shall bear all the expenses of such uncovering, exposure, observation, inspection and testing, and of satisfactory reconstruction, (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals) and an appropriate deductive Change Order shall be issued. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, Owner may make a Claim as provided in paragraph 11.01.
 - 2. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, Contractor may make a Claim as provided in paragraph 11.01.

13.04 DEFECTIVE WORK

- A. Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.
- B. Engineer's Authority: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

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 furnish or 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, 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. If required by Engineer or Owner, Contractor shall promptly either correct all defective Work, whether or not fabricated, installed or completed, or if the Work has been rejected by Engineer, remove it from the Site and replace it with non-defective Work. Contractor shall pay all claims, costs, losses, damages and expenses caused by or resulting from such correction or removal (including, but not limited to all costs of repair or replacement of work of others) and shall take no action that would void or otherwise impair Owner's special warranty or guarantee, if any, on such Work.

13.07 GUARANTEE PERIOD

- A. If within 1 year after the date of Substantial Completion (or such longer period of time as may be prescribed by Laws or Regulations or 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, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. repair defective land or areas;

2. correct such defective Work;
 3. if the defective Work has been rejected by Owner, remove it from the Site and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work or the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses, damages and expenses caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement or work of others) shall be paid by Contractor.
- C. Repair or replacements made under the guarantee shall bear an additional 1 year guarantee dated from the acceptance of repair or replacement.

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, also Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, damages and expenses attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness). In such case, if acceptance occurs prior to Engineer's recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate reduction in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount shall 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, or if Contractor fails to perform the Work in accordance with the Contract Documents (including any requirements of the Progress Schedule), Owner may, after 48 hours' written notice to Contractor and his Surety without prejudice to any other remedy he may have, correct and remedy any such deficiency.
- B. In exercising his rights and remedies under this paragraph 13.09, Owner shall proceed expeditiously. To the extent necessary to complete corrective and 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's consultants such access to the Site as may be necessary to enable Owner to exercise his rights and remedies under this paragraph 13.09.
- C. All claims, costs, losses, damages and expenses incurred or sustained by Owner in exercising such rights and remedies shall be charged against Contractor and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. Owner shall be entitled to an appropriate reduction in the Contract Price equivalent to such claims, costs, losses, damages and expenses including 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 Time because of any delay in performance of the Work attributable to the exercise by Owner of Owner's rights under this Article 13.

ARTICLE 14 PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 SCHEDULES

- A. At least 10 days prior to submitting the first Application for Payment, Contractor shall submit to Engineer a final Schedule of Submittals, and, where applicable, a Schedule of Values for the Work. These schedules shall be satisfactory in form and substance to Engineer as provided in Article 2.
- B. The Schedule of Values shall include quantities and unit prices aggregating the Contract Price and shall subdivide the Work into component parts. Each unit cost so established shall include its proportionate share of Contractor's general operating charges such as profit, overhead, supervision, insurance, bond premiums, interest, equipment cost, depreciation and rental, contingencies, expendable tools, equipment and supplies. The total cost of the items and quantities Contractor lists in the Schedule of Values shall equal the total Contract Price established in the Proposal.
- C. The Schedule of Values shall include a complete set of detailed work sheets on bid take off and bid summary covering estimated general conditions expense (field overhead), general overhead, profit mark ups and revisions leading to the final bid amount.
- D. When the Schedule of Values is approved by Engineer, it shall become part of the Agreement and shall be used as the basis for Contractor progress payments.
- E. Progress payments based upon Unit Price Work will be based upon the number of units completed.

14.02 APPLICATION FOR PROGRESS PAYMENT

- A. At least 20 days before each Application for Payment falls due (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment, Contractor's Declaration, Payment Schedule, and updated Progress Schedules indicating the anticipated completion dates of the various stages of the Work and estimated payments during the next 3 months. Contractor's Application for Payment shall be filled out on the form provided in the Contract Documents and signed by Contractor covering the Work completed as of the date of the Application for Payment and accompanied by such supporting documentation as is required by the Contract Documents and as Engineer or Owner may reasonably require. The Payment Schedule shall be on the form provided in the Contract Documents or in a format acceptable to Engineer or Owner. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement shall be required for all Work completed and paid for on previous certificates.
- B. 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 such data, satisfactory to Owner, as will establish Owner's title to the material and equipment and protect Owner's interest therein, including applicable insurance. A receipted vendor's invoice showing the quantities of materials and the amounts paid will be required and shall accompany the Application for Payment.
- C. Retainage with respect to progress payments will be in accordance with paragraph 14.03, and it will be retained until after completion of the entire Work and its final acceptance. When the amount to be retained is reduced to less than 10 percent, Contractor shall file with Owner the written consent of the Surety to such reduction and shall furnish an affidavit that all Contractor's indebtedness by reason of the Contract has been paid.

14.03 RETAINAGE

- A. On Contracts with a dollar value of \$30,000 and greater or on Contracts that provide for more than 3 progress payments, progress payments and retainage shall be governed by the provisions of any statutes, rules or regulations regarding retention and these are incorporated herein by reference and made a part of this Contract.

- B. If there are no statutes, rules, or regulations applicable to retention, retainage shall be 10%, or such an amount as Owner deems necessary.

14.04 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

- A. Engineer will, within 10 days after receipt of each Contractor's Application for Payment and Payment Schedule, including each resubmittal, either indicate in writing a recommendation of payment and present an Engineer's Certificate for Payment to Owner, or may 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.
- B. Engineer's recommendation of any payment requested in Contractor's Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's review of the Contractor's Application for Payment and Certificate for Payment and the accompanying data and schedules, as an experienced and qualified design professional that to the best of Engineer's knowledge, information and belief;
1. the Work has progressed to the point indicated;
 2. the quality of the Work is in accordance with the technical aspects of the Contract Documents subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for any Unit Price Work under paragraph 12.03, and any qualifications stated in the recommendation; and
 3. 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.
- C. However, by recommending any such payment Engineer will not thereby be deemed to have represented that:
1. exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work; or
 2. involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 3. 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.
- D. Neither Engineer's review of Contractor's Work for the purpose of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
1. to supervise, direct or control the Work;
 2. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 3. for the failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of Work;
 4. for any failure of Contractor to perform or furnish Work in accordance with the Contract Documents;
 5. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price;
 6. to determine that title to any Work, materials, or equipment has passed to Owner free and clear of Liens.
- E. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make such representations as stated above to Owner. Engineer

may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

1. the Work is defective, or completed Work has been damaged requiring correction or replacement;
2. the Contract Price has been reduced because of Change Orders;
3. Owner has been required to correct defective Work in accordance with paragraph 13.09, or has accepted defective Work in accordance with paragraph 13.08;
4. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
5. Engineer has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.

14.05 PAYMENT BECOMES DUE

- A. Thirty (30) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of paragraph 14.05.B) become due, (or only if Owner is a public agency, within 15 days after Owner receives the funds which are to be provided by a department or agency of the federal or state government, whichever is later, or in accordance with any time periods required by any applicable statute, rule or regulation) and when due will be paid by Owner to Contractor.
- B. Owner may refuse to make payment of the full amount recommended by Engineer because:
 1. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries,
 2. adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 3. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 4. Contractor has failed to provide and maintain required bonds or insurance;
 5. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 6. Owner has incurred extra charges or engineering costs related to Submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 7. The Work is defective, requiring correction or replacement;
 8. Owner has been required to correct defective Work in accordance with paragraph 13.09, or has accepted defective Work pursuant to paragraph 13.08;
 9. The Contract Price has been reduced by Change Orders;
 10. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 11. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 12. 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;

13. there are other items as set forth in the Contract Documents entitling Owner to a set off against the amount recommended; or
 14. Owner has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.04.E.1 through 14.04.E.5.
- C. 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 corrects, to Owner's satisfaction, the reasons for such action. The reduction imposed shall be binding on Contractor unless Contractor duly submits a Change Proposal contesting the reduction.
- D. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.05.

14.06 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 at the time of payment free and clear of all Liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

14.07 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 and request that Engineer issue a Certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- 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. Once Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary Certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefore. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final Certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary Certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. 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 punch list.

14.08 PARTIAL UTILIZATION

- A. Use by Owner of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:
 - 1. Owner at any time may request Contractor in writing to permit Owner to use any part of the Work which Owner believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If Contractor agrees, Contractor will certify to Owner and Engineer that said part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time thereafter Owner, Contractor and Engineer shall make an inspection of that part of the Work to determine its status of completion.
 - a. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving his reasons therefor.
 - b. If Engineer considers that part of the Work to be substantially complete, Engineer will execute and deliver to Owner and Contractor a certificate to that effect, fixing the date of Substantial Completion for that part of the Work, attaching thereto a punch list of items to be completed or corrected before final payment.
 - 2. Prior to issuing a certificate of Substantial Completion for that part of the Work, Engineer will deliver to Owner and Contractor a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities and insurance for that part of the Work, which shall become binding upon Owner and Contractor at the time of issuing the definitive certificate of Substantial Completion for that part of the Work unless Owner and Contractor shall have otherwise agreed in writing and so informed Engineer.
 - 3. Owner shall have the right to exclude Contractor from any part of the Work which Engineer has so certified to be substantially complete, but Owner shall allow Contractor reasonable access to complete or correct items on the punch list.
 - 4. In lieu of the issuance of a certificate of Substantial Completion as to part of the Work, Owner may take over operation of a facility constituting part of the Work whether or not it is Substantially Complete if such facility is functionally and separately usable; provided that prior to any such takeover, Owner and Contractor have agreed as to the division of responsibilities between Owner and Contractor for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

14.09 FINAL INSPECTION

- A. Upon written notice from Contractor that the Work is complete, Engineer will 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.

14.10 FINAL APPLICATION FOR PAYMENT

- A. After Contractor has completed all corrections to the satisfaction of Engineer and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked up record documents and other documents (all as required by the Contract

Documents), and after Engineer has indicated that the Work is acceptable, subject to the provisions of paragraph 14.13, Contractor may make application for final payment following the procedure for progress payments.

- B. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as Engineer may reasonably require, consent of Surety, if any, to final payment, together with complete and legally effective releases or waivers, satisfactory to Owner, of all Liens arising out of or filed in connection with the Work.
- C. In lieu of the releases or waivers of Lien, if approved by Owner, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or his property might in any way be responsible, have been paid or otherwise satisfied.
- D. If any Subcontractor, manufacturer, fabricator, Supplier or distributor fails to furnish a release or receipt in full, Contractor may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Claim or Lien.

14.11 FINAL PAYMENT AND ACCEPTANCE

- A. 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 (all as required by the Contract Documents), Engineer is satisfied that to the best of Engineer's knowledge, information and belief as a design professional that the Work has been completed and Contractor has fulfilled all of his obligations under the Contract Documents, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's Certificate for Payment and present the application to Owner for payment. At that time Engineer will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of paragraph 14.13.
- B. Otherwise, Engineer will return the Application 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.
- C. If the Application and accompanying documentation are appropriate as to form and substance, Owner shall, within 45 days (or within the time period required by any applicable statute, rule or regulation) after receipt thereof pay Contractor the amount recommended by Engineer less any amounts of Owner claimed set-offs allowed under the Contract Documents, including but not limited to any applicable liquidated damages as determined by Owner. If Owner rejects the Application, Owner shall do so in writing stating the appropriate sections of the Contract Documents upon which the rejection is based. Contractor may take the necessary remedial actions and resubmit the Application.

14.12 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 and recommendation of Engineer, and without terminating the Agreement, 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.

14.13 WAIVER OF CLAIMS

- A. The making and acceptance of final payment shall 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 14.09, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; and shall not constitute a waiver by Owner of any rights in respect of Contractor's existing or continuing obligations under the Contract Documents; and,
2. a waiver of all Claims by Contractor against Owner other than those previously made in writing and still pending in accordance with Article 16.

14.14 LATE PAYMENTS

- A. All monies not paid when due hereunder, except monies involving Federal and/or State Loans, Grants, or other sources which are delinquent because of no fault of Owner, shall bear interest at the maximum rate allowed by law at the time and place of the Project.

ARTICLE 15 SUSPENSION OF WORK AND TERMINATION

15.01 OWNER MAY SUSPEND WORK

- A. Owner may, at any time and without cause, suspend the Work or any portion thereof for a period as Owner may deem necessary by notice in writing to Contractor and Engineer. If it should become necessary to stop work for an indefinite period, Contractor shall store all materials in such manner that they will not become an obstruction, nor become damaged in any way, and Contractor shall take every precaution to prevent damage or deterioration of the Work performed; provide suitable drainage by opening ditches and drains, and erect temporary structures where necessary. Contractor may request an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if he makes a Claim therefor as provided in paragraph 11.01.

15.02 OWNER MAY TERMINATE FOR CAUSE

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 1. Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time;
 2. a petition is filed against Contractor under any chapter of the Bankruptcy Code as now or hereinafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any other federal or state law in effect at the time relating to bankruptcy or insolvency;
 3. Contractor makes a general assignment for the benefit of creditors;
 4. a trustee, receiver, custodian or agent of Contractor is appointed under applicable law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors;
 5. Contractor admits in writing an inability to pay its debts generally as they become due;
 6. Contractor persistently fails 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 2.05 as revised from time to time);
 7. Contractor disregards Laws and Regulations of any public body having jurisdiction;
 8. Contractor disregards the authority of Engineer or Owner; or,
 9. Contractor otherwise violates any provisions of the Contract Documents.

- B. Owner may, after giving Contractor (and the Surety, if there be one) 7 days' written notice, and to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the Site, 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), incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, finish the Work as Owner may deem expedient, and/or enforce the rights available to Owner under any applicable Performance Bond.
- C. In such case, Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, damages and expenses sustained by Owner arising out of or resulting from completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, damages and expenses exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, damages and expenses incurred by Owner will be reviewed as to reasonableness by Engineer and when so approved, incorporated in a Change Order, but when exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Where Contractor's services have been so terminated by Owner, the termination shall not affect any rights or remedies of Owner against Contractor or its Surety then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

15.03 TERMINATION FOR CONVENIENCE

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy, elect to terminate the Agreement. In such case, Contractor shall be paid (without duplication of any items):
 - 1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;
 - 2. for actual 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; and
 - 3. for reasonable expenses directly attributable to protecting work as a result of 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.
- C. Upon such termination, Contractor shall:
 - 1. Immediately discontinue Work on the date and to the extent specified in the notice except to the extent necessary to protect Work in place;
 - 2. Place no further orders for materials, services, or facilities, other than as may be necessary or required for completion of such portion of Work under the Contract that is not terminated;
 - 3. Promptly make every reasonable effort to obtain cancellation upon terms reasonably satisfactory to Owner of all purchase orders and subcontracts to the extent they relate to the performance of Work terminated or assign to Owner those orders and subcontracts and revoke agreements specified in such notice;
 - 4. Reasonably assist Owner, as specifically requested in writing, in the maintenance, protection and disposition of property acquired by Owner under the Contract Documents, as may be necessary;
 - 5. Complete performance of any Work which is not terminated; and
 - 6. Deliver to Owner an affidavit regarding the identity of potential unpaid Subcontractors or Suppliers and the amounts due to each.

15.04 CONTRACTOR MAY STOP WORK OR TERMINATE

- A. If Owner has failed to pay Contractor any sum finally determined to be due in accordance with the time limits specified in paragraph 14.05, Contractor may upon 7 days' written notice to Owner and Engineer, stop the Work until payment of all amounts then due.
- B. If through no act or fault of Contractor, the Work is suspended for a period of more than 90 days by Owner, or under an order of court or other public authority, then Contractor may, upon 7 days written notice to Owner and Engineer and provided Owner or Engineer does not remedy such suspension or failure within that time, terminate the Agreement and recover from Owner payment on the same terms as provided in paragraph 15.03.
- C. The provisions of this paragraph 15.04 shall not relieve Contractor of his obligations under paragraph 6.22 to carry on the Work in accordance with the Progress Schedule and without delay during disputes and disagreements with Owner.

ARTICLE 16 FINAL RESOLUTION OF DISPUTES**16.01 METHODS AND PROCEDURES**

- A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents and arising after final payment has been made.
- B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, the following dispute resolution process shall be followed:
 - a. The parties shall submit the dispute to mediation under the mediation procedures outlined in the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Rules.
 - b. If the dispute is not resolved by mediation, the parties shall proceed to resolve the dispute by arbitration in accordance with the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Association. The decision of the arbitrator(s) shall be final and binding and is enforceable in 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 to Owner, Engineer, or Contractor, it shall be deemed to have been validly given only if delivered:
 - 1. in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended;
 - 2. by registered or certified mail postage prepaid to, the last business address known to the giver of the notice;
 - 3. or delivered in person to such person by a commercial courier service or otherwise to the recipient's place of business; or
 - 4. by secure file transfer with receipt documentation or other document control software.

17.02 COMPUTATION OF TIME

- A. When any period of time is referred to in the Contract Documents by days, it shall 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 shall be omitted from the computation.

17.03 GENERAL

- 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 shall not 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 Law or Regulation, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this paragraph shall 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.
- B. All representations, warranties and guarantees made in the Contract Documents shall survive final payment and termination or completion of this Agreement.

17.04 PROFESSIONAL FEES AND COURT COSTS INCLUDED

- A. Whenever reference is made to "claims, costs, losses, damages and expenses," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

17.05 NONDISCRIMINATION OF EMPLOYMENT

- A. Contractor shall covenant and agree not to discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, sex, age, religion, national origin or ancestry, height, weight, or marital status, or any other classification protected by law, and to require a similar covenant on the part of any Subcontractor employed in the performance of the Contract.

17.06 POST COMPLETION DATE ENGINEERING AND INSPECTION COSTS

- A. All engineering and inspection costs incurred after the specified completion date shall be paid by Contractor to Owner prior to final payment authorization. However, Contractor shall not be charged with any post completion date engineering and inspection costs when the delay in completion of the Work is due to the following and Contractor has promptly given written notice of such delay to Owner or Engineer:
1. to any preference, priority or allocation order duly issued by Owner;
 2. to unforeseeable causes beyond the control and without the fault or negligence of Contractor, including but not restricted to, acts of God, or of the public enemy, acts of Owner, acts of another contractor in the performance of a Contract with Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and,
 3. to any delays of Subcontractors or Suppliers occasioned by any of the causes specified in this Article.
- B. Charges after the specified completion date shall be made at such times and in such amounts as Engineer shall invoice Owner, provided, however said charges shall be in accordance with Engineer's current rate schedule at the time the costs are incurred. Engineering and inspection costs so incurred shall be deducted from Contractor's progress payments.

17.07 WAIVER OF CONSEQUENTIAL DAMAGES

- A. Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract or the Work. This mutual waiver includes but is not limited to:

1. damages incurred by Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
 2. damages incurred by Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit in connection with any other project or anticipated project.
- B. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination or default. Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. Contractor also waives any Claim for consequential damages against Engineer where such Claims arise out of or relate in any way to the Project or the Contract Documents.

17.08NO WAIVER

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

17.09CONTROLLING LAW

- A. This Contract is to be governed by the Law of the state in which the Project is located.

17.10HEADINGS

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

END OF SECTION 00 72 00

**SECTION 00 73 00
SUPPLEMENTARY CONDITIONS**

PART 1 GENERAL

1.01 SUMMARY

- A. These Supplementary Conditions amend and supplement Section 00 72 00 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.
- B. The terms used in these Supplementary Conditions that are defined and have the meanings assigned to them in Section 00 72 00 - General Conditions.

1.02 MODIFICATIONS TO GENERAL CONDITIONS

A. SGC-1.01 Defined Terms

- 1. The definition for "Substantial Completion" in Section 00 72 00 - General Conditions will be revised as follows:

Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by the Engineer's written recommendation of final payment in accordance with Article 14.11 of Section 00 72 00 - General Conditions. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

B. SGC-4.02 Subsurface and Physical Conditions; Investigations and Reports

- 1. In the preparation of Plans and Specifications, the Engineer has relied upon the following reports and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work: Insert Geotechnical Report Reference
- 2. Copies of the following reports and/or tests are attached as Exhibits: Insert Geotechnical Report Reference _____

C. SGC-5.03 Additional Insured

- 1. Add the following language as a new Article 5.03.A.9 of Section 00 72 00 - General Conditions:

City of Taylor, Wade Trim Associates, Inc., Wade Trim Associates, Inc. 's Subconsultant(s), and any other person or entity required to be named as an additional insured under the Contract Documents, including each of the aforementioned's respective parent companies, affiliates, subsidiaries, officers, directors, employees, and agents, are required to be designated as additional insureds on all policies of insurance required by Article 5.03 of the Section 00 72 00 - General Conditions and elsewhere in the Contract Documents (except for Worker's Compensation insurance and Professional Liability insurance, unless otherwise specifically required by the Contract Documents).

D. SGC-5.04 Limits of Liability

- 1. The required limits of liability for insurance coverages requested in Article 5.03 of Section 00 72 00 - General Conditions will be not less than the following:

SGC-5.04.A Worker's Compensation

Coverage A – Compensation: Statutory

Coverage B – Employer’s Liability

Each Accident: \$100,000

Disease – Policy Limit: \$500,000

Disease – Each Employee: \$100,000

SGC-5.04.B Comprehensive General Liability

General Aggregate: \$2,000,000

Products – Com/Ops Aggregate: \$1,000,000

Personal and Advertising Injury: \$1,000,000

Each Occurrence: \$1,000,000

Fire Damage (any one fire): \$100,000

Medical Expense (any one person): \$100,000

SGC-5.04.C Comprehensive Automobile Liability (coverage shall include owned, non-owned and hired autos)

Bodily Injury: \$500,000

Property Damage: \$500,000

or combined single limit: \$1,000,000

SGC-5.04.D Owner’s Protective

Policy to be written with City of Taylor, Michigan, and its Officials, Officers, Agents, Representatives, Employees, Boards, Commissions and Volunteers, as the Insured, and Wade Trim Associates, Inc., and any other entities or Sub-Consultants, as Additional Insured.

General Aggregate:\$2,000,000

Each Occurrence: \$1,000,000

SGC-5.04.E Builder’s Risk-Installation Floater

Cost to Replace at Time of Loss

SGC-5.04.F Umbrella or Excess Liability: \$2,000,000

E. SGC- 12.04 Lump Sum Work

1. Add the following new paragraph after Article 12.03 of Section 00 72 00 - General Conditions, which is to read as follows:

12.04 LUMP SUM WORK

- a. When additional work or deletion of work, which is covered by a lump sum item, is required due to a modification, not a normal overrun or underrun in estimated quantities, payment or credit for the work will be based upon apparent unit prices which will be derived by dividing the lump sum price by the estimated plan quantities.
- b. Renumber subsequent paragraphs accordingly.

F. SGC-18 Liquidated Damages

1. Liquidated damages, if applicable, are referenced in the Proposal and Agreement. The requirements for liquidated damages should be included herein.

ARTICLE 18 LIQUIDATED DAMAGES

- a. If the Contractor fails to Substantially Complete the Work within the Contract Time, or extension of time granted by the Owner, then the Contractor will pay to the Owner the amount for liquidated damages as specified in the Agreement for each calendar day that the Contractor will be in default after the time stipulated in the Contract Documents. The liquidated damages charged will be deducted from the Contractor's progress payments.
- b. Contractor will not be charged with liquidated damages or any excess cost when the delay in Substantial Completion of the Work is due to the following and the Contractor has given written notice of such delay within seven (7) calendar days to Owner or Engineer.
- c. To any preference, priority or allocation order duly issued by the Owner.
- d. To unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a Contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and
- e. To any delays of subcontractors occasioned by any of the causes specified in paragraph "a" and "b" of this Article.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 73 00

**SECTION 00 91 13
ADDENDUM**

To all prospective Bidders and others concerned, YOU ARE HEREBY ADVISED THAT the Contract Documents for the above referenced Project are revised in the following particulars:

Section	Description of Change
Sheet	Description of Change

This Addendum is hereby incorporated into the original Contract Documents for the bidding referred to above and is considered as binding as though originally appearing therein. Receipt of this Addendum must be noted in the place provided in Section 00 42 43 - Proposal, dated _____, 20____.

SECTION 01 11 00 SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

This Project includes enclosing approximately 700 LF of the Frank & Poet Drain on Eureka Road east of Telegraph Road by placing a 700 – ft long by 8-ft long by 22-foot concrete box culvert, improving approximately 3,910 LF of the Drain to create a low flow channel and floodplain terrace within the existing drain channel alignment (with the exception of the realignment at the upstream end of the Project). Drain improvements further include excavation and fill material including rip rap, fabric wrapped soil lifts and plantings in the Drain to construct grade control and the floodplain terrace. The existing Racho Road culvert is to be replaced with a 135-foot long by 8-foot by 22-foot concrete box culvert.

New headwalls at each of the existing culvert crossings throughout the open channel enhancement limits are proposed.

Streetscape improvements throughout the Eureka Road corridor include sidewalk replacements and enhancements, trees and plantings, elevated sidewalks at two overpasses, lighting upgrades (to be completed by DTE) and all related appurtenances.

Two additive alternates are included in the Proposal for construction of new connecting sidewalk adjacent to Meijer and the construction of a new Pergola and related appurtenances in front of Southland Mall.

Off-site mitigation for the Frank & Poet Drain activities includes approximately 400 lineal feet of stream channel restoration, culvert replacement and associated restoration activities at the Lakes of Taylor Golf Course. Coordination with the Lakes of Taylor Golf Course and construction during the off-season will be required.

Communication, schedule, coordination of construction activities and minimization of impact to area businesses and residents are paramount to the Project's success.

Coordination is required with Panhandle Eastern to facilitate construction of a concrete collar protective measure within the Racho Road culvert replacement area. Further coordination is required with the City of Taylor Fire Station No. 3 relative to maintaining emergency access. Access to all businesses must be maintained at all times throughout the entire Project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 50 00 - Temporary Facilities and Controls

1.03 WORK BY OTHERS

- A. Work within the Superior Road and Pardee Road intersection is anticipated to commence in the summer of 2025 Schedules, access and maintenance of traffic activities to be coordinated.
- B. Work within the Lakes of Taylor Golf Course is anticipated to occur during the off-season of 2025/2026. This work includes bridge rehabilitation throughout the Golf Course as well as bunker rehabilitation activities. Schedules and access to be coordinated.
- C. Work on the Telegraph Road Culvert Replacement Project over the Frank and Poet Drain will be ongoing during this project. Contractor will coordinate with the contractor for the Project to ensure the orderly completion of the work, maintenance of traffic coordination and the timely completion of the Contract.
- D. Work on the Eureka Way Sign Project and ADA ramp replacements within the Eureka Road/Telegraph Road intersection will be ongoing during this project. Contractor will coordinate

with the contractor for the Project to ensure the orderly completion of the work, maintenance of traffic coordination and the timely completion of the Contract.

- E. With the anticipated duration of the Project, Contractor should anticipate construction activities within private property throughout the entire Project limits.
- F. It is understood the Downriver Utility Wastewater Authority (DUWA) has projected cleaning and televising of its sanitary sewer located on the north side of Eureka Road within the project area during 2025. The timeframe is not currently known and will require follow-up and coordination.

1.04 RIGHT-OF-WAY JURISDICTION/PERMITS

- A. Eureka and Allen Roads are under the jurisdiction of the Wayne County Department of Public Services.
- B. Telegraph Road is under the jurisdiction of the Michigan Department of Transportation.
- C. Other roads and streets in the vicinity of the Project are under the jurisdiction of the City of Taylor.
- D. The Frank & Poet Drain(s) is under the jurisdiction of Wayne County Department of Public Services and Michigan Department of Environment, Great Lakes, and Energy (EGLE).
- E. The Lakes of Taylor Golf Course is under the Ownership of the City of Taylor.
- F. Work in the Wayne County Department of Public Services right-of-way requires a permit from the Wayne County Department of Public Services. Contractor will obtain the permit and pay all fees in connection with obtaining the permit. The fees for the permit are based upon a permit fee, plan review fee, and an inspection deposit.
 1. The cost of all inspection including any necessary soil compaction tests and concrete testing performed by Wayne County Department of Public Services on this Project will be deducted from the inspection deposit. A cash inspection deposit (along with the permit fee and the plan review fee) will be required to be paid by the Contractor prior to obtaining the permit.
 2. Note: this is only a deposit. The Contractor is cautioned that the deposit is based upon the estimated cost. The actual cost of the inspection fee will be the actual costs incurred by Wayne County Department of Public Services for inspection on the Project. The Contractor will be responsible for any additional costs over and above the fee calculated above and will be refunded any excess amounts.
- G. Soil erosion and sedimentation control is under the jurisdiction of the City of Taylor.
- H. Contractor will secure any permits required by the agency having jurisdiction, will abide by all rules and regulations of each, and will pay all costs in connection with the permits. Contractor will pay for all permit and inspection fees as the agencies may charge to ensure compliance with their requirements.

1.05 COORDINATION

- A. Maintaining access to all properties and businesses throughout the entire project is a priority and a requirement of the Project. Proposed phasing schedules are to be proposed by the Contractor and provided to the Engineer and Owner for review and approval. Construction operations during high volume shopping (Holiday season(s)) should be limited. Construction operations during low-precipitation periods should be considered to limit bypass pumping operations; winter construction should be anticipated for the Racho Road culvert replacement and the Frank & Poet Drain enclosure.
- B. Contractor to coordinate emergency access with City of Taylor Fire Station No. 3 located at 23747 Eureka Road.
- C. A shutoff notice will be delivered by the Contractor to all affected residences and businesses a minimum of two days before any water main is shut off for construction.

- D. Whenever an existing gate valve must be opened or closed, the City of Taylor Water Department will be notified. Valves will be opened or closed only by the City of Taylor Water Department.
- E. While both existing and new fire hydrants are in place, the Contractor will clearly mark those hydrants not in service and notify the City of Taylor Fire Department of hydrants not in service.
- F. It will be the responsibility of the Contractor to coordinate Contractor's operations and those of the Contractor's subcontractors in such a manner so as to avoid interference and delays in the areas of common construction activities.
- G. Replacement of the Racho Road Culvert requires Work to be completed by others, notably Panhandle Eastern Pipe Line Company, LP. Three (3) days of full and complete access to the site will be required with coordination required by the Contractor. Contractor is responsible to divert water as necessary during the three (3) days of Work to enable Panhandle to focus on exposing and inspecting its pipe, pouring the required flowable fill/concrete slab and backfilling. Period of access/Work to be weather appropriate and occur once removals in the area have been completed by the Contractor.
- H. Off-site mitigation construction must be completed in accordance with EGLE requirements, noting completion either to occur concurrent or in advance of activities within Eureka Road.

1.06 CONTRACTOR'S USE OF PREMISES

- A. Contractor will maintain construction operations within the presently existing road rights-of-way and easements throughout the Project area. In the event that the Contractor deems it necessary or advisable to operate beyond the limits of the existing rights-of-way or easements, Contractor will be responsible for making special written agreements with the property owners and will furnish such copies of agreement to the Owner.

1.07 PHOTOGRAPHS

- A. Photographs as specified in Section 01 33 00 - Submittal Procedures will be required for this Project.
- B. An audio/video route survey as specified in Section 01 3300, Submittal Procedures, shall be required for this Project. Complete coverage shall include the entire Eureka Road Corridor project limits and Off-Site Mitigation (Lakes of Taylor) project limits, including any lay down or materials or equipment storage areas.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 11 00

SECTION 01 21 00 ALLOWANCES

PART 1 GENERAL

1.01 GENERAL

- A. Contractor will include Allowance(s) listed in the Bid Proposal that will cover work, manufactured equipment or services that will be provided either by Contractor or by others who may be selected by Owner.
- B. Work performed under Allowances will be subject to Owner approval and under special terms described herein. Contractor will coordinate and cause the work covered by these Allowances.
- C. It is understood that Contractor has included in the Contract Price Allowances so named in the Contract Documents and will cause the work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner.

1.02 REQUIREMENTS

- A. Allowances will be administered in accordance with the provisions of the General Conditions of the Contract. Contractor will be required to coordinate this work with the agency involved and pay costs the agency may charge in connection with this work.
- B. Thereafter, if the actual price for this work is more or less than the allowance, the Contract Price will be adjusted accordingly by Change Order. The adjustment in Contract Price will be made on the basis of the actual invoice price without additional charge or markups for overhead, insurances, bonds, or any other incidental expenses.
- C. Contractor will be responsible for all coordination with the agency involved and for the timely completion of the Work to fit his schedule. Contractor will not be allowed any additional compensation for the failure of the agency involved to meet any schedule.

1.03 DEFINITIONS

- A. Lump Sum Allowance: A monetary sum that includes, as part of the Contract Price, the associated costs and requirements to complete the specified Allowance.
- B. Owner-Controlled Change Allowance: A monetary sum that is, as part of the Contract Price, the sole use of Owner to cover unanticipated costs and will be used only under the direction of Owner.

1.04 SUBMITTALS

- A. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the Site for use in fulfillment of each Allowance.

1.05 INSTRUCTIONS

- A. At the earliest feasible date after Contract Award, Contractor will advise Engineer of the date when the final selection and purchase of each product or system described by an Allowance must be completed in order to avoid delay in performance of the work.
- B. When requested by Engineer, Contractor will obtain Bids for each Allowance for use in making final selections; include recommendations that are relevant to performance of the Work.
- C. Contractor will purchase products and systems as selected by Engineer from the designated Supplier.
- D. Allowances will be used only as directed for Owner's purposes, and only by Change Orders which designate amounts to be charged to the Allowance.

- E. If the actual price for the specified Allowance is more or less than the stated Allowance, the Contract Price will be adjusted accordingly by Change Order. The adjustment in Contract Price will be made in accordance with the General Conditions.
- F. At Project closeout, any amounts remaining in Allowances will be credited to Owner by Change Order.

1.06 SPECIFIC ALLOWANCES

- A. Item 14: Allowance, Irrigation System, Replacements Other Areas, will be paid for at the actual cost as invoiced by the irrigation contractor involved. Price paid will be payment in full for labor, material, and equipment required for repairing of existing irrigation system and replacing it will include, but is not limited to, excavation, protection of remaining system, reinstalling valves, piping, connections, fittings, heads, boxes, and controllers; furnishing and installing new material; removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements; restoration, and other items necessary to complete the job, whether specifically mentioned or implied. The Contractor shall not be allowed any markups from the amount as invoiced by the irrigation company. All costs for coordination, profit, overhead, and the time necessary to obtain irrigation service, shall be incidental to the Project.
- B. Item 16: Allowance Streetscape Lighting Modifications and Replacements, Contractor to Coordinate with DTE. Allowance for utility company service fees will be paid for at the actual cost as invoiced by the utility company involved. The Contractor shall not be allowed any markups from the amount as invoiced by the utility company. All costs for coordination, profit, overhead, and the time necessary to obtain streetscape lighting modifications and replacements shall be incidental to the project.
- C. Item 102: Allowance, Easement Acquisition to cover costs to complete and obtain outstanding easements that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding easement(s) and markups are not allowed. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.
- D. Item 104: Allowance, Permit Fees, Eureka Road Corridor, to cover costs to complete and obtain outstanding permits that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s). The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.
- E. Item 105: Allowance, Contingency, 7.5% of Project Cost, to cover costs to unforeseen work which may arise during the course of construction and will only be used at the Owner's direction.
 - This allowance is for unforeseen work which may arise during the course of construction and will only be used at the Owner's direction.
- F. BASE BID – OFF-SITE MITIGATION (LAKES OF TAYLOR): Item 2: Allowance, Permit Fees, Off-Site Mitigation, Lakes of Taylor, to cover costs to complete and obtain outstanding permits that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s) and no markups are allowed. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

SECTION 01 22 00 UNIT PRICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section describes the method of measurement and basis of payment for items of Work included in the Contract and specified in Section 00 42 43 - Proposal. Contractor will provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.
- B. The scope and quantity of Work estimated in the Proposal is the best estimate of the Engineer. It is anticipated that the quantity of Work to be completed will vary from the estimated quantities in Section 00 42 43 - Proposal.
- C. Owner will make no allowances for items not included in Section 00 42 43 - Proposal.

1.02 ITEMS OF THE PROPOSAL

BASE BID – EUREKA ROAD CORRIDOR

Item 1

Mobilization (5%) will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and equipment necessary for preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of Contractor's, Engineer's, and Owner's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items on the project site. It will also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Mobilization is not to exceed 5% of total contract price.

Item 2

Bypass Pumping, will be paid for at the Contract Unit Price on a Lump Sum basis. Price will be payment in full for labor, material, and equipment required to set up, operate, and maintain bypass pumping as necessary to divert the flow of water or sewage around the section of pipe in which liner preparation and installation is being performed. This pay item will include, but is not limited to, contractor design and sequencing of the by-pass pumping, bulkheads, pumping equipment capable of handling the anticipated flows, stand-by pumps, piping, valves, joints, fittings, thrust and restraint blocks, standby power source, pump operators available 24-hours a day, barricading, restoration, cleanup, and other related appurtenances necessary to complete the job, whether specifically mentioned or implied.

Item 3

Traffic Maintenance and Control will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and equipment required for maintaining traffic, and will include, but is not limited to, furnishing, installing, operating, and maintaining barricades, lighted arrow boards, drums, traffic control devices, signs, channeling devices, cones, flagmen, flag control, pavement markings, warning flashers, concrete barriers, minor traffic devices, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 4

Soil Erosion and Sedimentation Control, Comple will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and

equipment required for furnishing, installing, and maintaining erosion control devices as shown on the plans or as determined by the Engineer and will include, but is not limited to, furnishing, installing, and maintaining, geotextile silt fence, straw bales, sediment traps, filter bags, establishing permanent erosion control, removal of devices, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 5

Culvert, Remove of the size and type specified will be paid for at the Contract Unit Price on a per Linear Foot (LFT) basis. Price paid will be payment in full for labor, material and equipment necessary for removal of culverts, and will include, but is not limited to, excavation, sheeting, shoring, bracing and dewatering, protection of existing improvements, removal and disposal of unsuitable material and debris, removal and disposal of end sections and headwalls, backfill, backfilling, rebuilding and reconnecting live sewers, maintaining a satisfactory sewer bypass service, maintaining drainage, and other items necessary to complete the job, whether specifically mentioned or implied.

Removing culverts will be determined by field measure of storm sewer and culverts removed.

Items 6-7

Concrete Curb and Gutter, Remove will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the removal of concrete curb and gutter, as shown on the Plans or as determined by Engineer, and will include, but is not limited to, saw cutting, removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, backfilling, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of concrete curb and gutter will be determined by field measure of concrete curb and gutter removed.

Item 8

Concrete Pavement, Remove will be paid for at the Contract Unit Price per Square Yard (SY). Price paid will be payment in full for labor, material, and equipment necessary for the removal of concrete pavement in excess of six (6) inches thick, or for the removal of concrete base course with asphalt surfacing in excess of six (6) inches thick, as shown on the Plans or as determined by Engineer. This work will include, but is not limited to saw cutting, removal and disposal of asphaltic surface courses and integral curbs, removal and disposal of unsuitable materials, furnishing, placing, and compacting backfill, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied. Pay item includes removal of composite paving material on Racho Rd.

Measurement for removal of concrete pavement in excess of six (6) inches thick, and for concrete base course with asphalt surfacing will be determined by field measure of concrete pavement or concrete base course with asphalt surfacing removed.

Item 9

Bituminous Pavement, Remove regardless of thickness, will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material and equipment necessary for removing bituminous pavement, and will include, but is not limited to, sawcutting, excavation, protection of existing improvements, removal and disposal of unsuitable material, barricading, miscellaneous restoration or cleanup, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for removal of bituminous pavement will be determined by field measure of bituminous pavement removed.

Item 10

Tree and Stump, Remove will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for the complete removal and disposal of each tree or stump.

Removal and disposal of stumps, hedges, brush, shrubs, roots, and trees having a diameter of less than six (6) inches will be considered incidental to the Project. Removal of trees in clearing and grubbing areas will not be paid for separately.

Item 11

Stump, Remove will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for the complete removal and disposal of each stump.

Item 12

Guardrail, Remove will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for removal of existing guardrail and replacing after construction, as shown on the Plans, or as determined by Engineer. Work will include, but is not limited to, removal guardrails, buffered end sections, end shoes, steel fasteners, specials, wire rope and fittings, reflectorized washers, wood posts, concrete anchorage, furnishing and installing new material for material that could not be salvaged, necessary excavation and backfill, repair of galvanized surfaces, barricading, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of guardrail will be determined by field measure of guardrail removed.

Item 13

Irrigation System, Remove and Replace Southland Mall, will be paid for at the Contract Unit Price on a per Lump Sum basis. Price paid will be payment in full for labor, material, and equipment required for repairing of existing irrigation system and replacing it will include, but is not limited to, excavation, protection of remaining system, reinstalling valves, piping, connections, fittings, heads, boxes, and controllers; furnishing and installing new material; removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements; restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 14

Allowance for Irrigation System Replacements in Other Areas, will be paid for at the actual cost as invoiced by the irrigation contractor involved. Price paid will be payment in full for labor, material, and equipment required for repairing of existing irrigation system and replacing it will include, but is not limited to, excavation, protection of remaining system, reinstalling valves, piping, connections, fittings, heads, boxes, and controllers; furnishing and installing new material; removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements; restoration, and other items necessary to complete the job, whether specifically mentioned or implied. The Contractor shall not be allowed any markups from the amount as invoiced by the irrigation company. All costs for coordination, profit, overhead, and the time necessary to obtain irrigation service, shall be incidental to the Project.

Item 15

Tree Protection Fencing will be paid for at the Contract Unit Price per Linear Foot (LF). Price paid will be payment in full for labor, material, and equipment required for installation of tree protection fencing as specified on plans, and other items necessary to complete the Work, whether specifically mentioned or implied.

Item 16

Allowance, Streetscape Lighting Modifications and Replacements, Contractor to Coordinate with DTE, Allowance for utility company service fees will be paid for at the actual cost as invoiced by the utility company involved. The Contractor shall not be allowed any markups from the amount as invoiced by the utility company. All costs for coordination, profit, overhead, and the time necessary to obtain streetscape lighting modifications and replacements shall be incidental to the project.

Item 17

Split Rail Fence, Remove and Replace will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment required for the removal and disposal of the existing fencing, as shown on the Plans, or as determined by Engineer, and will include, but is not limited to, removal of fencing, gates, and posts, the removal of attached parts and connections, removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements, barricading, furnishing and installing temporary fencing, and other items necessary to complete the job, whether specifically mentioned or implied. Item also includes installation of replacement fence as specified on plans according to manufacturer's instructions.

Measurement for Split Rail Fence, Removal and Replacement will be determined by field measure of fence removed and replaced.

Item 18

Clearing and Grubbing will be paid for at the Contract Unit Price per Acre (Ac). Price paid will be payment in full for labor, material, and equipment necessary for clearing and grubbing and will include, but is not limited to, cutting, chipping, removing and disposing of trees, stumps, brush, hedges, roots, corduroy, logs, matted roots, other vegetation and debris, also the protection of plant life, existing structures and improvements not designated for removal, also the backfill, backfilling of holes, restoration, and for other items necessary to complete the job, whether specifically mentioned or implied.

Clearing and grubbing will be measured in acres, as specified. The area in acres of clearing and grubbing, within the limits shown on the Plans or authorized by Engineer will be computed as the area bounded by the outside line of the trees removed. The length of the clearing and grubbing area will be measured along the road centerline or reference line established by Engineer.

Items 19-22

Excavation, of the type specified on plans, will be paid for at the Contract Unit Price per Cubic Yard (CYD) . Price paid will be payment in full for labor, material, and equipment necessary for excavation to the lines and grades shown on the plans, and will include, but is not limited to, excavation and disposal of unsuitable material including, but not limited to, asphalt pavement, removal of temporary roadway, asphalt approaches and asphalt drives, aggregate surfaces, concrete end headers, rocks, earth, large stones, culverts, sewers, abandoned utilities, structures, the excavation, removal, and stockpiling of topsoil, protecting existing improvements, filling holes and voids with compacted granular backfill, the excavation and disposal of other items exposed in excavating to the subgrade, also for fine grading and compacting the subgrade, barricading, and other items necessary to complete the job, whether specifically mentioned or implied.

Payment for earth excavation will be per cubic yard with the quantity of earth excavation calculated from existing and proposed grades. The quantity paid will be based on plan quantity unless there is a field change which affects the plan quantity. No field measurement for payment of this item will be done at the time of construction.

Item 23

Structural Backfill will be paid for at the Contract Unit Price per Cubic Yard (CYD). Price paid will be payment in full for labor, material, and equipment required for furnishing and installing trench structural backfill, in areas as shown on the plans or as determined by Engineer, and will include, but is not limited to, construction, excavation, protection of existing improvements and utilities, removal and disposal of unsuitable and excess material, miscellaneous restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for trench structural backfill will be per cubic yard determined by certified batch plant delivery tickets submitted to Engineer at the time of placement.

Item 24

Rip-Rap of the size, type, and material specified will be paid for at the Contract Unit Price per Cubic Yard (CYD). Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing riprap, and will include, but is not limited to, necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing riprap, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for riprap will be in square yards determined by field measure of rip-rap in place.

Item 25

Substrate/Channel Fill (Pool Bottom Low Flow Areas, 8" Depth) of the size, type, and material specified will be paid for at the Contract Unit Price per Cubic Yard (CYD). Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing fill, and will include, but is not limited to, necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing fill, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Item 26

Rock Channel Lining, Complete, of the size, type, and material specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing riprap, and will include, but is not limited to, necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing riprap, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for rock channel lining will be in square yards determined by field measure.

Item 27

Rock Grade Control Structure, Complete, of the size, type, and material specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing structure, and will include, but is not limited to, necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing structure, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for rock grade control structure will be in square yards determined by field measure of in place.

Item 28

Fabric Wrapped Low Flow Channel Bank, Complete, of the size, type, and material specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing fabric wrapped low flow channel bank, and will include, but is not limited to,

necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for fabric wrapped channel bank will be in square yards determined by field measure in place.

Item 29

Bituminous Patch to Match Existing Conditions, will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the bituminous pavement patch and will include, but is not limited to, excavation, protection of existing improvements, also compacting and fine grading subgrade, also furnishing, placing and compacting backfill and subbase, also the furnishing, placing, rolling and compacting the various bituminous lifts or courses, also the furnishing and applying of prime and bond coats, barricading, restoration, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for bituminous pavement patch will be determined by field measure of bituminous pavement in place.

Item 30

Road Reconstruction, Racho Rd., of the type and thickness specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the bituminous pavement and will include, but is not limited to, excavation, protection of existing improvements, also compacting and fine grading subgrade, also furnishing, placing and compacting backfill and subbase, also the furnishing, placing, rolling and compacting the various bituminous lifts or courses, also the furnishing and applying of prime and bond coats, barricading, restoration, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for bituminous pavement will be determined by field measure of bituminous pavement in place.

Items 31-32

Pavement, Concrete of the type and thickness specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the concrete pavement and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing and compacting backfill and subbase, also compacting and fine grading subgrade, also the furnishing and installing of hook bolt assemblies, tie bar assemblies, dowel bar assemblies, contraction joint basket assemblies, expansion joint basket assemblies, polyethylene planks, polystyrene or other fillers, hot-poured elastic joint compound, mesh reinforcement, bar mat reinforcement, also forming, placing, jointing, finishing, texturing and curing the concrete, also providing protection against rain and cold weather, also for barricading, restoration, pavement gapping, part width construction, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete pavement will be determined by field measure of concrete in place.

Item 33-34

Curb, Concrete of the type and height specified will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the concrete curb and gutter section and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing, and compacting backfill and subbase, compacting and fine grading subgrade, providing and installing hook bolt assemblies, tie bar assemblies, reinforcing steel, also forming, placing, jointing, finishing, texturing and curing the concrete, providing protection against rain and

cold weather, backfilling, barricading, restoration, gapping, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete curb and gutter will be determined by field measure of curb and gutter in place.

Item 35

Standard Curb and Gutter, Concrete, Racho Road of the type and height specified will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the concrete curb and gutter section and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing, and compacting backfill and subbase, compacting and fine grading subgrade, providing and installing hook bolt assemblies, tie bar assemblies, reinforcing steel, also forming, placing, jointing, finishing, texturing and curing the concrete, providing protection against rain and cold weather, backfilling, barricading, restoration, gapping, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete curb and gutter will be in linear feet, determined by field measure of curb and gutter in place.

Item 36

Crosswalk Restriping of the type, width, and color specified will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for pavement word and/or symbol markings and shall include, but not be limited to, preparation of surface, layout, removing old markings, applying proposed pavement markings, pavement word and/or symbol markings, glass beads, providing temporary barricading, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 37

Sidewalk Ramp, Concrete, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Square Foot (SFT). Price paid shall be payment in full for labor, material, and equipment necessary for sidewalk ramps and shall include, but is not limited to, excavation, construction, protection of existing improvements, undercutting and backfilling the subgrade, compacting and fine grading subgrade, furnishing, placing, and compacting backfill and subbase, construction of expansion joints, also forming, placing, jointing, finishing and curing the concrete, construction of detectable warning, providing protection against rain and cold weather, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for sidewalk ramps will be determined by field measure of sidewalk ramps in place. Sidewalk ramps will be measured from back of curb to the key flag or to the end of the monolithic rolled curb, whichever is less.

Item 38

Fire Hydrant, Salvage, Remove and Replace will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material and equipment necessary to remove and replace fire hydrant, and shall include, but is not limited to, excavation, sheeting, shoring, bracing and dewatering, protection of existing improvements, removal of thrust block, fire hydrant, and valve, capping water main as necessary, furnishing and installing connecting piping and fittings, re-installing fire hydrant and valve, connection to water main (including fittings and appurtenances as necessary), construction of thrust blocks, backfilling, disposal of excess excavated material, restoration, and other items necessary to complete the Work, whether specifically mentioned or implied.

Items 39-40

Railing, of the size, type, and material specified, will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary to install the railing as shown on the Plans or as determined by Engineer, and will include, but is not limited to, the installation of the specified railing, as well as attached parts, connections anchorage; removal and disposal of unsuitable materials; furnishing, protection of existing improvements; barricading; and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for railing will be determined by field measure of railing replaced.

Item 41

Benches, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for installing the benches, as shown on the plans, or as determined by Engineer, and will include, but is not limited to, the installation of the specified benches, as well as attached parts, connections anchorage; removal and disposal of unsuitable materials; furnishing, protection of existing improvements; barricading; and other items necessary to complete the job, whether specifically mentioned or implied.

Item 42

Trash Receptacle, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for installing the litter bins, as shown on the plans, or as determined by Engineer, and will include, but is not limited to, the installation of the specified trash receptacles, as well as attached parts, connections anchorage; removal and disposal of unsuitable materials; furnishing, protection of existing improvements; barricading; and other items necessary to complete the job, whether specifically mentioned or implied.

Item 43

Culvert Bedding, 12" Depth, Complete, of the size, type, and material specified will be paid for at the Contract Unit Price per [Cubic Yard (CYD)]. Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing bedding material, and will include, but is not limited to, necessary sub-grade preparation, removal and disposal of excess and unsuitable material, placing fill, geotextile filter fabric, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for culvert bedding will be in cubic yards determined by field measure of bedding in place.

Items 44-53

Storm Sewers and Culverts, of the type and diameter specified on the Plans, in open cut trench will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid shall be payment in full for labor, material, and equipment necessary for storm sewer pipe and culvert pipe in open cut trench shall include but is not limited to, excavation, sheeting, shoring, bracing, and dewatering, construction, protection of existing improvements, sand backfill, sand, stone or concrete pipe bedding, placing and removing of stoppers and bulkheads, final inspection which includes cleaning, stubs in drainage structures, connection to drainage structures and sewers, end sections, barricading, restoration, cleanup and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for storm sewers and culverts, will be measured per linear feet in place, from center to center of manholes, catch basins, standard inlets, headwalls, or other standard drainage structures, with no deduction in length for intermediate standard structures.

Item 54

Manhole Access on Box Culvert, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for a complete manhole, and shall include, but is not limited to, frame and cover, adjusting rings,

cone section, bottom section, flexible joint connections, excavation, sheeting, shoring and bracing, dewatering, sand backfill and other items necessary to complete the job, whether specifically mentioned or implied.

Items 55-58

Manhole, Standard of the type and diameter indicated, for depths up to eight (8) feet and for the first eight (8) feet of deeper manholes will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for a complete manhole, and shall include, but is not limited to, all excavation, dewatering, construction, frame and cover, adjusting rings, cone section, bottom section, flexible joint connections, sand backfill and other items necessary to complete the job, whether specifically mentioned or implied.

Item 59

Catch Basin Structure, Standard, of the size, type, and material specified will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material and equipment necessary for installation of structure, and will include, but is not limited to, excavation, sheeting, shoring, bracing and dewatering, protection of existing improvements, removal and disposal of unsuitable material and debris, backfill, backfilling, connecting live sewers, providing and maintaining a satisfactory sewer bypass service, maintaining drainage, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 60

Connection to Existing Culvert with Concrete Collar, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for a complete manhole, and shall include, but is not limited to, frame and cover, adjusting rings, cone section, bottom section, flexible joint connections, excavation, sheeting, shoring and bracing, dewatering, sand backfill and other items necessary to complete the job, whether specifically mentioned or implied.

Items 61-62

Remove Existing Headwalls & Wingwalls, of the type and diameter specified on the Plans, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment required for removing end sections and shall include, but is not limited to, excavation, sheeting, shoring and bracing, wood handrail with mesh panel, construction, dewatering, preparation, protection of existing improvements, and other items necessary to complete the job, whether specifically mentioned or implied.

Items 63-67

Headwalls & Wingwalls, of the type and diameter specified on the Plans, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment required for installing end sections and shall include, but is not limited to, excavation, wood handrail with mesh panel, construction, dewatering, preparation, protection of existing improvements, stone pipe bedding, sand backfill, headwall, reinforcement, baffle, mortar, wingwalls, foundation, connection to proposed sewer, backfilling, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 68

Sheet Pile Improvements for Existing Headwalls & Wingwalls will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material and equipment necessary to furnish and install sheet pile steel, and will include, but is not limited to, construction, excavation, furnishing and installing steel post, concrete footing, filling with concrete, painting, and other items necessary to complete the Work, whether specifically mentioned or implied.

Item 69

Lower Existing Water Main, 8" as specified on the plans, will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water main and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess excavated material, temporary blow-offs, thrust blocks, encasement, barricading, restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for water main will be in linear feet along the centerline of the pipe taken from end-to-end with no reduction for fittings and valves.

Item 70

1. **Road Sign, Salvage, Remove and Relocate**, will be paid for at the Contract Unit Price on a per Each basis. Price paid will be payment in full for labor, materials, and equipment required for removing, salvaging, relocating, and reinstalling existing signs as specified on plans, and will include, but is not limited to, removing sign, post, and hardware, construction, furnishing and driving post, backfill, cleanup, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 71

Segmental Retaining Wall, will be paid for at the Contract Unit Price per Square Foot (SFT) of segmental retaining wall in place. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and placing the segmental retaining wall, and shall include, but is not limited to, excavation, subgrade preparation, removal and disposal of excess material, furnishing wall materials, anchors and fasteners, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 72

Restoration, Coir Fiber Matting, Complete, will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment required for furnishing and placing matting, and will include, but is not limited to, construction, preparation of subgrade, securing matting, securing pins and washers, construction of seams, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for fiber matting will be determined by field measure of matting in place. No allowance will be made for material in laps and seams or for securing pins. No measure of nor payment will be made for coir fiber replaced because of defects in manufacture, contamination or damage due to either fault or negligence of Contractor.

Items 73-75

Restoration, Complete, of the type specified will be paid for at the Contract Unit Price per Square Yard (SYD) of area seeded. Price paid shall be payment in full for providing labor, material, and equipment, necessary for seeding and shall include, but is not limited to, soil preparation, providing topsoil, grading, shaping, placing and spreading topsoil, seeding, mulching, mulch anchoring, fertilizing, discing and harrowing, rolling, watering, mowing, lawn establishment, reseeding and other items necessary to complete the job, whether specifically mentioned or implied. Contractor shall seed areas disturbed by Contractor's operations.

Seeding will be field measured by area in Square Yard (for the areas indicated on the plans to be seeded).

Areas disturbed outside of the areas indicated on the plans shall be seeded at Contractor's expense.

Items 76

Restoration Lawn, Complete, of the type specified will be paid for at the Contract Unit Price per Lump Sum of area seeded. Price paid shall be payment in full for providing labor, material, and equipment, necessary for seeding and shall include, but is not limited to, soil preparation, providing topsoil, grading, shaping, placing and spreading topsoil, seeding, mulching, mulch anchoring, fertilizing, discing and harrowing, rolling, watering, mowing, lawn establishment, reseeding and other items necessary to complete the job, whether specifically mentioned or implied. Contractor shall seed areas disturbed by Contractor's operations.

Areas disturbed outside of the areas indicated on the plans shall be seeded at Contractor's expense.

Items 77-98

Tree, of the type and size specified will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for planting specified plant material(s) and shall include, but is not limited to, selection and transporting, protection, hole excavation, pruning, planting, topsoil or planting mixture backfilling, mulching, watering, guying and bracing, wrapping, dressing, warranty of plant material establishment; cleanup and other items necessary to complete the job, whether specifically mentioned or implied.

Item 99

Underpass Structural Repairs will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to complete the construction of underpass structural repairs. Work shall include but is not limited to, all excavation, dewatering, saw cutting and removal of deteriorated concrete and reinforcement steel, forming, installation of reinforcement steel, concrete placement, stripping of the same, barricading, restoration, and all other items necessary to complete the job whether specifically mentioned or implied

Item 100

Underpass Retaining Wall will be paid for at the Contract Unit Price on a Linear Foot basis. Price paid shall be payment in full for all labor, material, and equipment necessary to complete the construction of underpass retaining wall. Work shall include but is not limited to, all excavation, dewatering, forming, installation of reinforcement steel, concrete placement, stripping and backfill, barricading, restoration, and all other items necessary to complete the job whether specifically mentioned or implied.

Item 101

Soil Evaluation will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment required for soil evaluation to confirm soil is suitable for re-installation of fire station mast arm as specified in plans.

Item 102

Allowance, Easement Acquisition to cover costs to complete and obtain outstanding easements that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding easement(s) and markups are not allowed. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.

Item 103

1 Year Maintenance Contract will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment required for maintaining all planted material in a vigorous, healthy, sound growing condition and shall include, but is not limited to, cultivating; weeding; pruning; watering; mowing; fertilizing; mulching; re-guying; repairing or replacing damaged, diseased, dead, or infested plant material; and all other items necessary to complete the job, whether specifically mentioned or implied, for the period of the maintenance contract.

Item 104

Allowance, Permit Fees, Eureka Road Corridor, to cover costs to complete and obtain outstanding permits that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s). The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.

Item 105

Allowance, Contingency, 7.5% of Project Cost, to cover costs to unforeseen work which may arise during the course of construction and will only be used at the Owner's direction.

Item Alternate 1

Meijer Sidewalk-East Connection, will be paid for will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and equipment necessary for the concrete pavement and crosswalk striping as specified on plan sheet C-8.04 and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing and compacting backfill and subbase, also compacting and fine grading subgrade, also the furnishing and installing of hook bolt assemblies, tie bar assemblies, dowel bar assemblies, contraction joint basket assemblies, expansion joint basket assemblies, polyethylene planks, polystyrene or other fillers, hot-poured elastic joint compound, mesh reinforcement, bar mat reinforcement, also forming, placing, jointing, finishing, texturing and curing the concrete, also providing protection against rain and cold weather, also for barricading, restoration, pavement gapping, part width construction, and other items necessary to complete the job, whether specifically mentioned or implied.

Item Alternate 2

Meijer Sidewalk-West Connection, will be paid for will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and equipment necessary for the concrete pavement and crosswalk striping as specified on plan sheet C-8.03 and C-8.04 and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing and compacting backfill and subbase, also compacting and fine grading subgrade, also the furnishing and installing of hook bolt assemblies, tie bar assemblies, dowel bar assemblies, contraction joint basket assemblies, expansion joint basket assemblies, polyethylene planks, polystyrene or other fillers, hot-poured elastic joint compound, mesh reinforcement, bar mat reinforcement, also forming, placing, jointing, finishing, texturing and curing the concrete, also providing protection against rain and cold weather, also for barricading, restoration, pavement gapping, part width construction, and other items necessary to complete the job, whether specifically mentioned or implied.

Item Alternate 3

Pergola and Related Appurtenances, Southland Mall, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for installing the shade structure, as shown on the plans, or as determined by Engineer, and will include, but is not limited to, the installation of the specified shade structure, as well as attached parts,

connections anchorage; labor, material, and equipment necessary for furnishing and pouring the concrete seat wall, base material, excavation, subgrade preparation; removal and disposal of unsuitable materials; furnishing, protection of existing improvements; barricading; and other items necessary to complete the job, whether specifically mentioned or implied.

BASE BID – OFF-SITE MITIGATION (LAKES OF TAYLOR): Item 1

Off-Site Mitigation (Lakes of Taylor), will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for installing the project items as specified in the attached plans, or as determined by Engineer, and will include, but is not limited to, installing approximately 400 lineal feet of stream channel restoration, culvert replacement restoration activities at the Lakes of Taylor Golf Course; bituminous asphalt patching with related base and subbase material; installation of trees, shrubs, and perennial plantings with associated soil; and other items necessary to complete the job, whether specifically mentioned or implied.

BASE BID – OFF-SITE MITIGATION (LAKES OF TAYLOR): Item 2

Allowance, Permit Fees, Off-Site Mitigation, Lakes of Taylor, to cover costs to complete and obtain outstanding permits that are required for the specified Work. Contractor shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s) and no markups are allowed. The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 22 00

SECTION 01 31 19 PROJECT MEETINGS

PART 1 GENERAL

1.01 PRECONSTRUCTION MEETING

- A. Prior to the delivery of materials or the start of any construction, the Contractor will request a Preconstruction Meeting from the Engineer. A minimum three (3) working days' notification to meeting participants will be required.
- B. Schedule:
 - 1. Engineer will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. Contractor will notify major Subcontractors.
- C. Attendance:
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - a. Major Subcontractors
 - 4. Utility Companies
 - 5. Safety Representatives
 - 6. Governmental Agencies
- D. Agenda:
 - 1. Distribution by the Contractor and discussion, review and acceptance of:
 - a. List of names and telephone numbers for superintendent, foreman and other key personnel.
 - b. List of major Subcontractors and Suppliers.
 - c. Projected construction preliminary progress schedules.
 - d. Preliminary schedule of Shop Drawings and Sample submittals.
 - e. Estimated monthly payment schedule and schedule of values
 - 2. Critical Work sequencing.
 - 3. Major equipment deliveries and priorities.
 - 4. Project coordination.
 - 5. Responsibilities of Owner, Engineer, Contractor and other agencies.
 - 6. Procedures and processing of:
 - a. Field decisions.
 - b. Proposal requests.
 - c. Submittals.
 - d. Change Orders.
 - e. Applications for Payment.
 - 7. Adequacy of distribution of Contract Documents.
 - 8. Procedures for maintaining Record Documents.

9. Use of premises.
10. Construction facilities, controls and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.
15. Testing

E. Minutes:

1. Engineer will prepare and distribute copies to participants within seven (7) days of meeting. Participants will report corrections and comments within ten (10) days of receipt of minutes.

1.02 PROGRESS MEETINGS

A. Periodic Progress Meetings will be held as required by the progress of the Work.

B. Schedule:

1. Engineer will establish the meeting place, time and date, distribute agenda, notify participants and administer the meeting. Contractor will notify major Subcontractors.

C. Attendance:

1. Engineer
2. Contractor
3. Subcontractor as appropriate to the agenda.
4. Suppliers as appropriate to the agenda.
5. Others

D. Agenda:

1. Review minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Review field observations, problems, conflicts.
4. Review problems which impede Construction Schedules.
5. Review of off-site fabrication, delivery schedules.
6. Review corrective measures and procedures to regain projected schedule.
7. Review revisions to Construction Schedules.
8. Review plan progress, schedule, during succeeding Work period.
9. Review coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Review maintenance of quality standards.
12. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other Contracts of the Project.
13. Other business.

E. Minutes:

1. Engineer will prepare and distribute copies to participants and the Owner within seven (7) days of meeting for review at the next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 31 19

SECTION 01 32 16 CONSTRUCTION PROJECT SCHEDULE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor will be responsible for the Project construction schedule for the full Contract Time, including without limitation the following:
 - 1. Contractor's construction schedule updates will be submitted on a monthly basis, or as requested by Owner.
 - 2. Contractor's short-term look-ahead schedule submitted at each progress meeting and as required by the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures

1.03 DEFINITIONS

- A. Activity: A discrete part of a project that is identified in the Contractor's planning, scheduling, executing, monitoring, and controlling of the construction Project. Activities included in a construction schedule consume time and resources.
- B. Critical Activity: An activity on the critical path of the construction schedule.
- C. Predecessor Activity: An activity that precedes another activity in the network.
- D. Successor Activity: An activity that follows another activity in the network.
- E. Cost Loading: The allocation to each activity within the Critical Path Method (CPM) Schedule of the portion of the Contract Price reflecting the Contractor's anticipated costs to perform that portion of the Work, including a proportional share of overheads and profit. The sum of costs for all activities must equal the total Contract Sum. The cost loaded CPM Schedule will be referenced to the contract, purchase order line item, and bid breakdown item.
- F. Critical Path Method (CPM): Scheduling method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path to complete the Work of the Project within the specified Contract Times and interim completion milestones.
- G. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- H. Event: The starting or ending point of an activity.
- I. Free Float: is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
- J. Total Float: is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
- K. Contract Float: is the measure, in calendar days, of leeway between the Contractor's anticipated date for completion of all or any part of the Work and the corresponding specified Contract Time regardless of the float values calculated by the software used to produce the CPM Schedule.
- L. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

- M. Work Breakdown Structure (WBS): A deliverable-oriented breakdown of a project into smaller components. A work breakdown structure is a key project deliverable that organizes the team's work into manageable sections.
- N. Detailed Cost Breakdown (DCB): An itemized breakdown of the Work and Contract Amount detailing quantities and dollar amounts for each pay item, developed by summarizing the cost-loaded CPM schedule to a level of detail appropriate for use in progress payment estimates. The sum of all pay items will equal the Contract Price.
- O. Milestone: The date of a significant event, used to monitor schedule performance and define Contract deadlines.
- P. Data Date: The reporting cut-off date through which progress is incorporated into a schedule.
- Q. The term "day" as used in these Contract Documents will mean calendar day unless otherwise specifically designated. Contract Time computations will be made in Days. Total Float and Contract Float values computed in Working Days will be converted to Days when such computations are made for the purpose of calculating changes in Contract Time.

1.04 CPM SCHEDULE

- A. Contractor's approach to prosecution of the Work will be disclosed by submission of computerized, cost-and-resource loaded CPM Schedules as required herein. These requirements are in addition to, and not in limitation of, those imposed elsewhere in the Specifications.
- B. CPM Schedule Submittals are intended to show:
 1. the priority and sequencing by which the Contractor intends to execute the Work (or Work remaining) to comply with the Contract Times, those sequences of Work indicated in or required by the Contract Documents and any other requirements of the Contract Documents;
 2. how the Contractor anticipates foreseeable events, site conditions and all other general, local and prevailing conditions that may in any manner affect cost, progress, schedule, performance and furnishing of the Work;
 3. how the Means and Methods chosen by the Contractor translate into Activities and sequencing;
 4. the actual timing and sequencing of completed Work; and
 5. the allocation of the Contract Price and construction craft labor hours to the Activities.
- C. CPM Schedule will clearly define the prosecution of the Work from Date of Commencement of the Contract Time to Final Completion by using separate CPM Activities for, but not limited to: Notice to Proceed, submittal, resubmittal, review and approval of basis of design, preliminary design and final design (applicable for design/build contracts); construction/installation; permitting (by the Contractor and Owner); workshops (instrumentation, software, and controls), submittal preparation; submittal review and return, resubmission and re-review; mechanical, electrical, controls systems and information systems layout drawings; procurement and fabrication; deliveries to the site or storage; Owner-furnished items or _____; interfaces with other work (other contractors, public utilities, etc.); planned shutdowns or other impacts to Owner's operating equipment or facilities; start-up and testing of the equipment/system; Field Acceptance Test (FAT); Site Acceptance Test (SAT) for controls; Substantial Completion, final inspection; Owner training; O&M and Training Manuals; punch list; final clean-up; submittal of as-built drawings and other record documents; close-out; and Final Completion.
- D. The CPM Schedule will detail CPM Activities and logic ties as required to demonstrate the Contractor's approach to all the Work. CPM Activity durations will equate to the days required to complete the associated Work. Activities shall not combine:
- E. equate to the days required to complete the associated Work. Activities will not combine:

1. separate items of Unit Price or lump sum Work;
 2. distinct classes of Work (e.g., CSI Divisions or equivalent);
 3. Work in separate areas, structures or facilities and, if requested by Engineer, Work in separate locations or elevations within an area, structure or facility; or
 4. rough-in and finish Work.
- F. Start-to-finish relationships and negative lags will not be utilized unless approved in advance by the Engineer. Activities will be cost and resource loaded.
- G. The activities will form a complete network wherein all activities (except for the start and completion milestones) will have at least one predecessor and one successor. Each activity will have as many predecessor or successor activities as is necessary to accurately reflect the requirements to complete the work. The number of activities and level of detail in the schedule will be subject to the Engineer's review.
- H. Schedule calendars must be developed to accurately reflect the working times for each activity based on the specific requirements of the project. If not specified, assume 5 calendar days and 40 hours per week. Observed federal, state and non-work holidays should be included, as appropriate.
- I. Installation CPM Activities will last from fifteen (15) to forty-five (45) days unless a shorter or longer duration is required to properly depict the Work. The schedule will provide not less than thirty (30) days for each submittal review or re-review activity and for each submittal will include separate activities for review, re-submittal, and re-review. Submittal, delivery and start-up CPM Activities may combine materials and equipment in the same class of Work, based on the detail of related installation CPM Activities. Furnish, install, and test will be separate activities. Contractor will include weather contingencies and other anticipated/foreseeable events/conditions in the schedule and the schedule narrative.
- J. Contractor will refrain from constraining activity dates in the schedule other than Contract milestones. If the Contractor feels constraints are necessary, the Contractor will detail the reasons for the constraints to the Engineer and in the schedule narrative and will require approval of their use.
- K. Activities will be assigned consistent descriptions, activity identification, Work Breakdown Structure, and activity codes consistent with schemes provided by the Engineer or, if none is provided, with the Engineer's approval. For each activity, separate activity codes will be provided for work location, phase of work, responsible firm (Contractor, a Subcontractor or a Supplier), system, specification section, and DCB item. Constraint dates/basis will be explained.
- L. Owner maintains an Integrated Master Schedule (IMS) that includes all activities in the Capital Improvement Plan (CIP). Contractor's construction schedules are a key component to maintaining the IMS. In order to create uniformity in the data presented, the following fields must be standardized for all schedules: WBS (location, division, and specification section), Activity IDs, Activity Names, Calendars, Activity Codes, Resource Naming Convention, Data Dates, Monthly Reporting Requirements, and Approved cost loading). The standardization approach for these items will be provided in Appendix A or provided by the Engineer.
- M. The CPM Schedule will be prepared using the latest version of Oracle Corporation Primavera P6 Project Management Software unless the Engineer determines that integration with the IMS is not required, in which case Microsoft Project may be used for Contracts valued at less than one million dollars provided that CPM schedule integrity is maintained as specified herein, or graphical Microsoft Excel schedules may be utilized for Contracts valued at less than \$500,000. Unless otherwise approved by the Engineer CPM schedule calculations will be performed:
1. utilizing retained logic in lieu of progress override;
 2. using expected finish dates;
 3. with critical activities defined as the longest path;

4. with total float defined as the smallest of start float or finish float; and
 5. with the predecessor calendar used for lags.
- N. In preparing CPM Schedules, it is the Contractor's responsibility to:
1. request interpretations from the Engineer, as warranted
 2. point out to the Engineer, by specific, separate notation, any aspects of the CPM Schedule that may reflect variations from the Contract Documents
 3. work with Subcontractors and Suppliers in finalizing Activities and logic ties.
- O. Early Dates in the CPM Schedule will be based on proceeding with all or part of the Work exactly on the date when the corresponding Contract Time commences to run. Late Dates will be based on completing all or part of the Work exactly on the corresponding Contract Time, regardless of whether the Contractor anticipates early completion or not. If sequences of Work are indicated in or required by the Contract Documents, the CPM Schedule will show in detail the Contractor's approach to conforming with those sequences.
- P. A narrative will accompany all CPM Schedule Submittals which will:
1. Discuss the Contractor's planning and approach to the Project and any changes therein;
 2. Identify planned staffing, resources, and work hours;
 3. Identify the basis for any constraints incorporated into the CPM schedule;
 4. Itemize shifts, non-Working Days and any multiple calendars applied to the CPM Activities;
 5. Compare current activity dates and the Contract Times;
 6. Recap progress and days gained or lost vs. the As-Planned Schedule;
 7. Provide activity reporting based on the CPM Schedule discussing progress by CPM Activity;
 8. Detail Contractor's Site Management Plan, Construction Equipment Usage, Labor Buildup over first three months and de-staffing plans (when applicable);
 9. Describe all changes in resources to be used on remaining Work;
 10. Identify delays and causes and any actions taken to mitigate impact;
 11. Explain the basis for any logic ties other than finish-to-start (FS), and for each lag incorporated into the schedule;
 12. Define abbreviations used in the schedule;
 13. Itemize any revisions made in the activities or Work sequences, and
 14. Identify all approved logic changes.
- Q. The narrative will include monthly and cumulative plots of planned and actual manpower and payments, in a form acceptable to the Engineer, comparing the Contractor's anticipated rate of progress in the most current CPM Schedule Submittal and that anticipated in the As-Planned Schedule.
- R. CPM Schedule Submittals will include:
1. Electronic copies of the Contractor's native P6 schedule files (.xer);
 2. A narrative;
 3. Activity report/Gantt charts including CPM Activity code, description, duration, calendar, Early and Late Dates (calendar dates), Total Float, labor man-hours, cost, and sort codes. The Late Finish Date (or the Early Start Date) of any CPM Activity highlighting a Contract Time (or commencement of all or any part of the Work) will equal the corresponding

Contract Time (or Contract date). Provide PDF file (11-inch x 17-inch printable, with headers and footers).

4. S-curves showing projected early and late earnings and earnings to date;
 5. Total contract earnings report detailing contract value to date, total contract earnings to date and current period earnings by activity, sorted and subtotaled by responsibility, with actual, early start, early finish, late start and late finish dates;
 6. Total Float report
 7. Critical path
 8. Other reports and Gantt charts as designated by the Engineer
 9. Three (3) color copies and an electronic pdf copy of all of the above items.
 10. Critical paths with zero or negative Total Float will be shown in red. If the Contractor plans to finish the work earlier than the Substantial Completion Date and Final Completion Date, then the activities with minimum Total Float will be identified in red color as the near critical path.
 11. Schedule update reports will include the prior update baseline.
- S. Each CPM Schedule Submittal will bear the Contractor's stamp or written indication of approval as representation to the Owner that the Contractor has determined or verified all data on that CPM Schedule, and that the Contractor and the Subcontractors and Suppliers have reviewed and coordinated the sequences in that CPM Schedule with the requirements of the Work. CPM Schedule Submittals are not Contract Documents.
- T. Owner's review of CPM Schedule Submittals may result in comments relating to conformance with:
1. the Contract Times,
 2. those sequences of Work indicated in or required by the Contract Documents
 3. any other Contract Document requirements that may have a significant bearing on the use of CPM Schedule Submittals to resolve issues affecting Contract Price and/or Contract Time. The review of CPM Schedule Updates may, in addition result in comments as to whether the Contractor's scheduling of Work remaining continues to conform with the Contract Times and those sequences of Work indicated in or required by the Contract Documents. Review comments may also respond to Contractor's proposed schedule recovery plans, when and as appropriate, and to Contractor requests for extensions in Contract Time. CPM Schedule review comments may also result in the selection of Targets and recording of Target Times.
- U. The review of CPM Schedule Updates may, in addition result in comments as to whether the Contractor's scheduling of Work remaining continues to conform with the Contract Times and those sequences of Work indicated in or required by the Contract Documents. Review comments may also respond to Contractor's proposed schedule recovery plans, when and as appropriate, and to Contractor requests for extensions in Contract Time. CPM Schedule review comments may also result in the selection of Targets and recording of Target Times.
- V. No CPM Schedule review by the Engineer will relieve the Contractor from the responsibility to:
1. comply with the Contract Times and any sequences of Work indicated in or required by the Contract Documents
 2. complete omitted Work within the Contract Times.
- Nor will any such CPM Schedule review by the Engineer lead to approval of, or consent to, any variation from the Contract Documents.
- W. CPM Schedule reviews will not impose on the Owner any responsibility for:

1. the means, methods, sequences or techniques by which the Contractor plans and executes the Work;
2. verifying whether Work is omitted;
3. Activity durations are reasonable;
4. the adequacy of the level of labor, materials and construction equipment;
5. the reasonableness of the Contractor's chosen Means and Methods; or
6. whether Work sequences and Activity timing are practicable.

Even if any comments or objections are noted from the reviews of CPM Schedule Submittals, no such reviews or objections noted will be effective or construed to create or impose on the Owner or Engineer any responsibility for the timing, planning, scheduling or execution of the Work or for the correctness of any such CPM Schedule details. The correctness of the CPM Schedule will remain the sole responsibility of the Contractor.

- X. The initial CPM Schedule is known as Revision 0 (Rev. 0) and, once approved by the Engineer, becomes the As-Planned Schedule and the initial Record Baseline Schedule. Within 30 days following the Contract Start Work Date, Contractor will provide the Rev. 0 cost-loaded CPM Schedule Submittal and a list of all project submittals for Engineer's review and approval.
1. The Rev. 0 Submittal will reflect Contractor's plan for the Work as awarded in full accordance with the Contract, and will not include any delays, changes, Change Orders, Construction Change Directives or substitutions, or "or-equals". Activity durations and Work sequences in the CPM Schedule Rev. 0 Submittal will be based on furnishing named or specified materials/equipment nominated in the Contract and the means and methods indicated in or required by the Contract Documents. No activity durations or Work sequences in the Rev. 0 CPM Schedule will be based on or-equals or substitutions even if the Contractor intends to pursue such under the provisions of the Specifications. Any additional modifications to the contract dates, scope, or costs are managed through approval of subsequent CPM Schedule Submittals.
 2. Contractor will cause Work covered by Allowances as well as specified Unit Price Work and contingent Unit Price Work to be done within the Contract Times. Contractor will be responsible for completing, within the Contract Time for Substantial Completion, up to one hundred twenty-five percent (125%) of the estimated quantities for each specified item of Unit Price Work. The CPM Schedule will incorporate within the limits of the Contract Times:
 - a. Contractor's best estimate of the activities and logic ties required by Cash Allowances and Work to be authorized under any Provisionary Allowances and under any contingent Unit Price Work; and,
 - b. Activities relating to requisite tasks of Owner, and to interfaces with other work, based on the information given in the Contract Documents, and if not given, as indicated by the Engineer. Provisionary Allowance activity will be for the entire duration of the Contract. In any case, Contractor will allow not less than the times indicated in the Contract, or if no times are indicated, 15 days or such greater time as is reasonable under the circumstances for each required action by Engineer, Owner or other contractors.
 - c. The Rev. 0 schedule will allow sufficient time to accommodate Owner activities as well as time for facility operational constraints that may affect the ability to obtain equipment shutdowns. Required durations for Owner submittal review will be not less than those referenced in Section 01 33 00 - Submittal Procedures.
 - d. Planned durations for weather-exposed activities will include sufficient time allowances to accommodate without delay the loss, within each calendar month, of not less than the number of work-days specified below due solely to adverse weather.

Monthly Required Allowance for Workdays Lost Due to Adverse Weather											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	5	5	6	6	6	8	5	8	4	5	4

No extension in Contract Time will be justified due to adverse weather except to the extent that the number of work days lost in a calendar month due solely to adverse weather exceeds the number of days specified in the table above.

3. Contractor will cost and resource load the activities within the CPM schedule by allocating to each activity the applicable portion of the Contract Price proportionate to the Work required to perform the activity. The cost-loaded CPM Schedule will tabulate schedule activity number, quantities (for Unit Price Items), required craft labor hours, and activity cost value for each activity. Contractor may add non-work activities to the CPM schedule as necessary to account for all elements within the total Contract price. Activities for submittals and other non-construction activities (excluding mobilization and design deliverables under design/build delivery) will not be cost-loaded within the CPM Schedule. Activities for bonds, builders risk insurance and stored materials will be cost loaded at invoiced cost (excluding any general conditions, overheads or profit). The cost-loaded schedule will include activities and costs for specific deliverables within the following categories: (a) CPM schedules; (b) testing, start-up, commissioning; (c) operation and maintenance manuals; (d) training; (e) delivery of updated as-built record documents; (f) clean-up, and (g) punch list work for each trade or subcontractor in an amount not less than 1% of the total Work of that trade or subcontractor. The aggregate total of all activity costs within the cost-loaded schedule will equal the Contract Price. Delivery activities will be cost loaded if the Contractor intends to request payment for materials properly stored on-site. Costs shown for each activity in the cost-loaded CPM Schedule will reflect a share of the Contract Price that is proportionate to the estimated costs to perform the associated Work, including a proportional share of Contractor's and subcontractor's mark-ups, and will be an accurate and correct allocation of the Contract Price.
4. Unless otherwise approved by the Engineer activity cost amounts within the cost-loaded schedule will be summarized into payment items comprising a Detailed Cost Breakdown (DCB) to be used to prepare Progress Payment Estimates. In such case each schedule activity will be cross-referenced to one and only one summary payment item through assignment of a payment item code. A single DCB payment item may include one or more schedule activities. The aggregate total of all DCB payment items will equal the Contract Price. Separate DCB items and cost-loaded schedule activities will be provided for furnishing, installing and testing of equipment.
5. The cost-loaded CPM Schedule and DCB will be submitted for Engineer's review and approval in accordance with the requirements of the General Conditions and will:
 - a. show the allocation of the Contract Price among activities representing the various components of the Work, in sufficient detail as the Engineer may require;
 - b. divide the Work into activities by significant Sections of the Specifications within areas, structures and Facilities, or Work Breakdowns, or vice versa;
 - c. identify total amounts for each Work activity;
 - d. segregate work by the various subcontractors and identify the subcontractor performing each element of the work; and
 - e. for Unit Price Items only, tabulate quantities and unit prices.
6. Contractor will hold a baseline schedule presentation meeting for the Owner and Engineer. This meeting is meant for the Contractor to present, in detail, the schedule plan.
 - a. Examples of items for presentation include but are not limited to work breakdown structure, a description of each activity name, basis for durations, general work

sequence, the critical path, and weather assumptions. This meeting could also take place during schedule updates, if requested.

7. **The first Progress Payment will not be finalized until the Engineer returns to the Contractor the Rev. 0 CPM Schedule Submittal (including the DCB) as "Approved" or "Approved As Noted."** Once the Rev. 0, or Rev. 0A, etc. CPM Schedule Submittal is returned by the Engineer as "Approved" or "Approved As Noted", it will represent the As-Planned Schedule, and will be used for Payment Submittals until revisions to the CPM Schedule are approved by the Engineer. If Engineer does not approve the cost-loaded CPM Schedule or the DCB, Contractor will address Engineer's comments, revise and resubmit until approved by the Engineer. The cost-loaded CPM Schedule report and the DCB will include spaces for signatures of Engineer and Contractor to confirm the approval of each party. Once the Rev. 0 cost-loaded CPM Schedule and DCB are approved, the Contractor will not modify any activity value or pay item, unless otherwise authorized by the Engineer in writing. Engineer may require reallocation of costs for uninstalled material, amounts not expended for bonds or insurances, or to properly reflect authorized Construction Change Directives or Change Orders. Contractor represents and warrants to Owner that the final cost-loaded CPM Schedule and DCB provide an accurate and correct allocation of the Contract Price.
8. CPM Schedule Updates. After approval of the Rev. 0 CPM Schedule Contractor will update the CPM Schedule monthly (or at shorter intervals if deemed necessary by the Engineer) using as a data date the first day of each calendar month. Each CPM Schedule Update will show the actual status of the Project as of the date of the updated CPM Schedule. CPM Schedule Updates will progress the Record Schedule, and will be due five (5) days after the closing of each Progress Payment period, whether the As-Planned Schedule has been established or not. Each CPM Schedule Update submittal will be accompanied by the following power point slides in a format acceptable to the Engineer: (1) Project milestone date trending; (2) Summary schedule; (3) Project activity progress (number of activities earlier or later than scheduled last month); (4) Project total float (mean and median total float trend each month); (5) Labor hour resources planned loading each month; and Actual Labor Count weekly history (from daily reports).
 - a. Each update will include the actual dates each activity is commenced and the date that the activity is completed sufficiently to allow subsequent activities to commence, delays and other significant events occurring since the previous Payment Submittal.
 - b. Contractor may revise schedule logic in each CPM Schedule Update provided that such revisions comply with Contract requirements, are identified in the accompanying narrative, and are acceptable to Engineer. Schedule logic and/or activities will be revised as necessary to accurately address out-of-sequence progress (e.g., successor activities started before completion of predecessor).
 - c. Subject to review and approval of Engineer, Contractor will update the physical percent complete for each activity started or in progress, based on realistic assessment of earned value and work remaining. Contractor will revise percent complete as required by Engineer. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. Punch list activities may be declared 100 percent complete upon completion and correction of punch list work identified during Owner's pre-final inspection.
 - d. Contractor will include the CPM Schedule Update with its monthly Payment Submittal, which will also include Contractor's certification that it has not been delayed or adversely impacted, as of the cut-off date, by any acts or omissions of Owner or Engineer, except as otherwise specifically stated.
 - e. The most recent CPM Schedule "Approved" or "Approved as Noted" by the Engineer will be the current Record Schedule and will be used by the Owner and Contractor to

monitor progress against Contract Times and resolve issues affecting Contract Prices and Contract Times and the assessment of liquidated damages.

- f. If the Early Dates in any CPM Schedule update submittal forecast any slippage in the Contract Times, the Contractor will indicate such overrun(s) by reporting negative Total Floats. Owner reserves the right not to approve schedules that do not reflect completion within the Contract Time.
- 9. Short-term look-ahead Schedules will subdivide CPM Activities into detailed tasks and cover the prior two (2) weeks and the next four (4) weeks. Each installation task will be cross-referenced to a CPM Activity and will not combine the Work for more than one crew.
- 10. Submittals will segregate preparation from review and will not combine items furnished by separate Suppliers.

1.05 CONTRACTOR'S SCHEDULER

- A. Contractor will appoint a project scheduler with the following minimum qualifications (unless otherwise modified by the Owner or Engineer): At least five years of experience using a recent version of Primavera P6 Professional Project Management software, and scheduling for at least three construction projects with cost and responsibility loaded CPM schedules. If the appointed project scheduler fails to perform to an adequate professional and technical standard or if Engineer, in the reasonable exercise of its discretion, objects to the appointed project scheduler, the Contractor will use a replacement project scheduler having the required qualifications, at no increase in Contract Price and/or Contract Time. Submit the scheduler qualifications and experience for Engineer review and approval.
- B. Contractor's scheduler will prepare the Baseline schedule, all schedule updates, look ahead schedules, time impact analysis, and recovery schedules required by the Contract Documents. Contractor's scheduler will attend all project meetings where scheduling input is necessary, as well as attend the meetings and perform the duties set out in the other Contract Documents. Owner and Engineer will be invited to all Contractor Scheduling meetings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROGRESS AND COMPLETION

- A. Time limits stated in the Contract Documents are of the essence of the Agreement. Contractor will begin the Work on the date of commencement indicated in the Notice to Proceed. It will carry the Work forward expeditiously with adequate resources, will at all times adhere to the CPM Schedule, and will achieve Substantial Completion and Final Completion within the time limits set forth in Project Calendar stated in the Contract Documents, as extended by change orders.
- B. The construction and completion of the Project will be undertaken and completed in accordance with the cost loaded CPM Schedule described in the Contract Documents. The parties will use the CPM Schedule for planning and monitoring the progress of the Work. If the Contractor will fail to adhere to the CPM Schedule, as revised pursuant to the Contract, it must promptly request Engineer's approval to work outside of normal working hours and will work such additional time over regular hours, including Saturdays, Sundays and holidays and/or supply such additional workmen as may be required to bring the Work on schedule, without additional cost or expense to Owner, including claims for inefficiency due to the use of overtime. In the event of such failure of Contractor to adhere to the CPM Schedule, Contractor may alternatively propose revisions to the CPM schedule to recover the delay for Engineer's review and approval. If Engineer agrees that such revisions are feasible and likely to recover the delay, Contractor will promptly implement the measures necessary to recover the delay.
- C. If Contractor is late in achieving Substantial Completion, Final Completion, or if Contractor fails to adhere to the approved CPM Schedule or submits a CPM Schedule update which forecasts

delay in achieving any of the Contract Times, or if Engineer reasonably determines based on an evaluation of Contractor's rate of progress that there is a substantial probability of delay in achieving any of the Contract Times, Engineer may provide Contractor a notice to cure, request that Contractor submit a schedule recovery plan, and withhold liquidated damages in accordance with the applicable provisions of the Agreement.

- D. Upon receipt of a request for a schedule recovery plan:
1. To the extent that Contractor believes that it is entitled to an increase in Contract Time under the terms of the Contract, Contractor will comply with paragraphs 3.02 and 3.03 in providing notice, demonstration of entitlement, delay analysis, and supporting documentation demonstrating the number of days of Contract Time extension to which Contractor believes it is entitled.
 2. To the extent that delay exceeds any time extension to which Contractor is entitled, Contractor will submit a schedule recovery plan and immediately take measures necessary to recover delay. Contractor's schedule recovery plan will describe the cause of schedule slippage or delayed progress and the actions proposed and taken by the Contractor to recover schedule. Contractor will meet with the Engineer and present the Contractor's written schedule recovery plan. If, upon evaluation of the Contractor's schedule recovery plan, the Engineer determines that there is sufficient cause to withhold liquidated damages, the Owner may deduct from Requests for Payment the Owner's estimate of the liquidated damages then due using the Engineer's estimate of late completion of the Work.
- E. Contractor will carry on the Work with due diligence during all disputes or disagreements with the Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements. Contractor will exercise reasonable precautions, efforts and measures to avoid or mitigate situations that would cause Delays.

3.02 SUSPENSIONS AND DELAYS

- A. In accordance with the General Conditions the Engineer may order the Contractor in writing to suspend, defer, stop, delay, interrupt, slow down, or extend all or any part of the Work for such period as it may determine to be appropriate for the convenience of Owner.
1. To the extent practical, the Contractor will consult with Engineer and will mitigate the cost of suspensions and delays by reducing the size of its Project staff and demobilizing equipment to the extent practicable upon notice from the Engineer of any Owner caused delay or interruption which is likely to exceed seven (7) days. Upon the termination of the delay or as otherwise directed by Owner, the Contractor will restore the Project staff to the appropriate size.
- B. Contractor will provide Owner the opportunity to prevent or mitigate delays by Contractor's promptly furnishing of written notice of potential delay to Engineer before Contractor incurs actual delay or additional costs, and in any case not later than three (3) days after the occurrence of any of the following that Contractor believes: (a) to be within the responsibility of the Owner, and (b) may result in critical path delay to any of the Contract Times required by the Project Calendar included in the Contract Documents:
1. (i) Construction Change Directives or Change Orders issued by Owner; (ii) the Contractor receives a notice of a change in the Agreement or extra work to be performed; (iii) the Engineer provides a clarification or notice of a no-cost change or minor change as provided in the General Conditions; or (iv) Owner or Engineer directs a change in the Work in accordance with the changes provisions of the General Conditions that Contractor believes will result in critical path delay to any Contract Time;
 2. Contractor encounters concealed conditions in accordance with the provisions of the General Conditions that it believes will result in critical path delay to any Contract Time;
 3. Contractor believes that any act or failure to act by Owner or Engineer or any of Owner's other contractors or consultants, or any variation in quantities for unit price work, will cause

performance of all or any part of the Work to be delayed, deferred, stopped, slowed down, suspended or interrupted beyond the reasonable time for such actions as allowed under the Contract Documents and the CPM schedule, resulting in potential critical path delay to any Contract Time.

- C. Contractor will promptly provide written notice to Engineer before Contractor incurs actual delay or additional costs, and in any case not later than three (3) days after the occurrence of any event that (a) is not within the responsibility of either the Owner or the Contractor, and (b) may result in critical path delay to any Contract Time including without limitation:
1. Uncontrollable Circumstance as provided in the General Conditions
 2. Adverse weather within a calendar month that causes the loss of more work-days than specified herein.
 3. Conditions affecting Owner's facilities, that result in constraints to Contractor's work or impede shutdowns of Owner's systems at the times requested by Contractor, including without limitation operational effects of weather, plant conditions, ongoing maintenance, other work affecting available facilities, equipment failures or outages, requirements to maintain sufficient processing capacity, or other regulatory or operational issues affecting Owner's facilities, provided that such conditions are outside the reasonable control and reasonable advance planning of both Owner and Contractor.
 4. Delays caused by regulatory authorities, governmental agencies, public utilities, and other third parties.
- D. Contractor will promptly provide written notice to Engineer, in any case not later than three (3) days, after the start of any delay that is within the responsibility of the Contractor and will immediately take such action as is necessary to mitigate and recover the delay.
1. Contractor will provide notice and promptly take appropriate action to recover schedule whenever the Contractor anticipates, or any CPM Schedule Submittal demonstrates, that the scheduled early completion date for any required CPM Activity has slipped, due to acts or omissions within the control of the Contractor, beyond any Contract Time. If the Contractor is not responsible for such schedule slippage, the Contractor will give prompt written notice of a delay justifying a Contract Time extension in accordance with paragraph 3.02.B or 3.02.C.
 2. If schedule recovery is required, the Contractor will enclose with the next Schedule Update Submittal a schedule recovery plan consisting of (a) a narrative describing the cause of schedule slippage and the actions taken to recover schedule within the shortest reasonable time, and (b) a Recovery Schedule with the corresponding revisions in Activities and logic ties and other adjustments intended to recover the schedule. Appropriate schedule recovery actions may include: assignment of additional labor, Subcontractors or construction equipment; Work during other than normal working hours; resequencing of the Work; increasing the concurrency of sequential Work activities; expediting of Submittals and deliveries; and any combination of any of these or other similar actions. Activity shortening and overlapping will be explained as to their basis (and be supported by increases in resources).
 3. Contractor's failure, refusal or neglect to take appropriate schedule recovery action or, in the alternative, give written notice of a delay with a timely and properly supported Time extension request, and, in either case, to follow up with a timely CPM Schedule will be reasonable evidence that the Contractor is not prosecuting the Work with due diligence. Any such Contractor failure, refusal or neglect will give sufficient basis to the Owner, to elect any of the following:
 - a. demand adequate, written assurance of due performance, as provided in the General Conditions,
 - b. withhold liquidated damages, and

- c. in the Owner's sole discretion, direct alternate schedule recovery actions.
- E. Each Subcontractor will be bound by the foregoing provisions.

3.03 DELAYS AND EXTENSIONS OF TIME

- A. Extensions of the Contract Time will not be granted except as expressly provided for in the General Conditions and this Specification Section.
- B. If the Contractor determines that critical path delay will occur to any Contract Time due to the events identified in paragraphs 3.02.A, 3.02.B or 3.02.C, Contractor may request a commensurate adjustment in the affected Contract Times (but only to the minimum extent reasonably forced on the parties by the event) by submitting to the Engineer a properly supported written request for extension of Time no more than three (3) days after Contractor provides notice of a concealed condition as provided in the General Conditions, or the extent of the delay becomes known, or the Engineer requests such submittal, whichever is sooner, or if the delay continues for more than 30 days, submit requests for Time extension at 30 day intervals until the delay has ended. Requests for Time extension in connection with weather delays will be made on a monthly basis within three (3) days from the end of each month. Claims for adjustment in any of the Contract Times or Contract Price will be waived if not properly submitted in accordance with all requirements of the General Conditions and this Specification Section within the time limit required or if timely notice of delay was not submitted in accordance with paragraphs 3.02.A, 3.02.B or 3.02.C.
- C. No extension in Contract Time will be justified unless the Contractor demonstrates, through a detailed analysis of the CPM Schedule using the procedures specified in this paragraph 3.03, the occurrence of Delay which (a) is not reasonably foreseeable under the circumstances, (b) arises from unforeseeable causes, (c) is not caused in whole or in part by any act or omission within the control of the Contractor, and (d) necessarily extends the Work beyond the overall Contract Time (or a portion of the Work beyond a pertinent Contract Time).
- D. Properly supported requests for extension of Time will include:
 - 1. Explanation of the cause and duration of the delay together with identification of which schedule activities were affected.
 - 2. Justification for entitlement to a time extension under the Contract Documents.
 - 3. Identification of all concurrent delays with an explanation of their causes and which party is responsible for each.
 - 4. Critical path analysis, using the latest Record Schedule approved by the Engineer before the start of the delay, demonstrating the number of calendar days by which each of the Contract Times has been delayed due to each cause. Analysis will be accompanied by native electronic XER files and will be verifiable by an independent, objective evaluation by the Engineer, using the electronic files and data furnished by the Contractor. Unless otherwise required by the Engineer, prospective analysis will be prepared in accordance with AACEI Recommended Protocol RP-29, method implementation protocol MIP-3.6 ("Modeled / Additive / Single Base") and as specified herein, by using the most recent Engineer approved Record Schedule prior to the date that the delay commenced, incorporating any schedule review comments provided by Engineer, then updating the schedule with actual progress to the start of the delay and noting the updated dates calculated for achievement of each of the Contract Times before commencement of the delay.
 - a. Modeling of each delay will be accomplished by inserting into the updated pre- delay Record Schedule appropriate activities for each delay, with duration, constraints and logic accurately reflecting the actual delay and its impact on other activities.
 - b. If more than one delay is concurrently in progress at any time after the start of the delay the analysis will be conducted in the following sequential steps:

- 1) Delays under paragraph 3.02.C will be incorporated into the schedule that also includes the delays under paragraph 3.02.D, a copy of the schedule preserved, and resulting dates calculated for achievement of each of the Contract Times will be noted to determine the extent of delays that are not within the responsibility of the Owner.
 - 2) Using the same schedule containing all delays that are not within the responsibility of the Owner, all delays under paragraphs 3.02.A and 3.02.B will then be incorporated into the schedule, a copy of the schedule preserved, and the resulting further extension evaluated based on the dates calculated for achievement of each of the Contract Times.
- c. Reasonable delay mitigation to the extent commercially practicable will be incorporated into the schedule containing all delays by revising or deleting non- mandatory schedule logic, and increasing activity concurrency where practicable, and noting the resulting dates calculated for achievement of each of the Contract Times reflecting the effects of all schedule delays and commercially practicable mitigation.
 - d. Extensions for each of the Contract Times will not exceed the difference in time between the dates calculated under paragraph 3.03.D.4.c and those calculated under paragraph 3.03.D.4.b.1.
 - e. Unless otherwise required by the Engineer, retrospective delay analysis will be prepared in accordance with AACEI Recommended Protocol RP-29, method implementation protocol MIP-3.9 (“Modeled / Subtractive / Multiple Base”)
- E. Engineer may perform or obtain an independent evaluation of delays. Engineer will review timely submitted, properly supported, requests for extension of Time and will determine the extent to which each of the Contract Times is to be revised by Change Order.
- F. Minor Delays: No adjustment in any of the Contract Times will be justified as a result of (a) any delay of less than twenty-four (24) hours duration, or (b) delays to activities that are not on the critical path controlling the calculated date for achievement of any of the Contract Times, or (c) Contractor’s failure to allow sufficient time in schedules in accordance with contract requirements.
- G. No adjustments to the Contract Price or Contract Time will be made under the provisions of the General Conditions or this paragraph 3.03 for any suspension, delay or interruption (i) to the extent that performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor; or (ii) for which an equitable adjustment is provided or excluded under any other provision of the Agreement. Further, no suspension of Work or delay will justify an increase in Contract Price or Contract Time unless the resulting Delay exceeds the time allowed in the Contract Documents for the act or failure to act.
- H. To the extent that compensation for delays is permitted under the General Conditions, for critical path delays to any of the Contract Times due solely to the causes specified under paragraph 3.02.A or 3.02.B, and to the extent that the Work would not have been delayed due to any cause not within the responsibility of the Owner, Contractor may include in its timely properly supported requests for extension of time a Request for Change Order in accordance with the applicable provisions of the Contract General Conditions requesting compensation for additional costs incurred solely due to such critical path delays. However, no request or claim by the Contractor under this paragraph 3.03.H for an adjustment in Contract Time or for compensation for additional costs will be allowed (a) for any Delay or costs incurred more than three (3) Days before the Contractor gives written notice (except for Engineer’s written orders to Contractor provided under the provisions of the General Conditions), or (b) if made after final payment. Delay for which compensation may be requested will be calculated as the difference between the dates for achievement of the Contract Times for Substantial Completion and for Final Completion calculated under paragraph 3.03.D.4.c and those calculated under paragraph

3.03.D.4.b.2. Compensation for such delays will be calculated in accordance with the General Conditions and applicable Specification Sections.

- I. Owner's exercise of any of its rights under the Agreement and its Contract Documents, including requirement of correction or re-execution of the Work, regardless of the extent, number or frequency of Owner's exercise of such rights or remedies, will not under any circumstances be construed as interference with the Contractor's performance of the Work or as providing grounds for the Contractor to seek extensions of Contract Time or damages for delay of the Project.
- J. Extension of the Contract Time will be the Contractor's sole remedy for any delay due to any of the causes identified under paragraph 3.02.C. In no event will the Contractor be entitled to any compensation or recovery of any damages in connection with any delay under paragraph 3.02.C, including, without limitation, extended overheads, extended general conditions, consequential damages, lost opportunity costs, impact damages or other similar remuneration.
- K. For delays due to any of the causes identified under paragraph 3.02.D, or for acceleration to overcome such delays, Contractor will not be entitled to any increase in Contract Price and/or Contract Time, and the Contractor will assume all resulting direct, indirect and consequential costs, of both the Owner and Contractor.
- L. If Contractor fails to complete the Work within any of the Contract Times due to delays within the responsibility of the Contractor, Owner may in its sole discretion (a) proceed to terminate the Contract for cause in accordance with the provisions of the General Conditions or (b) unilaterally issue a Change Order that both increases the Contract Time to the extent that Engineer determines necessary for completion of the Work, and provides a commensurate reduction in the Contract Price calculated as the cumulative total of the product of the number of days by which each Contract Time is extended due to delay within the responsibility of the Contractor times the daily liquidated damage rate that would have been applicable under the Contract had the Contract Time not been extended; or (c) execute a bilateral Change Order mutually agreed upon between Owner and the Contractor, to extend the Contract Time and compensate Owner for its damages; or (d) exercise any other rights available to the Owner under the Contract or by law or equity. If a Change Order or Construction Change Directive results in reduction of the Contract Price to an amount less than the cumulative total paid by Owner, Contractor will provide to the Owner a cash refund of the excess amount paid.
- M. To the extent that the Owner authorizes (a) changes in the Work or (b) agrees to changes in Contract-required constraints or sequences, or (c) takes other actions that result in critical path reductions in the Time required to perform the Work, Owner will be entitled to commensurate reductions in the Contract Time and the Contract Price, or alternatively, if so directed by the Engineer, a period of Owner's float may be incorporated into the CPM Schedule for the Owner's exclusive use to mitigate delays within the responsibility of the Owner. Owner will provide notice to Contractor together with a critical path schedule analysis demonstrating the extent of reduction in any of the Contract Times, or the quantum of Owner's float created.
- N. Notwithstanding anything contained herein to the contrary, Contractor acknowledges that no extensions of the Contract Time or increase to the Contract Price will be permitted except as approved in advance by Owner's execution of a Change Order in accordance with the executed Contract.
- O. Each Subcontractor and supplier/vendor will be bound by the foregoing provisions.

3.04 ACCELERATION OF PERFORMANCE

- A. Owner may direct acceleration of performance in accordance with the provisions of the General Conditions. Upon receipt of a written order from the Engineer directing acceleration of performance for the Owner's convenience, Contractor will consult with the Engineer regarding measures available to accelerate the work and will take such measures as the Engineer will direct, including for example resequencing of the CPM schedule, increasing concurrency of

activities, increasing staff, accelerating submittals and material deliveries, and employing overtime work as so ordered.

- B. If Contractor believes that schedule recovery is necessary due to delays that are not within the responsibility of the Contractor, the Contractor will provide prompt notice and a request for Time extension in accordance with paragraphs 3.02 and 3.03. Before acting to accelerate the work, Contractor will furnish to Engineer a written notice of planned acceleration specifying the actions that Contractor intends to take and the reasons therefor. Owner will bear no responsibility for costs incurred by the Contractor for schedule recovery efforts:

1. before providing such notice to the Engineer; or
2. to the extent of delays that are within the responsibility of the Contractor.

In any case, when performing efforts to recover delays that Contractor believes are the responsibility of the Owner, Contractor will maintain cost records in accordance with applicable requirements of the General Conditions and will submit for Engineer's signature daily time sheets showing overtime premiums paid. To the extent that Contractor demonstrates to Engineer's satisfaction that

1. Contractor had timely submitted a request for Contract Time extension justifying an extension of Time;
2. an extension of Time was justified under the Contract but not granted by Owner;
3. that the cause of the delay was not mitigated;
4. Contractor provided notice as specified before undertaking acceleration; and
5. that Contractor incurred additional overtime costs to accelerate its Work solely to recover such delay, Owner will reimburse as additional compensation only the premium cost of such overtime work, as shown on the time slips checked and approved each day by the Engineer, and no overhead, profits, costs, commissions, claims for inefficiencies or otherwise, or other costs or claims will be charged or due with respect to use of overtime work or the acceleration of performance.

- C. Each Subcontractor will be bound by the foregoing provisions.

3.05 USE OF FLOAT

- A. Total Float and Contract Float, whether expressly disclosed or implied by the use of float suppression techniques, are not for the exclusive benefit of the Contractor or Owner and will be available to both the Contractor and Owner.
- B. The amount of Total Float available for sharing by the Owner will not be artificially reduced through the Contractor's unreasonable use of float suppression techniques. Total Float hidden using such techniques as preferential sequencing, late starts of follow-up trades, small crews, extended durations, imposed dates, scheduling Work not required for a Contract Time as if it were required Work, and so forth will be Total Float otherwise available for sharing with the Owner.
- C. If the Engineer determines that the Contractor is utilizing unreasonable float suppression techniques and preferential sequencing (including, but not limited to late starts of follow-on trades, unreasonably small crews, extended durations, imposed dates, or scheduling Work not required) in violation of the float sharing provisions of the Contract Documents, the Contractor will not be entitled to any changes in Contract Price or Contract Time.

- D. Early Completion Schedules: Contractor's bid and the Contract Price will be premised upon completion exactly on the Contract Time, without any contemplation of early completion. Contractor will not have a right to finish early. Submittal of a CPM Schedule having an early completion date for any Contract Milestone that is before the corresponding Contract Time will constitute Contractor's agreement that all days between the scheduled early completion date and the Contract Time constitute contract float available to both parties to absorb delays that occur due to any cause. Delays that do not extend the Work beyond the Contract Time will not justify an extension of Contract Time nor will the Owner have any liability under any circumstances for any delay from a planned early completion date.

END OF SECTION 01 32 16

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Contractor will submit Shop Drawings, product data, and samples, as required by the individual Specification sections, to the Engineer for review in accordance with the provisions of Section 00 72 00 - General Conditions.

1.02 PROGRESS SCHEDULES

- A. Contractor will submit one (1) electronic copy in PDF format of Progress Schedules indicating the starting and completion dates of the various stages of the Work and estimated payments to the Engineer.
 - 1. Proposed Progress Schedules will be submitted to the Engineer prior to the pre-construction meeting.
 - 2. Contractor will distribute hard copies of the Progress Schedules during the pre-construction meeting for discussion.
 - 3. Progress Schedules will be updated by the Contractor and submitted electronically (in PDF format) to the Engineer, as a part of applications for progress payments, through completion of the Work. Failure to update Progress Schedule may be the basis for rejection of Applications for Progress Payments.

1.03 SHOP DRAWING SCHEDULE

- A. Contractor will submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to the Engineer.
 - 1. A preliminary Shop Drawing Schedule in accordance with the requirements in Section 00 72 00 will be submitted by the Contractor prior to the pre-construction meeting.
 - 2. Contractor will distribute hard copies of the Shop Drawing Schedule during the pre-construction meeting for discussion.
 - 3. A final electronic copy of the Shop Drawing Schedule (in PDF format) will be submitted by the Contractor at least ten (10) days prior to submitting the first Application for a Payment.

1.04 SCHEDULE OF VALUES

- A. Contractor, if applicable, will submit one (1) electronic copy in PDF format Schedule of Values of the Work to the Engineer.
 - 1. A preliminary Schedule of Values will be submitted by the Contractor prior to the pre-construction meeting.
 - 2. Contractor will distribute hard copies of the Schedule of Values during the pre-construction meeting for discussion.
 - 3. A final Schedule of Values (in PDF format), prepared in accordance with the Section 00 72 00 and presented in sufficient detail to serve as the basis for payments during construction, will be submitted to the Engineer for review at least ten (10) days prior to submitting the first Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

- A. Contractor will submit one (1) electronic copy in PDF format Applications for Payment to the Engineer in accordance with the provisions of Article 14 of Section 00 72 00.
- B. Applications for Payment will be made on forms provided by or approved by the Engineer.

1. Samples of the Contractor's Application for Payment, Payment Schedule and Engineer's Certificate for Payment forms are included in the Contract Documents and can be obtained in digital format from the Engineer.
- C. Copies of these forms, with Project specific information completed by the Engineer, will be given to the Contractor at the preconstruction meeting or, if applicable, after approval of the final Schedule of Values.
- D. Contractor will submit a completed Payment Schedule with an executed Contractor's Application for Payment and Contractor's Declaration to the Engineer not more often than once per month.
- E. Engineer will certify payments with the use of Engineer's Certificate for Payment.

1.06 SHOP DRAWINGS

- A. Shop Drawings will be presented in a clear and thorough manner. Details will be identified by reference to plan sheet number, detail number if applicable, and Specification Section number, and article number.

1.07 PRODUCT DATA

- A. Product Data will be presented in a clear and thorough manner identified the same as the Shop Drawings. Included with the information will be performance characteristics and capacities depicting dimensions and clearances required.
- B. Manufacturer's standard schematic drawings and diagrams will be modified to delete information which is not applicable to the Work. Manufacturer's standard information will be supplemented to provide information specifically applicable to the Work.

1.08 SAMPLES

- A. Samples will be of sufficient size and quantity to clearly illustrate functional characteristics of the product with integrally related parts and attachment devices depicting full range of color, texture and pattern.

1.09 SUBMISSION REQUIREMENTS

- A. Contractor will make Submittals in accordance with the approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor. No damages will be awarded, or extension of time granted, due to the Shop Drawing and product data review process.
- B. Contractor will submit an entire package of Shop Drawings and Product Data information for major items of Work so that the Engineer can review the package as a unit.
- C. Contractor will submit one (1) electronic copy in PDF format of Shop Drawings and Product Data information containing the following information at a minimum:
 1. Field dimensions clearly identified as such.
 2. Relation to adjacent or critical features of the Work or materials.
 3. Applicable standards, such as ASTM or Federal Specification Numbers.
 4. Identification of deviations from Contract Documents.
 5. Identification of revisions on resubmittals.
 6. Project Title, Date of Submission, Date of Previous Submission, and Specification Section number.
- D. Contractor will initial or sign Shop Drawings and Product Data submittals, certifying the Contractor's review and approval of Submittal per Section 00 72 00; verification of products, field measurements, field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

- E. Engineer will initial or sign Shop Drawings and Product Data submittal and will indicate the status of the Submittal, or requirements for resubmittal. Engineer will return to the Contractor one (1) electronic copy of the Shop Drawing and/or Product Data submittal (in PDF format) for distribution or for resubmission.

1.10 ENGINEER'S REVIEW

- A. Upon receipt of any Submittal defined above, the Engineer will:
1. Check each for completeness, clarity, correctness, cohesiveness, legibility, and reproducibility.
 2. Review each only for general conformity with the Contract Documents as specified in Section 00 72 00.
- B. After review of any Submittal, the Engineer will appropriately affix a stamp, electronic notation box or other means, signifying the Submittal as having received full consideration and review.
- C. The "status" of any such Submittal or portion thereof, as appropriate, will be evidenced by any one or more of the following notations clearly signified by a "X" or other similar mark placed in the box adjacent to the notation:
1. Notations for Engineer's Review:
 - a. No Exceptions Taken
 - b. Note Markings
 - c. Comments Attached
 - d. Rejected
 2. Notations for Response Required by Contractor:
 - a. None
 - b. Confirm
 - c. Resubmit
- D. Notation Meanings:
1. Elements marked "No Exceptions Taken" indicate that the Contractor may commence with construction, fabrication or purchase of such items.
 2. Elements marked "Note Markings" indicate that the Contractor may commence with construction, fabrication or purchase of such items.
 - a. Proceeds in strict accordance with the Engineer's notes and/or required corrections/deletions/additions indicated thereon;
 - b. Pending appropriate response by the Contractor as further noted.
 3. Elements marked "Comments Attached" indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by the Contractor as further noted.
 4. Elements marked "Rejected" indicate that the Contractor must make the required corrections as shown or noted and resubmit such items to the Engineer for further review.
 5. Elements marked "None" indicate that the Submittal requires no further action by the Contractor.
 6. Elements marked "Confirm" requires the Contractor to provide affirmation to the Engineer regarding comments, notes, markings, etc. made by the Engineer, and to affirm that the Contractor will comply with the comments, notes, markings, etc.

7. Elements marked "Resubmit" indicate that the Contractor may not commence with construction, fabrication or purchase of such items, and that the Contractor must resubmit items for review that comply with the Contract Documents in the event that those originally submitted do not, or with any comments, notes, markings, etc. made by the Engineer.

1.11 RESUBMISSION REQUIREMENTS

- A. Contractor will make corrections or changes in the Submittals required by Engineer and resubmit. Contractor will indicate any changes which have been made other than those requested by the Engineer.

1.12 MANUFACTURER'S OPERATION AND MAINTENANCE DATA

- A. Contractor will submit one (1) electronic copy in PDF format and one (1) bound copy of all operation and maintenance data required per the various Specification sections.
 1. Prior to 50% completion of the Project, Contractor will have submitted one (1) acceptable copy to the Engineer for review.
- B. Final copies of the operation and maintenance data will be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover will be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents will be provided in the front of each binder to list the various sections in the manual.
- C. The information to be provided in each section of the manual, for each piece of equipment and project component will include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and subassemblies; installation and operational procedures; complete wiring and piping schematics; lubrication materials and procedures; maintenance procedures; and parts lists complete enough to permit identification of parts by nomenclature, manufacturer's part number and use.
- D. At the front of each section a maintenance schedule will be provided for each piece of equipment in the section.
 1. The schedule will display the daily, weekly, monthly, semi-annual, annual or fraction thereof, lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimum performance and life of the unit.
 2. A common schedule format is to be developed and used for all of the sections. Photocopies or reproductions of the manufacturer's literature will not be accepted.

1.13 AUDIO/VIDEO ROUTE SURVEY

- A. When required in Section 00 42 43 - Proposal or Section 01 11 00 - Summary of Work, the Contractor will furnish the Engineer with an "Audio/Video Route Survey" record of the existing conditions prior to the start of construction. Contractor must enlist the services of a firm having a minimum of one (1) year experience in audio/video recording of construction projects.
- B. Prior to beginning the audio/video recording, the Contractor will review with Engineer the Project requirements to ensure that the audio/video is adequate for its intended purpose. Owner will have the authority to designate areas for which coverage may be added or omitted. The audio/video recording will be done prior to placement of materials or equipment on the construction area and furnished one (1) week prior to the pre-construction meeting.
- C. Format:
 1. Audio/Video route survey will be submitted in the format(s) as specified in Section 01 11 00.
 - a. Audio/video route survey submission will be on USB media
 - b. Format: USB – Video

- c. Video Encoding: Highest available bit rate (6-9 Megabit), 60 fields per second interlaced video
 - d. Audio Encoding: Uncompressed stereo wave or stereo Dolby Digital (256 kilobit or better)
 - e. Aspect Ratio: 4x3 (720x480 pixels)
 - f. No Macrovision or other copy protection encoding. No region code or region code 1.
- D. Complete coverage will include all surface features located within the public right-of-way, easement areas and adjacent private properties up to building line when such properties lie within the zone of influence of construction and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage will include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage will be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.
 - E. Houses and buildings will be identified visually by house number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, location will be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.
 - F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground will be not less than 12 feet (3.5 m) to ensure proper perspective. The rate of speed in the general direction of travel of the conveyance used during recording will not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates will be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.
 - G. Video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information in the upper left hand third of the screen to include the date and time of recording, as well as the corresponding engineering stationing numbers as shown on the Contract Drawings.
 - 1. The date information will contain the month, day, and year. For example, mm/dd/yy, and be placed directly below the time information.
 - 2. The time information will consist of hours, minutes, and seconds, separated by colons. For example, hh:mm:ss.
 - H. Engineering stationing numbers must be continuous, accurate and correspond to the Project stationing and must include the standard engineering symbols. For example, Station 14+84.
 - I. Recording will be done during times of good visibility. No recording will be done during periods of visible precipitation, or when more than ten (10) percent of the ground area is covered with snow or standing water, unless otherwise authorized by the Owner.
 - J. In some instances, audio/video coverage may not be suitable for recording necessary details. In such instances, the Owner may specify still photographs to provide coverage. One (1) color photograph will be provided in accordance with this Section with a suitable description of the photograph's location.
 - K. Any portion of the Audio/Video Route Survey of insufficient quality as determined by the Engineer will be redone by the Contractor at no additional cost to the Owner.
 - L. Each USB will be properly identified with the Project Title, location, time, and date in a manner acceptable to the Owner.

1.14 PHOTOGRAPHS

- A. When required in Section 00 42 43 - Proposal or Section 01 11 00 - Summary of Work, the Contractor will furnish the Engineer with a total of 6 to 10 digital color photographs each month

during construction of the Project, unless some other number and times is specified in Section 01 11 00 - Summary of Work.

- B. Photos will be in digital format (i.e., JPEG, TIFF, GIF, PNG or PDF) and will have a minimum resolution of 300 dpi.
- C. The following information will be placed on the photo itself or embedded in the digital file:
 - 1. Project Title
 - 2. Contract Number
 - 3. Description of photo's content
 - 4. Date and Time of photo
- D. Contractor will submit photographs monthly along with the Application for Payment as described in Article 14 of Section 00 72 00.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 33 00

SECTION 01 45 00 QUALITY CONTROL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Sampling of materials will be made by the Engineer in accordance with the methods designated by the Specifications. Contractor will furnish such facilities as the Engineer may require for collecting, storing, and forwarding samples to the Laboratory. Contractor will furnish the required samples to the Owner without charge.

1.02 TESTS OF MATERIALS

- A. Materials in the Work will meet the requirements of the Contract Documents.
- B. Tests of materials will be made as specified herein. Engineer will at all times have access to materials intended for use in the Work as well as to the plants where such materials are produced. Plant inspection may be made if the quantities are sufficient to warrant such inspection and if it is to the best interest of the Owner. In any case materials may be either inspected or tested when received on the Project.
- C. Materials will not be used until approval has been received from the Engineer. Approval of materials at the producing plant does not constitute a waiver of the Engineer's right for re-examination at the Project site.
- D. The standards for testing materials unless otherwise specified, will be as established by the American Society for Testing and Materials (ASTM). Tests of materials will be made in accordance with the methods described or designated in the Specifications.
- E. The sampling and testing of all materials not specifically mentioned will be done by generally accepted methods, unless otherwise specified by the Engineer.

1.03 CERTIFICATION OF MATERIALS

- A. At the request of the Engineer, the Contractor will provide the Engineer with certification that the various materials to be used conform to the standards referred to in the Contract Documents.

1.04 SOURCE QUALITY CONTROL

- A. Testing identified in the Contract Documents for quality control, which is required to establish quality of materials, equipment or fabricated items, will be paid for by the Contractor unless otherwise noted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 45 00

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SITE ACCESS AND PARKING

- A. Contractor will locate roads, drives, walks and parking facilities to provide uninterrupted access to construction offices, mobilization, Work, storage areas, and other areas required for execution of the Contract. Access drives and parking areas will be hard surfaced unless otherwise approved by the Engineer.
- B. Contractor will maintain driveways a minimum of 15 feet (5 meters) wide between and around combustible materials in storage and mobilization areas.
- C. Contractor will maintain traffic areas as free as possible of excavated materials, construction equipment, products, snow, ice, and debris.
- D. Contractor will not utilize existing parking facilities for construction personnel or for Contractor's vehicles or equipment, unless written permission from owner of parking facility is obtained.

1.02 TRUCKING ROUTE AND PUBLIC ROAD MAINTENANCE

- A. Prior to the start of construction, the Contractor will submit for review a schedule and list indicating the streets and roads within the municipality that Contractor's equipment will use off the Project site.
- B. Contractor will comply with safety requirements, weight restrictions and speed limits.
- C. Gravel and dirt roads or streets used will be maintained by grading, placing dust palliatives and maintenance gravel in sufficient quantities to eliminate dust and maintain traffic.
- D. Paved streets will be maintained in a reasonable state of cleanliness and the Contractor will remove accumulations of debris, dirt or mud caused by Contractor's operations. Removal will be done in such a manner as to prevent the release of dust. This will be done at least every day at the close of each day's operation or additionally when requested by the Engineer.
- E. Roads or streets damaged by the Contractor's operations, will be repaired or removed and replaced to satisfactions of the agency having jurisdiction at no additional cost to the Project.
- F. In order to ensure adequate street maintenance and restoration as outlined above, the Contractor may be required to deposit with the agency having jurisdiction a cash Road Protection Bond. This Bond, if required, will be held in escrow until final release is given by the agency having jurisdiction.
 - 1. In the event the Contractor fails or neglects to maintain or restore the streets to the satisfaction of the agency having jurisdiction, the agency having jurisdiction will have the required maintenance or restoration work done and the cost incurred will be deducted from the Road Protection Bond.
 - 2. At the completion of the Project, the agency having jurisdiction will return the Road Protection Bond less any monies expended by the agency having jurisdiction and will render to the Contractor an accounting of all monies so expended.
- G. Contractor will not store any equipment, supplies, construction material or excess excavated material on any roads or streets unless otherwise approved by the Engineer.

1.03 EMERGENCY ACCESS

- A. Contractor will at all times provide emergency access to property in the vicinity of the construction for police vehicles, fire equipment, ambulances or other emergency vehicles to protect life, health and property. Areas damaged by emergency vehicles will be restored by the Contractor at no additional cost to the Owner.

1.04 PRIVATE OR PUBLIC ROADS, SIDEWALKS, AND PARKING AREAS

- A. Where public roads, driveways, parking areas and sidewalks are encountered throughout the community, the Contractor will maintain those portions affected by the construction operations in a passable condition until such time as final restoration of these improvements can be made as specified.
 - 1. If, in the opinion of the Engineer, the public safety is in danger or the necessity exists for maintaining traffic, the Engineer may direct that backfilling be completed immediately.
 - 2. In the event that the necessary backfill material and equipment are not available when direction is given for immediate backfill, the trench will be backfilled with native material to provide for the necessary maintenance of traffic and safety; however, the native material will be removed within 48 hours and the trench properly backfilled as specified.
- B. Contractor will provide written notice to residences and businesses of driveway access interruption 72 hours in advance of interruptions.
 - 1. Written notices require approval for distribution from the Engineer.
 - 2. Contractor will provide the Engineer with copies of notices at least five (5) working days in advance of their distribution for review and approval.
- C. Where private roads are encountered throughout the community, the Contractor will maintain those portions affected by its construction operations in a passable condition. These roads will be maintained by the use of 21A road maintenance gravel, stone or slag.
 - 1. In the event the original subbase has been destroyed, the Contractor will furnish and install 1-inch to 2-inch aggregate to stabilize the existing subbase.
- D. Upon completion of the construction activities, the Contractor will shape and regrade these roads leaving them in a condition as good as or better than original, and adequate for normal travel.

1.05 WORK WITHIN RAILROAD COMPANY RIGHT-OF-WAY

- A. Contractor will be responsible for complying with the requirements of the Railroad Company for all Work of the Project and/or temporary crossings for trucking routes. Unless otherwise provided by an item of these Specifications, the Contractor will bear costs and expenses incidental thereto, including, but not limited to, protection, flagmen, construction engineering inspection by the railroad, and incidental work such as drainage facilities and removal, alteration and replacement of railroad fences.

1.06 ROAD CLOSING

- A. No street, road or section thereof will be closed to through traffic unless otherwise provided for on the Plans, Specifications, or authorized by the agency with jurisdiction over the roads. Prior to closing a street, road, or section thereof, the Contractor will provide the Engineer with a copy of a detour plan approved by the agency having jurisdiction over the roads.
- B. In the event roads or streets are to be closed, the Contractor will notify the local fire department, police department, local road authority, ambulance and emergency services, Department of Public Works, public transit authority and public school system daily as to what streets will be partly blocked or closed, the length of time the streets will be blocked or closed and when the streets will be reopened to traffic. Contractor will designate one responsible employee to carry out the requirements of this condition.
- C. During the time that the road is closed, the Contractor will make provision for trash, leaf, and rubbish (garbage) pickup.

1.07 MAINTAINING TRAFFIC

- A. Contractor will provide access for local traffic to property along the Project by means of temporary roads, drives, culverts or other means approved by the Engineer. Contractor will

grade, add surfacing materials, and dust palliatives to such temporary roads and drives as necessary for the proper maintenance of traffic.

- B. Where the shoulder is used to maintain traffic, the shoulder will be graded, surfaced, treated for dust, constructed, or reconstructed, as specified herein or as shown on the Plans.
- C. If the construction work is suspended due to weather conditions, winter shut down or for any other reason, sufficient labor, materials and equipment will be ready for immediate use at all times for the proper maintenance of traffic. Surfacing materials and dust palliatives will be applied at such times and locations and in such amounts as necessary to safely maintain traffic and as determined by the Engineer.
- D. Where shoulders are low, high, soft or rough, adequate provisions will be taken to inform and protect the traveling public by means such as construction warning signs, barricades, lighted devices, etc. Such shoulder hazards will be eliminated as soon as practicable.
- E. Contractor will furnish, erect and maintain all signs, barricades, lights, and traffic regulators, in accordance with the requirements of the current "Michigan Manual of Uniform Traffic Control Devices".
 - 1. Furnish all flagmen and watchmen as are necessary to maintain and safeguard traffic along the entire Project. Failure to comply with these requirements may be cause for the Owner to issue a stop Work order, which will remain in effect until all necessary devices are in place and operational. The issuance of a stop Work order will not be reason for granting additional compensation or an extension to the Contract Time.
 - 2. Furnishing, installing, and maintaining traffic control devices will be incidental to the Project unless otherwise provided for in the Proposal.

1.08 EXISTING SIGNS

- A. No stop sign, traffic control or warning device or sign will be taken down until the agency having jurisdiction over the roads has been notified and arrangements for the immediate reinstallation has been made. Contractor will provide temporary signs, traffic control devices, warning devices, or watchmen continuously from the time the item is removed until it is reinstalled. Signs removed will be replaced with signs meeting requirements of the agency having jurisdiction over the roads.

1.09 TEMPORARY ELECTRICITY AND LIGHTING

- A. Contractor will be responsible for and pay all costs for the installation and removal of circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords and will pay all costs of electrical power used.
- B. Electrical wiring and distribution will conform to the National Electrical Code as adopted by the State of Michigan.

1.10 TELEPHONE

- A. Contractor is required by MIOSHA regulations to provide telephone service for contacting emergency services. Such emergency telephone service will also be available for the use of the Owner and Engineer whether or not a field office is required for the Project. Emergency phone numbers are required to be posted per MIOSHA regulations
- B. Contractor will pay all costs for installation, maintenance and removal, and service charges for local calls to provide service for Contractor's construction site office as well as for the Engineer's field office. Toll charges for calls relating to Project business will be at the Contractor's expense.

1.11 USE OF WATER

- A. Contractor will acquire permits, post bonds and pay fees required by the local agency having jurisdiction prior to using any hydrant or any other source of water.

- B. Contractor will reimburse the local community for all water consumed during course of the Project at the current rate as set by the agency having jurisdiction.

1.12 SANITARY PROVISIONS

- A. Contractor will be responsible for installation, maintenance and removal of temporary sanitary facilities per MIOSHA regulations for use of construction personnel including the Owner and Engineer. Rules and regulations of the State and local health officials will be observed, with precautions taken to avoid creating unsanitary conditions.

1.13 POTABLE WATER

- A. Contractor will furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer.

1.14 MEDICAL SERVICES AND FIRST AID

- A. Contractor will furnish first aid supplies and a person trained in first aid with a valid first aid certificate, per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer. Contractor will also furnish a communication system for contacting emergency services. The telephone numbers of the physician, hospital, or emergency services will be conspicuously posted at the job site.

1.15 POSTAL SERVICE

- A. Residents in this Project area may receive their mail at roadside mailboxes. Since the postal service will not deliver mail to a resident without a mailbox or a mailbox that is not in its proper position, the Contractor will relocate, replace and repair all mailboxes and posts in a condition and height acceptable to the post office within 24 hours of the removal.
- B. If required, the Contractor will furnish new posts for the mailboxes if the existing posts are broken or rotted to the extent that they cannot be reused.
- C. Any mailbox damaged by the Contractor's operations or by anyone else while the box is down due to the Contractor's operation, will be replaced by the Contractor with a new mailbox meeting the postal officials' specifications and the resident's name and address neatly lettered with paint or other acceptable means to the satisfaction of the resident and postal authorities.
- D. The cost for relocating mailboxes will be incidental to the Project unless otherwise specified in Section 00 42 43 - Proposal.

1.16 NEWSPAPER DELIVERY

- A. Residents in this Project area may receive their newspapers at roadside tubes. Since the resident arranges for newspaper delivery, the Contractor will notify the resident 24 hours prior to removal of any newspaper tube.
- B. Newspaper tubes damaged by the Contractor while carrying out Contractor's operations or by anyone else while the tube is down due to the Contractor's operation, will be replaced as agreed between the Contractor and the newspaper who owns the damaged tube. The cost will be incidental to the Project.

1.17 BUS STOPS AND SHELTERS

- A. Prior to the start of any construction, the Contractor will notify the transit authority that has bus stops within the area of the Work. Removal, relocation and/or replacement of signs and/or benches will be the responsibility of the Contractor in accordance with any requirements of the transit authority. The cost will be incidental to the Project.

1.18 BY-PASS PUMPING

- A. Contractor will maintain flow in existing sanitary and storm sewers by pumping, bypassing, or fluming, as necessary. During wet weather events, the flow in the sewer will rise rapidly and may become surcharged. Contractor will maintain flow in such a manner as the existing flow

can be adequately transported including wet weather flow. Contractor will furnish, install, operate, and maintain temporary pumping facilities to service the upstream area including piping, temporary channels, pumps, sumps, controls, temporary plugs, and bulkheads.

- B. For sanitary sewerage, by-pass piping will be PVC Schedule 80, ABS truss pipe, equivalent with solvent welded joints, HDPE with butt fused joints, or _____. Flexible hoses of whatever types are not acceptable. Bypassed flow shall be discharged to a sanitary sewer of acceptable size to handle the bypassed and existing flows. Contractor shall plan construction operations such that there will be no backups, leaks, or discharges of pollutants.
- C. Contractor will furnish and have available on-site, redundant pumping facilities in case of any failure of the pumping system including pumps, piping, electrical, connections, etc. Redundant pumping facilities also include having a backup power generator in case the primary power source fails. Contractor will provide an adequate labor force to oversee the by-pass pumping including providing labor to maintain 24 hour per day operation and emergency backup service.
- D. Costs for pumping and by-passing flow will be included in the unit price bid for other items of Work unless otherwise specified in the Proposal.
- E. Contractor will submit a by-pass pumping/diversion scheme to the Engineer for approval not less than 15 calendar days prior to any anticipated by-pass pumping/diversion. The by-pass pumping plan will include pumping capacity and expected flow rates.

PART 2 PRODUCTS

2.01 BARRICADES, ARROW BOARDS, TEMPORARY PAVEMENT MARKINGS, AND TEMPORARY SIGNS

- A. Barricades, arrow boards, temporary pavement markings, temporary signs, and other traffic control devices will be in accordance with the current edition of the MDOT Standard Specifications for Construction, and the current edition of the "Michigan Manual of Uniform Traffic Control Devices".

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 50 00

**Wayne County Department of Public Services
SPECIAL PROVISION
FOR
MAINTAINING TRAFFIC**

1 of 6

Description

This work shall be in accordance with the requirements of Section 812 of the 2020 MDOT Standard Specifications for Construction and as herein specified. The Contractor is advised that the 2011 Michigan Manual of Uniform Traffic Control Devices (2009 Federal Edition) is hereby established as governing all work in connection with traffic control devices, barricade lighting, etc., required on this project.

The requirements for “Maintaining Traffic Along Project,” as described in Subsection 812.03.G of the 2020 MDOT Standard Specifications for Construction, shall also apply to the maintenance of local traffic, where directed by the Engineer.

General Requirements

The Contractor shall furnish, erect, maintain and, upon completion of the work, remove all traffic control devices and barricade lights within and around the perimeter of the project that were erected for the safety and protection of through and local traffic. This includes, but is not limited to: advance, regulatory, and warning signs, barricades and channeling devices at intersecting streets on which traffic is to be maintained; barricades at the ends of the project and at right-of-way lines for intersecting streets which are to be closed to traffic; and signs, barricades and lights at the intersections of these streets to be closed with the first usable street on each side of the project. Traffic regulators, where required by the Engineer, are included.

Lane closures shall be removed as soon as the work in the lane is complete. Lanes should not be closed unless necessary.

Street name signs and mailboxes in the way of construction will be removed and reset immediately in a temporary location. Street name signs and mailboxes shall finally be set by the Contractor in a location designated by the Engineer upon the completion of final grading in the section involved. This work shall be included in other items of work. New mailbox posts, where required by the Engineer, will be paid for separately.

Provision for and protection of pedestrian traffic shall be maintained at all times.

All areas which are disturbed through the Contractor’s activities or traffic maintenance operations shall be restored to their original condition at the Contractor’s expense.

All labor and materials for Maintaining Traffic, as specified herein and as shown on the plans will be covered under the Lump Sum pay item “Traffic Maintenance and Control”.

MAINTAINING TRAFFIC

Maintenance During Construction

Routine maintenance shall be in accordance with Subsection 104.07.C of the 2020 MDOT Standard Specifications for Construction except as herein modified.

The last sentence of the first paragraph under subsection 104.07.C.2 shall be deleted and replaced with the following:

“The Contractor shall be reimbursed for the tonnage of temporary patching material as approved by the Engineer. This material will be paid for as “Bit Mixture for Patching, Temp”.

Utility Trenches

When traffic is to be maintained at utility trenches in pavements as shown on the plans or as directed by the Engineer, Maintenance Aggregate, 21AA and Bit Mixture for Patching, Temp must be used at these locations. All necessary maintenance, including materials, are incidental to the Traffic Maintenance and Control pay item.

If the contract calls for maintaining traffic at utility crossings in concrete or asphalt pavement, a full 9 inches compacted temporary base of Maintenance Aggregate, 21AA shall be placed with a 2inch surface course of Bit Mixture for Patching, Temp.

The Contractor will be billed for any emergency work performed by municipalities or the County of Wayne resulting from the Contractor's failure to address the emergency work after notification.

Stage or Part Width Construction

Where the existing pavement or partial widths of new pavement are to be utilized for the maintenance of local or through traffic, Plastic Drums will be required at 50-foot intervals on tangent sections and 25-foot intervals on tapered sections, or as directed by the Engineer, for channeling and directing traffic through the construction area.

Walks, driveways, and entrances to buildings shall not be unnecessarily blocked. Vehicular access shall be maintained to all commercial properties designated by the Engineer. Construction shall be completed in such a manner as to maintain the required entrance width for traffic as shown on the plans and as directed by the Engineer. When partial widths of new pavement are available to local traffic, access to drives shall be provided immediately.

MAINTAINING TRAFFIC

Temporary access to street returns, residential drives or commercial drives required as part of staged or part width construction or gapping operations shall not be paid for separately.

Residential side streets may be closed to through traffic except as specified in the “Specific Requirements” section of this Special Provision.

Part-width construction will not be paid for separately.

No 24-hour lane closures shall be allowed unless shown on the staging plans or approved by the Engineer.

Milling

When the project calls for milling the full width of the existing pavement, the pavement construction shall be staged according to the following sequence:

For 5-lane and 4-lane pavements, in the first stage the Contractor shall mill and resurface (through the first HMA lift that is to be placed as called for on the plans) the outside/gutter lane in each direction and any right-turn lanes. Maintain traffic on the middle lanes (and the center left-turn lane for 5-lane pavements). To prevent uneven longitudinal joints, the Contractor shall construct longitudinal taper joints either by milling or by paving. The cost for the longitudinal taper joints will not be paid for separately, but shall be included in the cost of the associated milling or paving pay items. All longitudinal pavement edges shall be tapered at a rate of one inch (1”) on one foot (1’). Perform full-depth pavement repairs, conditioning, any sewer work that may be called for on the plans, and curb repairs for curbed roads. Manhole structures in the pavement work area (not including catch basins/inlets at the face of curb) shall be temporarily lowered before milling as called for on the plans or as directed by the Engineer.

In the second stage, the Contractor shall mill and resurface (through the first HMA lift that is to be placed as called for on the plans) the center three lanes (for 5-lane pavements) or 2 lanes (for 4-lane pavements). Maintain traffic on the outside/gutter lane in each direction. Perform full-depth pavement repairs, conditioning, and any sewer work that may be called for on the plans. Manhole structures in the pavement work area shall be temporarily lowered before milling as called for on the plans or as directed by the Engineer.

In the third stage, HMA overlay the full width of pavement with top course mixture as called for on the plans. Traffic shall be maintained in accordance with the MDOT Maintaining Traffic Typical that follow this special provision, and as agreed upon by the Contractor and the Engineer.

MAINTAINING TRAFFIC

At no time will traffic be allowed to drive on the longitudinally milled surface.

When the road has less than four lanes or more than five lanes, staging shall be as called for in the “specific requirements” section of this special provision, or as agreed upon by the Contractor and the Engineer.

HMA Paving Operations

The Contractor shall perform HMA paving work while the section of the road involved is in use by traffic. No traffic shall be allowed on the surface being placed until rolling has been completed and the surface has cooled to 170° F or less. The Contractor shall provide knowledgeable traffic regulators in sufficient number to maintain traffic as described herein, to keep traffic off sections being surfaced, and to provide for safe travel at all times as directed by the Engineer.

Base and curb repair, surface preparation, manhole, catch basin, and other structure adjustment or reconstruction shall be scheduled along the project in such a manner as to provide the required traffic flow without undue shifting of traffic from lane to lane.

Pressure distributors, pavers and rollers shall be equipped with approved flasher lights to warn traffic. The pressure distributor and each roller shall be equipped with not less than one flasher light which shall be mounted on the equipment so as to give a warning signal ahead and behind. Each paver shall be equipped with not less than one flasher light on each side which shall be mounted so as to give the warning signal ahead and behind.

All flasher lights shall operate continuously while work is in progress and at other times as directed by the Engineer.

Interference with traffic at all cross-streets must be held to a minimum during the time required for construction. At least one lane shall be maintained for traffic on the various cross-streets during all major construction except during the actual paving operation. During paving operations on intersecting street aprons, the cross-streets may be temporarily closed to traffic, provided that each cross-street has another outlet. Signing and barricading of these temporary crossings will be the responsibility of the Contractor, as directed by the Engineer.

Turning movements may be prohibited at various times during construction, as directed by the Engineer, upon recommendation from the Wayne County Department of Public Services Traffic & Safety Office.

MAINTAINING TRAFFIC

Sidewalk/Curb Ramp Construction Staging

The Contractor shall submit a plan for maintaining pedestrian movements during construction. The plan shall address construction methods and sequences to be implemented in order to maintain pedestrian movements. The current guidelines include MMUTCD and the Federal Access Board's Proposed Rights-of-Way Accessibility Guidelines (PROWAG).

The Contractor's plan shall include the following minimum guidelines:

- Limit the ramp/sidewalk construction activities to one side of the roadway at a time.
- Limit the duration of ramp/sidewalk construction activities (removal, replacement and concrete curing) to two (2) weeks at any one non-signalized location.
- Limit the duration of ramp/sidewalk construction activities (removal, replacement and concrete curing) to one (1) week at any one signalized location.
- Barricade all ramp/sidewalk construction locations with Pedestrian Type II Barricade, Temp placed directly across the walking path. (Caution tape alone is not acceptable.)

Pedestrian detours shall be as shown on the plans.

The Contractor shall be responsible for scheduling a pre-paving meeting with the Engineer, prior to commencing any ramp/sidewalk construction activities, including removals. In attendance shall be the Prime Contractor and all Sub-Contractor(s) involved in the ramp/sidewalk construction activities.

Specific Requirements

Traffic shall be maintained along the south side of Eureka Road, as shown on the plans. Pedestrian detour and Racho Road detour shall also be per project plans.

Traffic signal staging shall be conducted in accordance with the project plans. All labor and materials shall be covered by the "Traffic Maintenance and Control" Lump Sum pay item.

The traffic signal at the Taylor Fire Station will be taken out of operation during culvert construction when directed by the Engineer. The existing mast arm pole and arms on the north side of Eureka will be removed and stored during construction and re-installed after culvert construction. Contractor is responsible for providing a secure storage location and for the repair and replacement of any damaged items. Other signal bagging, signal heads adjustments, temporary signal heads, and pedestrian signal replacements within the project limits, as shown on the plans, are included.

MAINTAINING TRAFFIC

MDOT Maintaining Traffic Typical

Utilize the following Maintaining Traffic Typical.

Changes or adjustments to the Maintaining Traffic Typical may be necessary to fit field conditions, subject to approval of the Engineer or as determined by the Engineer.

- 101-GEN-SPACING-CHARTS
- 123-NFW-1LC-(R)
- 207-FW-2LC-(R)
- 160-INT-LD-CLT-MID

MDOT Traffic Signal Special Details

Utilize the following MDOT & Wayne County Traffic Signal Special Details.

- WC-026-A Color Code Wiring / Equipment Grounding
- WC-026-B Color Code Wiring Connect / Signal Lamps
- WC-028-B Pedestal Fdn & Signal Mounting Details
- WC-029-C Typical Pole Mtd Pedestrian Signals
- WC-030-A Span Wire Mounted TS Bracket Assembly
- SIG-070-A Pedestal Foundation
- SIG-071-A Pedestal Base Alternate Anchor Details
- SIG-250-A Conduit (Direct Burial/Encased)
- SIG-301-A Mast Arm Mounted TS Bracket Assembly
- SIG-400-A Pedestrian Push Button Details

Measurement and Payment

The completed work, as described, will be measured and paid for at the contract unit price using the following pay items:

Pay Item	Pay Unit
Traffic Maintenance and Control.....	Lump Sum

Traffic Maintenance and Control will be measured and paid for as a lump sum for all labor and materials to maintain traffic for this project as specified in this special provision, detailed on the plans, and as directed by the Engineer. All labor and materials shall meet the specifications and requirements of the 2020 MDOT Standard Specifications for Construction except where noted.

SECTION 01 57 13 TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes furnishing, installing, maintaining, and removing at project completion, soil erosion and sedimentation control devices. Devices include silt fence, straw bales, turbidity barriers, temporary gravel construction entrance/exits, inlet filters, ditch sediment traps, etc.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 22 00 - Grading
- D. Section 31 23 13 - Subgrade Preparation
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 33 - Trenching and Backfilling
- G. Section 31 35 00 - Slope Protection
- H. Section 32 92 19 - Seeding
- I. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile
- F. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractor shall secure all permits, and post bonds or deposits required to comply with the "Soil Erosion and Sedimentation Control," requirements, being Part 91 of PA 451 of 1994 as amended and the National Pollution Discharge Elimination System (NPDES) Rules for storm water discharges from construction activity.
- B. Comply with requirements of the agency having jurisdiction. Owner may withhold payment to Contractor equivalent to any fines resulting from non-compliance with applicable regulations.

1.05 PERFORMANCE REQUIREMENTS

- A. Employ Best Management Practices as defined by standard EPA 832-R-92-005.
- B. Put preventative measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- C. Control increased storm water runoff due to disturbance of surface cover due to construction activities for this Project.

- D. Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this Project.
- E. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall event that might occur in 10 years.
- F. Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this Project. Prevent windblown soil from leaving the project site. Comply with fugitive dust ordinances of agencies having jurisdiction. Prevent tracking or flowing of mud and sediment onto public or private roads, sidewalks or pavements outside of the site.
- G. Prevent sedimentation of waterways on or off the project site, including rivers, streams, lakes, ponds, open drainage ditches, storm sewers, and sanitary sewers. If sedimentation occurs, install or correct preventative measures immediately at no cost to Owner. Comply with requirements of agencies having jurisdiction.
- H. Maintain temporary preventative measures until permanent measures have been established. Remove temporary measures when permanent measures have been established.
- I. If erosion or sedimentation occurs due to non-compliance with these requirements, remove deposited sediment or restore eroded areas at no cost to Owner.

1.06 SUBMITTALS

- A. Submit schedule of Soil Erosion and Sedimentation Control activities to agency having jurisdiction. Include events (with days and/or dates of the various activities) for review and approval prior to obtaining a permit.
- B. Contractor must provide evidence of Storm Water Operator license.

PART 2 PRODUCTS

2.01 SILT FENCE

- A. Polypropylene geotextile fabric, resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; meeting the following requirements:
 1. Average Opening Size: 30 US std Sieve , maximum; ASTM D4751.
 2. Permittivity: 0.05 sec-1, minimum; ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 lb - f minimum, in cross-machine direction; 124 lb - f minimum in machine direction; ASTM D4632/D4632M.
 5. Elongation: 15 to 30%; ASTM D4632/D4632M.
 6. Tear Strength: 55 lb - f minimum; ASTM D4533/D4533M.
- B. Posts shall be 2 inch cross section hardwood stakes, minimum 3 feet long.

2.02 TURBIDITY BARRIER

- A. Geotextile fabric curtain suspended from flotation devices at the water surface and held in a vertical position by a ballast chain in the lower hem. Turbidity barrier curtain shall meet the following minimum requirements unless otherwise specified on the plans.
 1. Consist of vinyl laminate on 1000 denier polyester fabric weighing 18 oz per sq yard minimum.
 2. Tensile strength of fabric shall be 220 lb - f minimum.

3. Edges of fabric to be reinforced with minimum 5/8 inch diameter polypropylene rope.
4. Ballast chain minimum 5/16 inch galvanized steel.
5. Buoyancy blocks providing buoyancy of 18 lb - f.
6. Length of curtain (water depth) 5 feet.

2.03 DEWATERING DISCHARGE FILTER BAG

- A. UV-stabilized, non-woven geotextile bag to filter sediment from water prior to discharging. Geotextile fabric shall meet the following minimum average roll requirements:
 1. Tensile Strength: 180 lb - f minimum; ASTM D4632/D4632M
 2. Elongation: 50 percent minimum; ASTM D4632/D4632M
 3. CBR Puncture Strength: 300 lb f; ASTM D6241
 4. Trapezoidal Tear: 70 lb - f; ASTM D4533/D4533M
 5. Flow Rate: 80 gal/min/sft Minimum; ASTM D4491/D4491M
 6. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M
 7. Apparent Opening Size: 80 US std Sieve; ASTM D4751
 8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.04 EROSION CONTROL BLANKETS

- A. Erosion control blankets shall not be used on this project. In lieu of these blankets, the Contractor shall stabilize the seeded areas using straw crimped into the ground using a mulch anchoring tool (disc with vertical coulters) or by hydroseeding with a cellulose or wood fiber mulch.

2.05 BONDED FIBER MATRIX

- A. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high-strength, nontoxic adhesive. BFM shall be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous and erosion resistant mat that shall not inhibit the germination and growth of plants. BFM shall retain its form despite re-wetting.
- B. Bonded fiber matrix shall consist of:
 1. Seed and Fertilizer per Section 32 92 19.
 2. Wood Fiber Mulch: Thermo-mechanically defibrated long, softwood fibers manufactured from select northern softwood wood chips.
 3. Polyacrylamide Binder: Site specific, fully biodegradable, polyacrylamides (PAM's) binders, with cross-linking long organic jute fibers
- C. Materials shall be mixed at the rate of 80 lbs per acre of PAM binder and 2500 lbs per acre of wood fiber mulch.

2.06 INLET FILTER FABRIC

- A. Filter fabric shall be constructed of 100% continuous polyester needle-punched non-woven engineering fabric. Filter fabric shall be fabricated to provide a direct fit with the drainage structure cover. Filter fabric shall have the following minimum physical properties.
- B. Tensile Strength: 80 lb - f minimum; ASTM D4632/D4632M
- C. Elongation: 50 percent minimum; ASTM D4632/D4632M
- D. CBR Puncture Strength: 300 lb f minimum; ASTM D6241

- E. Trapezoidal Tear: 70 lb - f minimum; ASTM D4533/D4533M
- F. Flow Rate: 80 gal/min/sft minimum; ASTM D4491/D4491M
- G. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M
- H. Apparent Opening Size: 100 US std Sieve maximum; ASTM D4751
- I. UV-Stability: 70% retained strength; ASTM D4355/D4355M after 500 hours.

2.07 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following:
 - 1. Turbidity Barrier: Tough Guy Type II by Aer-flo Canvas Products, Inc.
 - 2. Wood Fiber Mulch: EcoFibre by Canfor Corporation.
 - 3. Polyacrylamide Binder: HydroTurboNet by Straw Net, Inc.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to the greatest extent possible.
- B. Except in areas to be cleared, do not remove, cut, deface, injure or destroy trees or shrubs without Engineer's approval. Protect existing trees or shrubs that are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations, with suitable fences or other means as approved by Engineer.

3.02 PREPARATION

- A. Review the drawings and Storm Water Pollution Prevention Plan (SWPPP).
- B. Revise SWPPP as necessary to address potential pollution from site identified after issuance of the SWPPP at no additional cost to Owner.
- C. Conduct storm water pre-construction meeting with Site Contractor, all ground-disturbing Subcontractors, site Engineer of record or someone from their office familiar with the site and SWPPP, and state or local agency personnel in accordance with requirements of the special conditions.
- D. Schedule work so that the soil surfaces are left exposed for the minimum amount of time. Place permanent soil and sedimentation control measures as soon as practical.

3.03 GENERAL

- A. Do not discharge excavation ground water to the sanitary sewer, storm sewer, or to rivers, streams, etc. without authorization from the agency having jurisdiction. Construction site runoff will be prevented from entering any storm drain, river, stream, etc. directly by the use of silt fences or other suitable methods. Contractor shall provide erosion protection of surrounding soils.
- B. Sedimentation control devices shall be installed prior to Contractor beginning Work. Soil erosion and sedimentation control devices shall be maintained in an effective functioning condition at all times during the course of the Work.
- C. Immediately bring earthwork to final grade and protect side slopes and backslopes from erosion. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.04 INSTALLATION - GENERAL

- A. Install silt fences, ditch sediment traps, check dams, inlet filters, temporary gravel construction entrance/exits, turbidity barriers, erosion control blankets and other soil erosion control devices

in accordance with the drawings and Storm Water Pollution Prevention Plan, or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

- B. Deficiencies or changes on the drawings or SWPP shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the SWPP and posted on the drawings.
- C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.
- D. Remove temporary control devices after permanent measure are established. Remove and replace temporary control devices if they become ineffective at no additional cost to Owner.
- E. Contractor shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.
- F. Contractor shall permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.

3.05 DUST CONTROL

- A. Keep dust down at all times, including during non-working periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming is not permitted.

3.06 APPLICATION OF BONDED FIBER MATRIX

- A. The slope shall be prepared and graded prior to application of Bonded Fiber Matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder shall be blended, with the appropriate amount of seed and fertilizer per Section 32 92 19, according to manufacturer's recommendations.
- B. BFM shall be hydraulically applied to the soil as a viscous mixture, crating a continuous, three-dimensional blanket that adheres to the soil surface. BFM shall be mixed and applied at the rate as specified in this Section unless otherwise indicated on the Plans.
- C. The resulting coverage must be at least 1/8 inch thick over the entire surface area. BFM shall be applied in two applications from alternate directions to eliminate shadowing and shall be applied when no rain is expected for 12 hours.

3.07 DEWATERING DISCHARGE

- A. Should it be necessary for Contractor to do any dewatering during the course of construction, Contractor shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water.
- B. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

3.08 MAINTENANCE

- A. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or Owner to control sediment until final stabilization.
- B. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to Owner.

3.09 INSPECTION

- A. General:
 - 1. Contractor is responsible to obtain and/or serve as the Certified Operator.

- a. Weekly inspections are to be conducted by Contractor as a minimum, and after every rainfall event. A copy of the inspection report shall be submitted to the agency having jurisdiction, as well as Owner and Engineer.
 2. Inspections shall be performed by a person familiar with the site, the nature of the major construction activities, and qualified to evaluate both overall system performance and individual component performance.
 3. Inspector must either be someone empowered to implement BMPs in order to increase effectiveness to an acceptable level or someone with the authority to cause such things to happen.
 4. Inspector must be certified as a "Storm Water Professional" through the EGLE storm water training program. Additionally, the inspector shall be properly authorized in accordance with the applicable General Permit to conduct the certified site storm water inspections.
- B. Inspection Frequency Reduction:
1. Inspection frequency may be reduced under the following conditions:
 - a. No active onsite construction activities.
 - b. Temporary cover has been provided across the entire site and no BMPs remain.
 - 1) Situation: waiting for grass to grow, but grass is dormant.
 - c. Ground is frozen and/or snow covered.
- C. Weekly Storm Water Meeting:
1. A weekly storm water meeting will be held by Contractor with those involved in ground-disturbing activities to review the requirements of the permits, the SWPPP, and address any problems that have arisen in implementing the SWPPP or maintaining the BMPs.
 2. Contractor shall maintain a log of weekly meetings and document the issues addressed in the meetings on site.
- D. Agency Storm Water Inspections:
1. A log of inspections by federal, state, or local storm water or other environmental agencies shall be kept in Contractor's SWPPP.
 2. The log form should include the date and time of visit and whether a report was issued or will be issued as a result of the inspection.
 3. Any reports issued will be sent to Engineer within 24 hours.

3.10 PROJECT COMPLETION

- A. Remove temporary soil erosion and sedimentation control devices as soon as permanent measures have been established.

END OF SECTION 01 57 13

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 TRANSPORTATION AND HANDLING

- A. Contractor shall provide for expeditious transportation and delivery of materials and equipment to the Project site in an undamaged condition and on a schedule to avoid delay of the Work. Materials and equipment shall be delivered in original containers or packaging with identifying labels intact and legible.
- B. Contractor shall provide equipment and personnel at the site to unload and handle materials and equipment in a manner to avoid damage. Materials and equipment shall be handled only at designated lifting points by methods to prevent bending or overstressing.

1.02 STORAGE AND PROTECTION

- A. Contractor shall store materials and equipment immediately on delivery, and protect it until installed in the Work.
- B. Products subject to damage by elements shall be stored in weather-tight enclosures with temperature and humidity ranges as required by manufacturer's instructions.
- C. Loose granular materials shall be stored on solid surfaces to prevent mixing with foreign matter.
- D. The place of storage shall be located so as to minimize interference with traffic and to provide easy access for inspection. No material shall be stored closer than 5 feet (1.5 meters) to the edge of a pavement or traveled way open to the public.
- E. Materials that have been stored shall be subject to retest and shall meet the requirements of their respective specifications at the time they are to be used in the Work.
- F. Contractor shall provide protection of stored or installed materials and equipment as necessary to prevent damage from traffic and subsequent operations.

1.03 MANUFACTURER'S INSTRUCTIONS

- A. When the Contract Documents require that installation of Work shall comply with manufacturer's instructions, the Contractor shall obtain and distribute copies of such instructions to parties involved in the installation including two (2) copies to the Engineer.
- B. Contractor shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements. Should Project conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

1.04 PRODUCTS LIST

- A. Within four (4) days of request, the Contractor shall submit a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor, if applicable, to the Engineer.

1.05 CONTRACTOR'S PRODUCT OPTIONS

- A. For products specified only by reference standard, the Contractor shall select any product meeting that standard.
- B. For products specified by naming several products or manufacturer's the Contractor shall select any one of the products or manufacturers named, which complies with the specifications.
- C. For products specified by naming one or more products or manufacturers and "or equal," the Contractor must submit a Substitution Request Form for any product or manufacturer not specifically named, in accordance with Section 00 72 00 - General Conditions.

D. For products specified by naming only one product and manufacturer, there is no option.

1.06 EQUIPMENT STARTUP AND TESTING

- A. Contractor shall perform a comprehensive startup and demonstration of equipment performance and compliance with the design requirements. When there is more than one mode of operation, the equipment shall be operated in every mode to verify proper operation.
- B. When equipment is to operate in conjunction with other equipment as a system, each piece of equipment shall be operated both by itself and automatically as a system to verify its proper operation.
- C. Contractor is to provide to the Engineer, in advance of startup, a schedule and listing of startup and testing procedures for review by the Engineer. Checklists and diagrams may be required to ensure adequate startup and testing. Engineer may recommend changes to the startup procedure as necessary.
- D. All equipment is to be inspected prior to operation for debris or other obstructions. Equipment is to be properly lubricated and calibrated prior to operation. Contractor shall make all adjustments necessary to assure correct operation. When required, equipment installation and operation is to be witnessed and checked by manufacturer.
- E. When required, the Contractor shall train the Owner's operation and maintenance personnel in the proper operation and maintenance of each piece of equipment and the system as a whole.
- F. Equipment startup is to be witnessed by the Owner and the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 77 00 CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 CLEANING

- A. Contractor will perform periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and wind-blown debris, resulting from construction operations.
- B. Waste material, debris and rubbish will be periodically removed from the site and disposed of at legal disposal areas away from the site.
- C. Prior to Owner acceptance, Contractor will conduct an inspection of sight-exposed interior and exterior surfaces, and Work areas, to verify that the entire Work is clean.
- D. Contractor will broom clean exterior paved surfaces and rake clean other exterior surfaces of the site.

1.02 PROJECT RECORD DOCUMENTS

- A. Contractor will deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings and Samples, annotated to show changes made during the construction process, to Engineer upon completion of the Work as record documents. Submittal of the record documents will be made with a transmittal letter containing:
 - 1. Date
 - 2. Project Title and Number
 - 3. Contractors Name and Address
 - 4. Title and Number of each Record Document
 - 5. Certification that each Document as submitted is complete and accurate
- B. Record Documents will include:
 - 1. Annotations, including changes during the execution of the work resulting from Requests of Information, Field Orders, Change Directives, and the as-built conditions which differ from the proposed plans.
 - a. Annotations will include dimensional changes from the proposed plans. Where different from the proposed plans, strike through the proposed dimension and provide the as-built dimension. Changes will be clouded.
 - b. Annotations may also be accompanied by sketches, photos, etc., as appropriate, to demonstrate as-built information or conditions.
 - 2. Underground utilities installed as part of the Project and utilities exposed during execution of the Work. Underground utilities will be surveyed to record their location and elevation. Utility locations will be based upon available Project data (i.e., coordinate system, benchmarks, etc.).
 - a. The utility information shall include:
 - 1) Straight run data every 100-feet.
 - 2) Bends, valves, fittings, wyes/tees, hydrants, etc.
 - 3) Crossings of other utilities.
- C. Record documents will be in Portable Document Format (pdf), full size (i.e., 22" x 34"), in good order and in a legible condition.

- D. Prior to delivery of the project record documents, Contractor will submit draft updates on a monthly basis to Engineer for review.

1.03 OPERATION AND MAINTENANCE DATA

- A. Prior to final inspection or acceptance, Contractor will fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of products, equipment and systems specified in the Contract Documents.
- B. Operation and maintenance data required by the individual Specification sections and the manufacturer's operation and maintenance data required in Section 01 33 00 - Submittal Procedures, will constitute the basis of such instruction.

1.04 START UP

- A. Contractor will coordinate efforts between Owner, Engineer, any equipment manufacturers, subcontractors and governing agencies in the start up of applicable portions of the Work.

1.05 WARRANTIES

- A. Written warranties from the manufacturer shall be provided for major equipment supplied under this Contract. The manufacturer's warranty period shall be concurrent with the Contractor's warranty period. The warranty from the manufacturer shall not relieve the Contractor of the one-year warranty starting at the time of Project Substantial Completion. Owner can request written warranties for equipment not classified as major.

1.06 SUBSTANTIAL COMPLETION

- A. Certification that the Work is substantially complete will be in accordance with the General Conditions.

1.07 FINAL PAYMENT AND ACCEPTANCE

- A. The final inspection, final application for payment and acceptance will be in accordance with the General Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 77 00

SECTION 01 89 00 SITE CONSTRUCTION PERFORMANCE REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes general performance requirements for earthwork complete with, removal and disposal of structures and obstructions, protection of existing sewers, tiles and mains; protection of existing building and improvements, protection of trees and other types of vegetation, protection of utility lines, requirements for pavement replacement, restoration of driveways and parking areas, restoration of sidewalks, restoration of lawns and disturbed areas, transportation and disposal of excess excavation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 57 13 - Temporary Erosion and Sediment Control
- B. Section 31 23 13 - Subgrade Preparation
- C. Section 31 23 16 - Structural Excavation and Backfill
- D. Section 31 23 19 - Dewatering
- E. Section 31 23 33 - Trenching and Backfilling
- F. Section 32 12 16 - Bituminous Paving
- G. Section 32 13 13 - Concrete Paving
- H. Section 32 13 15 - Sidewalks and Driveways
- I. Section 32 92 19 - Seeding
- J. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition.
 - 2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Contractor shall comply with Section 01 57 13 - Temporary Erosion and Sediment Control. Contractor, at Contractor's expense, shall secure all permits, and post all bonds or deposits required to comply with the Soil Erosion and Sedimentation Control, requirements, being Part 91 of PA 451 of 1994 as amended.
- B. Contractor shall comply with all requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.
- C. Contractor shall provide, maintain and remove such temporary and/or permanent Soil Erosion and Sedimentation Control measures as specified on the Plans or as determined by the Engineer.
 - 1. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

1.05 SUBMITTALS

- A. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to the Engineer.

1.06 PROTECTION OF PLANT LIFE

- A. All trees, shrubs, and other types of vegetation not within the limits of the Work or not designated on the Plans or by the Engineer to be removed, shall be carefully protected from damage or injury during the various construction operations.
- B. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by the Contractor's operation shall be repaired or replaced by the Contractor, at Contractor's expense, as determined by the Engineer.

1.07 PROTECTION OF EXISTING STRUCTURES AND IMPROVEMENTS

- A. Existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans to be removed, shall be carefully protected from damage during the construction operations.
- B. Existing structure or improvement not designated to be removed, but which is damaged by the Contractor's operations shall be repaired or replaced by the Contractor, to the satisfaction of the owner, at Contractor's expense.
- C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by the Contractor shall be cleaned out at the Contractor's expense.

1.08 MAINTAINING DRAINAGE

- A. Existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during construction.
- B. Drainage facility not designated to be abandoned, but which is damaged, or any drainage interrupted by the Contractor's operation shall be immediately repaired, replaced, or cleared by the Contractor.
- C. Costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

PART 2 PRODUCTS

2.01 GRANULAR MATERIAL

- A. Bank run sand meeting the requirements of MDOT, Granular Material Class II.

2.02 AGGREGATE FOR SHOULDERS, PARKING AREAS, DRIVEWAYS OR ROADS

- A. Crushed limestone, natural aggregate or slag and meeting the requirements MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

- A. The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry condition during the various construction operations.
- B. The costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at the Contractor's expense.

- C. Refer to Section 31 23 19 - Dewatering for additional requirements.

3.02 GENERAL

- A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If the Contractor requires additional area, the Contractor shall furnish the Engineer with written permission obtained from the property owner for any part of the operations he conducts outside of the right-of-way or limits indicated.

3.03 EXISTING IMPROVEMENTS

- A. Contractor shall expose existing sewers and structures to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required to align the new Work with the existing system.

3.04 EXISTING UTILITIES

- A. When existing utilities are shown on the Plans, their locations are approximate only, as secured in the field investigation and/or from available public records. Contractor, prior to the start of construction, shall contact 811 and the public agency or utility having jurisdiction to request the verification of all utilities within the construction area.
- B. When existing utility lines, structures or utility poles are encountered during the performance of the Work, the Contractor, at Contractor's expense, shall perform construction operations in such a manner that the service will be uninterrupted.
- C. Contractor shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. Contractor shall be responsible for any relocation required as a result of any conflict of existing utilities shown on the plans, with the proposed improvement.
- D. Should it become necessary to move any utility structure, line or pole shown on the Plans or otherwise found necessary to be moved, the Contractor shall make all arrangements with the owner of the utility for the moving. Costs incurred for such moving shall be at the Contractor's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, the Contractor shall furnish the Engineer with satisfactory evidence, in writing, that proper arrangements have been made with the owner of the utility.

3.05 UTILITY POLES

- A. Contractor shall be responsible for any removal or relocation required as a result of any conflict of existing utility poles (including street light poles, guy poles, telephone poles, etc.) with proposed improvements.
- B. Contractor shall make all arrangements for removing or relocating utility poles with the owner of the utility pole.
- C. Prior to disturbing any utility pole, the Contractor shall provide the Engineer with written evidence that proper arrangements have been made with the owner of the utility pole.
- D. When required by the Work, Contractor shall temporarily support poles in the vicinity of the Work at no additional cost to the Owner. Support shall be in accordance with and to the satisfaction of the utility company.

3.06 EXISTING SEWERS, TILE, AND MAINS

- A. Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.
- B. The new material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. The bedding and backfill material, unless otherwise

specified, shall be an approved Class II granular material, compacted to 95% of its maximum unit weight.

- C. Seepage bed tile and water mains shall be replaced in accordance with the requirement of the agency having jurisdiction.
- D. The relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at the Contractor's expense, unless otherwise indicated in the Contract Documents.

3.07 EXISTING STRUCTURES

- A. Existing surface and subsurface structures may be shown on the Plans, in locations considered most probable from information secured in the field investigation or from available public records.
- B. Neither the correctness nor completeness of such information is guaranteed or implied.
- C. Structures shall be protected, preserved or restored by the Contractor, to the satisfaction of the structure owner, at no additional cost to the Project.

3.08 EXISTING BUILDINGS

- A. Existing buildings or structures may be encountered throughout the Project within limits of the presently established right-of-way or easement. Good construction methods and procedures shall be employed by the Contractor, at Contractor's expense, to protect the structures.
- B. When it becomes necessary for the Contractor to move one of these buildings or structures in order to proceed with construction, the Contractor, at Contractor's expense, shall exercise all due care in moving the building or structure to prevent undue damage.
- C. Prior to moving an existing building or structure, the Contractor shall furnish the Engineer with satisfactory evidence, in writing, that proper arrangements have been made with the owner.
- D. Unless otherwise specified in the Contract Documents, the length of the move shall be maintained to a minimum which will allow for construction of the improvement.

3.09 REMOVAL OF SEWERS AND CULVERTS

- A. Unless otherwise specified in the Contract Documents, the Contractor, at Contractor's expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.
- B. When a sewer or culvert is removed at a structure, the Contractor shall install a masonry bulkhead in the structure.
- C. Removal of a culvert or sewer also includes the removal and disposal of any end treatments or headwalls.

3.10 REMOVAL OF STRUCTURES

- A. The removal of existing structures shall consist of removing and salvaging the existing frame and cover. The ends of the existing pipe shall be plugged and braced. The complete structure shall be removed entirely and disposed of. The excavation shall be backfilled with sand and compacted to 95% of its maximum unit weight. Maximum unit weight shall be determined by ASTM D698, Method B.
- B. If a structure is to be removed from a system that is to remain in service, a bypass system, approved by the Engineer, shall be installed and maintained by the Contractor, during the rebuilding period.

3.11 ABANDONING STRUCTURES

- A. The structure shall be broken down to at least 30 inches below the subgrade.

- B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by the Engineer.
- C. The structure shall be backfilled with flowable fill to 12 inches above the pipes and the remainder of the structure backfilled with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 12 inches below finished grade.
- D. The remainder of the excavation shall be backfilled with a granular material, compacted to 95% of its unit weight, and shall meet with the approval of the Engineer. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 SALVAGED MATERIAL

- A. Salvaged materials shall become the property of the Contractor unless otherwise specified in the Contract Documents, and shall be disposed of by the Contractor, at Contractor's expense.

3.13 CROP DAMAGE

- A. In areas where crops are encountered along the route of the construction, a written agreement shall be arrived at by the Contractor and the crop owner as to the type and nature of the crop concerned prior to any construction within the area.
- B. Contractor shall be responsible for making full reimbursement to the owner of the crop damage on the basis of the following procedure:
 - 1. The area of the crop damage shall be determined by measurements taken by the Engineer, and this area shall include those portions of the crop which may extend into the public right-of-way.
 - 2. The average yield of the crop shall be established by the County Office of the U.S. Agricultural Extension Service.
 - 3. The cost of the crop shall be determined by using the prevailing price at the time of harvest as furnished by the U.S. Agricultural Extension Service.
- C. Contractor shall furnish the Engineer with satisfactory evidence that payment for crop damage was made, prior to receiving final payment on the Project.

3.14 REMOVE AND REPLACE TREE

- A. Tree removal and replacement may be accomplished in two ways.
 - 1. Contractor may completely remove and dispose of the existing trees, and after the new improvement has been completed, tested, accepted and rough grading has been completed, the Contractor shall plant new trees, in approximately the same location as the existing trees, of size and species per the landscaping plans included in the Drawings.
 - 2. Contractor may remove and preserve the existing trees.
 - a. The trees shall be properly cared for and maintained in a healthy condition.
 - b. After the new improvement has been installed, tested, accepted and rough grading completed, the trees shall be replanted in approximately the same location.
 - c. Any trees damaged, destroyed or which die, shall be replaced at no additional cost.
- B. Trees, whether replanted or planted new, shall be guaranteed for a period of one year(s) from the date of Substantial Completion.

3.15 REMOVING PAVEMENT

- A. Removal of concrete and bituminous pavement as called for on the Plans shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.
- B. Pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.

- C. Cutting shall be accomplished by using a power-driven concrete saw approved by the Engineer. The depth of the saw cut shall be a minimum of 6 inches, to insure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.
- D. Residual concrete pavement shall not be less than 5 feet measured transversely, nor less than 6 feet longitudinally measured from a joint.
- E. In removing a concrete base course, where part of the existing bituminous surface is to remain in place, the bituminous surface shall be cut the full depth by the use of a power-driven saw, approved by the Engineer along a line parallel to and at least 12 inches from either side of the base course removal.
- F. Old pavement with a concrete cap shall be considered as only one (1) pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.
- G. Removal of Curb for Curb Drop:
 - 1. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling , approved by the Engineer, so as to leave a neat surface with a maximum 1 inch lip, without damage to the underlying pavement.
- H. Removal of Curb and Gutter:
 - 1. Where curb and gutter are to be removed, the operation shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans, or as approved by the Engineer. However, in no case shall the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.
- I. If during the pavement removal operation any concrete or bituminous pavement or surfacing is damaged beyond the removal limits designated, the damaged pavement or surfacing shall be removed and replaced at the Contractor's expense.
- J. Earth removed during the pavement removal operation shall be replaced by backfilling to the proposed subgrade with a suitable material, approved by the Engineer, at the Contractor's expense.

3.16 GUARDRAIL

- A. Beam guardrail shall be relocated or shall be removed as specified on the Plans or as determined by the Engineer. If the existing material is damaged or destroyed, the Contractor shall replace the material at Contractor's expense.
- B. Where guardrail is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.
- C. After the guardrail removal or relocation operations are complete, all surplus material shall be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.
- D. Holes or voids resulting from the guardrail removal operation shall be backfilled with a Class II granular material, approved by the Engineer.

3.17 FENCES

- A. Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, the Contractor shall replace the material at Contractor's expense.
- B. Where fencing is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.

- C. After the fence removal or relocation operations are complete, surplus material shall be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.
- D. Holes or voids resulting from the fence removal operation shall be backfilled with a suitable material, approved by the Engineer.
- E. Where fences are encountered that are being used to confine livestock or to provide security, the fence shall be immediately replaced following construction. During construction, the Contractor, at Contractor's expense, shall provide, install and maintain a temporary fence, meeting the approval of the Engineer.

3.18 HOLES

- A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material. The material shall be placed by the controlled density method or other effective means having the approval of the Engineer and shall be compacted to 95% of maximum unit weight.
- B. Furnishing, placing and compacting of the backfill material shall be at the Contractor's expense.

3.19 RESTORATION IN RIGHT-OF-WAY AND YARD AREAS

- A. Right-of-way and yard areas not paved or aggregate surfaced shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. Disturbed areas may be shaped by "Machine Grading" or another method approved by the Engineer to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter shall be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 shall be restored with sod.
- B. Excess material from the restoration operation shall be disposed of by the Contractor at Contractor's expense.
- C. Disturbed areas shall be graded to receive either topsoil and seed or topsoil and sod. The topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19 or 32 92 23.
- D. Contractor, at Contractor's expense, shall furnish, place, and compact any additional fill, meeting the approval of the Engineer, needed to restore the disturbed areas to the cross sections called for on the Plans or as determined by the Engineer.

3.20 RESTORATION OF AGGREGATE SURFACES

- A. Shoulders:
 - 1. The shoulder shall be regarded as the area between the edge of pavement and the ditch, or the area within 10 feet of the pavement, whichever is the lesser.
 - 2. The backfilling of trenches in the shoulder area shall be carried to within 5 inches of the existing surface as specified under Trench "A" or Trench "B" of Section 31 23 33. The remaining depth shall be backfilled with a minimum of 5 inches of compacted 22A or 23A aggregate with calcium chloride applied, at the rate of 6 pounds per ton of aggregate.
 - 3. Contractor, at Contractor's expense, shall furnish, place and compact all materials necessary to complete the backfilling and restoration operation within the shoulder area.
- B. Driveways and Parking Areas:
 - 1. Aggregate driveway areas shall be regarded as the area from the right-of-way line to the edge of the traveled roadway and shall include the shoulder area.
 - 2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas shall be carried to the bottom of the proposed base course as specified under Trench "B". The

remaining depth shall be backfilled with a minimum of 6 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per ton of aggregate.

3. Aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by the Engineer, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at the Contractor's expense.
 - a. The upper three 3 inches of disturbed areas shall be removed as necessary to allow the final elevation of the resurfacing course to be at the elevation of the drive or parking area which existed prior to excavation.
 - b. Disturbed area shall be resurfaced with a minimum of 3 inches of 22A or 23A compacted aggregate, with calcium chloride applied at the rate of of aggregate.
4. Contractor, at Contractor's expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.

C. Roads and Streets:

1. Backfilling of trenches crossing aggregate surfaced roads or streets shall be carried to within 12 inches of the existing surface as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling. The remaining depth shall be backfilled with two 6 inches layers of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per ton of aggregate.
2. Contractor, at Contractor's expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the roadway or street area.
3. Also, settlement of the aggregate surface shall be restored by placing additional aggregate, up to the original grade, and shall be done at the Contractor's expense.

D. Compaction

1. Compaction of aggregate shall be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.21 RESTORATION OF PAVED SURFACES

- A. Contractor shall furnish and provide the materials necessary to complete the backfilling and restoration operations, which shall include furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.
- B. Restoration of any roadways that are partially damaged shall include a minimum replacement of one (1), full width lane of roadway. The length of replacement shall be at least equal to the width.
- C. Concrete:
 1. The backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the proposed pavement as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.
 2. Unless otherwise specified on the Plans or as determined by the Engineer, the concrete removed shall be replaced with 3500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.
 3. The construction of concrete pavements shall be in accordance with Section 31 23 33 - Trenching and Backfilling.
 4. Restoration of sidewalks shall also include the construction of sidewalk ramps at the intersection of the curb and shall conform to the current rules and regulations of the state

of Michigan and to Section 32 13 15 - Sidewalks and Driveways, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.

D. Bituminous

1. The backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the base course as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.
2. Bituminous pavement or bituminous surface course with an aggregate base shall be replaced in accordance with Section 32 12 16 - Bituminous Paving.
3. Bituminous surfaced areas beyond the limits of the actual excavation which are disturbed by such operations, as temporary storage of materials or passage of equipment, shall be resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material shall extend to smooth-cut edges, shall be uniform in direction and shall be at an elevation which provides a uniform surface between the undisturbed abutting surfaces.
4. Restoration of any bituminous chip seal shoulders that are damaged or partially damaged, as determined by the Engineer, shall include complete replacement full width and length (extending a minimum of 25 feet beyond the damaged area both ways). Existing bituminous chip seal shoulders shall be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 12 16 - Bituminous Paving .

3.22 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall comply with the requirements of Section 01 57 13. Prior to commencing any type of earthwork, the Contractor shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.
- B. Contractor shall obtain all approvals, secure all permits and post all bonds and deposits required to comply with the Soil Erosion and Sedimentation Control Act, Part 91 of PA 451 of 1994, as amended, and those of the enforcing agency.
- C. Contractor shall provide the Engineer with a copy of the soil erosion permit issued by the local enforcing agency for the Project, prior to commencing any type of earthwork on the Project.

3.23 EXCESS EXCAVATION

- A. Excess excavation shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.
- B. Contractor, when requested by the Owner, shall transport excess excavation to a site(s) designated by the Owner.
 1. Excess excavation shall be graded by the Contractor to provide positive surface drainage of the site(s).
 2. Grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface ± 3 inches.
- C. When the excess excavation has not been requested by the Owner, the Contractor shall remove and properly dispose of the material at no additional cost to the Owner.
- D. Proper disposal of all excess excavation, including transportation, grading, and protection of adjacent properties shall be considered as a final cleanup item. No additional payment will be made for this item.
- E. Brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of the Contractor, and shall be disposed of per all

applicable Laws, rules or regulations. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.

- F. Owner approval of the final site(s) condition in writing will be required prior to final payment authorization.

END OF SECTION 01 89 00

SECTION 02 01 10
LOCATION AND MAINTENANCE OF EXISTING UNDERGROUND UTILITIES

PART 1 SCOPE OF WORK

1.01 GENERAL

- A. Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.
- B. Contractor shall verify the exact locations and depths of all utilities shown and the Contractor shall make exploratory excavations of all utilities that may interfere with the work. Exploratory excavations shall be performed as soon as practicable after award of the contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's work. When such exploratory excavations show the utility location as shown to be in error, the Contractor shall so notify the Engineer.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.02 RIGHTS-OF-WAY

- A. Contractor shall not do any work that would affect any oil, gas, water, sanitary sewer, or storm sewer pipeline; any telephone, cable television, fiber optic, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified that the Owner has secured authority therefore from the proper party.
- B. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.03 PROTECTION OF SURVEY MARKERS

- A. Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the Contractor shall be accurately restored after street or roadway resurfacing has been completed.

1.04 RESTORATION OF PAVEMENT

- A. General:
 - 1. Paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.
 - 2. The pavement restoration requirement to match existing sections shall apply to components of existing sections, including sub-base, base, and pavement.
 - 3. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner.
 - 4. Pavements which are subject to partial removal shall be neatly saw-cut in straight lines.
- B. Temporary Resurfacing:
 - 1. Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of

improvements.

C. Permanent Resurfacing:

1. To obtain a satisfactory junction with adjacent surfaces, the Contractor shall sawcut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement.
2. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by sawcutting in straight lines.
3. Pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways:

1. Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the Contractor shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

E. Restoration of Curb and Gutter:

1. Wherever curb and gutter have been removed for purposes of construction, the Contractor shall place suitable temporary curb and gutter promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the Contractor shall maintain said temporary curb and gutter until the final restoration thereof has been made.

1.05 EXISTING UTILITIES AND IMPROVEMENTS

A. General:

1. Contractor shall protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. Contractor shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.
2. Except where the Drawings indicate Utilities have been field located during design or certain Utility locations shall be exposed as part of the work, the Contractor shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work.
3. Exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's progress.
4. When exploratory excavations show the Utility location as shown on the Drawings to be in error, the Contractor shall so notify the Engineer.
5. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.
6. Costs of locating and repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such Utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the work which was interrupted or idled by removal or relocation of such Utility facilities, and which was necessarily idled during such work may be paid for as extra work in accordance with the provisions of Section 00 72 00 - General Conditions. Payment for such work shall be at the discretion of the Owner.

B. Utilities to be Moved:

1. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the Owner to move such property within a specified reasonable time.
2. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

C. Utilities to be Removed:

1. Where the proper completion of the work requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the Engineer and the owner of the facility.
2. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the Contractor in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

D. Owner's Right of Access:

1. The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the work of this Contract.

E. Underground Utilities Indicated:

1. Existing Utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the Contractor, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the Contractor shall reimburse said owner for the costs of repair.

F. Underground Utilities Not Indicated:

1. In the event that the Contractor damages existing Utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a verbal report of such damage shall be made immediately to the Engineer and a written report thereof shall be made promptly thereafter. Engineer will immediately notify the owner of the damaged Utility. If the Engineer is not immediately available, the Contractor shall notify the Utility owner of the damage. If directed by the Engineer, repairs shall be made by the Contractor. Additional compensation for such work will be at the discretion of the Owner.

G. Approval of Repairs:

1. Repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.

H. Maintaining in Service:

1. Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable.

Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.06 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General:

1. Except where trees or shrubs or other plantings are indicated to be removed, the Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs or other plantings, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner.
2. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the Contractor or a certified tree company under permit from the jurisdictional agency and/or the Owner. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.

B. Trimming:

1. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement:

1. Contractor shall immediately notify the jurisdictional agency and/or the OWNER if any tree or shrub is damaged by the Contractor's operations. If, in the opinion of said agency or the Owner, the damage is such that replacement is necessary, the Contractor shall replace the tree or shrub at Contractor's own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, the Contractor shall pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or Owner. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, the Contractor shall water and maintain the replacement trees and shrubs for 6 months after planting.

1.07 LAWN AREAS

- A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the Owner.

1.08 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 02 01 10

SECTION 02 41 13 SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall furnish labor, materials and equipment necessary for the removal and subsequent disposal of the area(s) slated for demolition, including but not limited to supports, piping, electrical equipment, mechanical equipment, floors, walls, ceilings, doors, windows, wood or metal framing, masonry, and asphalt paving, as shown on the Contract Drawings and specified herein. In addition, various utilities shall be cut, abandoned and capped, or completely removed; miscellaneous clearing and grubbing of trees, brush, and vegetation at boundary area shall be performed.
 - 1. Work includes the removal and disposal of the building materials and debris including the removal and disposal of miscellaneous site debris, including but not limited to building area debris, woods, piping materials, bricks, roof materials, metal equipment and all other non-specified material and debris found at the site.
 - 2. Work includes the removal and disposal of the building debris and concrete materials generated by the demolition of the structures listed above. Removal and disposal of concrete, rebar, and steel is incidental to the project. It is recommended that steel be recycled. Contractor may recycle concrete and asphalt to reduce cost.
- B. Contractor has salvage rights to all salvageable restaurant equipment, electrical equipment, metals, salable items, and other recyclable materials unless indicated otherwise.
 - 1. Contaminated building materials shall not be salvaged and shall be disposed of in accordance with applicable local, state, and federal regulations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 01 31 19 - Project Meetings
- C. Section 31 23 16 - Structural Excavation and Backfill

1.03 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to the Owner's designated storage area.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Owner, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.04 PERMITS

- A. Permits described here cover the general description of the permits called for demolition. The permits described below are not necessarily all of the permits required for completion of this project.

1. Demolition Permit: Contractor shall be responsible for obtaining a demolition permit from the Building Department. Contractor is responsible for all permit fees.
2. NESHAP Notification of Intent to Demolish: Contractor shall be responsible for filing and for the fee involved with submitting an intent to demolish permit from the Michigan Department of Environment, Great Lakes and Energy, Air Quality Division.
 - a. The notification shall describe the demolition tasks to be conducted and the quantities of asbestos containing materials specified for abatement.
3. Soil Erosion and Sedimentation Control: Contractor shall be responsible for filing and for the fee involved with obtaining soil erosion and sedimentation control permits from the agency having jurisdiction.

1.05 MATERIAL OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition legally at Contractor's option.

1.06 SUBMITTALS

- A. Submit each of the following items in accordance with Section 01 33 00:
 1. Work Plan: Prior to proceeding with the demolition, removal and disposal work, the Contractor shall submit a work plan which includes the means, methods and procedures proposed for the accomplishment of the removal and disposal work.
 - a. Means, methods and procedures shall provide for safe conduct of the work; careful removal and disposition of buildings and structures, and solid materials and wastes; and protection of property that is to remain undisturbed.
 - b. Procedures shall provide a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.
 - c. The name and location of disposal facilities for all removed materials shall be submitted in the Work Plan.
 - d. Work plan shall be based on work experience, and the guidance provided in this specification. The cost of work plan preparation is incidental to the project.
 2. Demolition Schedule: Contractor shall submit a complete coordination schedule for demolition work, including shut-off and continuation of utility services, with the Engineer's approval prior to start of the work.
 - a. Schedule shall indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.
 3. Disposal Documents: Contractor shall provide copies of all licenses, certifications, permits, agreements, manifests, chain of custody records, weigh tickets, meter recordings, delivery tickets, and receipts required or issued for the disposal of materials, the methods used, and the disposal areas and facilities. Contractor shall also provide a copy of the results of tests performed to comply with the requirements of each disposal facility.
 4. Manifests: Contractor shall submit a copy of the official manifest for each shipment of removed materials including, but not limited to, building and structure debris, concrete and brick debris, and miscellaneous site debris and solid wastes evidencing delivery of the material to an approved licensed disposal facility. All manifests shall be in accordance with the requirements of all the applicable federal, state and local regulations. Manifests shall be signed by the Owner or the Owner's Representative.

5. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions in accordance with Section 01 77 00.

1.07 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing Environmental Protection Agency notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Pre-Demolition Conference: Conduct conference at Project site to comply with Section 01 31 19.

1.08 PROJECT/SITE CONDITIONS

- A. Condition of Facilities: Owner assumes no responsibility for actual condition of facilities to be demolished. Contractor shall visit the site and inspect the existing facilities.
- B. Occupancy: Owner may continuously occupy areas of site immediately adjacent to areas of selective demolition. Conduct demolition work in manner that will minimize need for disruption of the Owner's normal operations.
- C. Protections: Provide temporary barricades and other forms of protection to protect the public from injury due to selective demolition work.
 1. Provide protective measures as required to provide free and safe passage of the Owner, tenants, vehicles, and general public to areas directly affected by demolition activities and those adjacent to such activities.
 2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.
 3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 4. Protect floors with suitable coverings when necessary.
 5. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing structures.
 6. Provide temporary dust and debris barriers of fire resistant materials to control dust and debris and to confine demolition of existing and finished work.
 7. Remove protections at completion of work.
- D. Damages: Promptly repair damages caused to adjacent facilities by demolition work.
- E. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
 1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without approval from the Owner and providing alternate routes around closed or obstructed traffic ways.
- F. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.
- G. Explosives: Use of explosives is not permitted.

- H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
1. General:
 - a. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing utilities or schedule work to install interrupted utilities first, as acceptable to the Owner.
 - b. Maintain fire protection services during selective demolition operations.
 - c. Provide temporary support and protection of existing utilities, which cross the proposed piping trench.
 - d. Permits shall be obtained from utility or agency having jurisdiction, if necessary. Contractor is responsible for all permit fees.
 - e. If relocation of any utility is necessary, the Contractor shall be responsible for associated fees or expenses, unless indicated otherwise.
 2. Electrical Disconnection: Contractor shall verify that on site electrical wiring entering all structures to be demolished or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or de-energized prior to proceeding with demolition operations.
 - a. Contractor shall coordinate with the local electrical utility company for any necessary relocation of utilities and be responsible for any associated fees or expenses.
 3. Water Disconnection: Contractor shall perform or verify that on-site water lines entering all structures or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.
 4. Sewer Disconnection: Contractor shall locate and bulkhead all sewer connections from the building structure prior to proceeding to demolition. The work shall be performed as indicated on Site Plans in accordance with .
 5. Gas Disconnection: Contractor shall verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.
 6. Telephone and Cable Disconnection: Contractor shall verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.
- I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
- J. Provide ventilation to maintain non-toxic unpolluted working area for adjacent the Owner's operating areas and construction/demolition areas. Welding and cutting torches producing smoke or toxic fumes must be adequately ventilated.

1.09 WARRANTY

- A. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.01 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Contractor shall use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Provide written pre-demolition report to the Engineer prior to start of Work. The report shall contain the following information:
 - 1. Determination of condition of framing, floors, and walls, and possibility of unplanned collapse of any portion of structure or adjacent structure where employees may be exposed.
 - 2. Various phases of demolition and description of how employees will be protected from unplanned contact with active utilities, exposure to toxic materials and gases, falling objects, structural collapse, and any other hazards routinely associated with demolition activities.
- B. Locate existing utilities within project limits prior to any demolition. Verify that utilities have been disconnected and capped.
 - 1. If unanticipated mechanical, electrical or structural elements that conflict with intended function or design are encountered, investigate and measure nature and extent of conflict and promptly submit a written report to the Engineer.
 - a. Pending review of the report by the Engineer, the Contractor shall rearrange the selective demolition schedule, and notify the Engineer and the Owner as necessary to continue overall job progress without delay.

3.02 PREPARATION

- A. Conduct demolition operations and remove debris in manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
- B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities designated to remain.
 - 1. Provide temporary barricades and other forms of protection as required for safety and security.
 - 2. Provide barriers and appropriate to restrict pedestrians from wandering into construction areas.
 - 3. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure no water leakage or damage occurs to structure or interior areas.
- C. Erect and maintain dust-proof partitions and temporary enclosures to limit dust or dust migration, and to separate areas from fumes and noise, if necessary.
- D. Provide and maintain interior and exterior shoring, bracing or structural support to preserve stability and prevent movement, settlement, or collapse of structures and adjacent facilities that are not part of demolition.
- E. Provide acceptable temporary security barriers where physical security of buildings or fences is compromised due to demolition work.

3.03 SALVAGE REQUIREMENTS

- A. Coordinate with the Owner to identify structure and/or building components and equipment required to be removed and delivered to the Owner subsequent to demolition.
 - 1. Owner shall tag components and equipment designated for salvage.
- B. Contractor shall protect designated salvage items from demolition operations until items can be removed.
 - 1. Carefully remove components and equipment indicated to be salvaged.
 - 2. Disassemble as required to permit removal .
 - 3. Package small and loose parts to avoid loss.
 - 4. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
 - 5. Deliver salvaged items to the Owner and obtain signed receipt from the Owner indicating that the Owner has received tagged items.

3.04 REPAIRS

- A. Contractor shall provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces whether shown or not shown, with materials and procedures approved by the Engineer.
- B. Return structures and surfaces not part of demolition, to conditions existing prior to commencement of demolition work.
- C. Contractor shall repair all damages caused to adjacent facilities by demolition as directed by the Engineer at no cost to the Owner.
- D. Contractor shall make a detailed inspection after patching and repairing has been completed, and shall carefully remove splattering of mortar from adjoining work (particularly, but not limited to, plumbing fixtures, trim, tile, and finish metal surfaces), and make good any damage caused by such cleaning operations.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. Contractor shall remove and legally dispose of demolished materials, site debris, rubbish, and other materials resulting from demolition operations shall be promptly removed.
 - 1. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the Owner.
 - 2. If the Contractor encounters material during removal that is suspected to be potential hazard, stop work immediately and notify the Engineer.
 - 3. Disposal shall conform to Federal, State and local requirements.
 - 4. Removed materials shall be documented by manifests and disposal facility tickets with copies given to the Engineer 48 hours after removal from the site.
- B. Burning of removed materials from demolished structures shall not be permitted on site.

3.06 RECYCLING

- A. Owner encourages the recycling of demolition debris where appropriate. Contractor has the option to recycle any material found or demolished on site in order to reduce costs or project duration.
- B. Although the materials are not limited, it is recommended that at least steel and concrete be recycled.

1. Steel and concrete to be recycled can be stockpiled on site and eventually removed. Steel separated from demolition rubble may be recycled and becomes the property of the Contractor.
2. Contractor will not be allowed to abate on site any lead paint found on the steel unless appropriate procedures and federal, state and local codes or regulations are followed.
3. Any material stockpiled for recycling shall be removed from the site prior to the contract end date and/or site restoration.

3.07 CLEANING

- A. During and upon completion of work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition in Division 1.
- B. Contractor shall clean adjacent structures and facilities of dust, dirt, and debris caused by demolition, as directed by the Engineer or Owner, and return adjacent areas to condition existing prior to start of work.

END OF SECTION 02 41 13

SECTION 03 01 30 CONCRETE REPAIR AND REHABILITATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section includes furnishing of materials, labor, tools, and equipment necessary to repair, patch, and restore poorly placed or deteriorated concrete; and repair of joints and reinforcing steel. This includes removal of deteriorated concrete, surface preparation and installation of repair materials at deteriorated areas, cracks, and joints in concrete floors, walls, and ceilings as indicated on the drawings and specified herein.
- B. Defects that require repair include tie holes, exposed steel, voids, holes, honeycombed areas, spalling, delamination, cracking, and other defects as determined by the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 11 00 - Concrete Forming
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 03 32 00 - Construction and Expansion Joints
- E. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 201.1R-08 Guide for Making a Condition Survey of Concrete in Service
 - 2. ACI 546R-04 Concrete Repair Guide
- B. American Society for Testing and Materials (ASTM)
- C. ASTM C109 Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 1. ASTM C157 Test Method for Length Change of Hardened Cement Mortar and Concrete.
 - 2. ASTM C666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing
 - 3. ASTM C882 Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
 - 4. ASTM D412 Test Methods for Vulcanized and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - 5. ASTM D624 Test Methods for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 6. ASTM D903 Test Methods for Peel or Stripping Strength of Adhesive Bonds.
 - 7. ASTM D3359 Standard Test Methods for Measuring Adhesion by Tape Test.
- D. The Society for Protective Coatings (SSPC)
 - 1. SSPC – SP13/NACE No. 6 Surface Preparation of Concrete

1.04 SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit manufacturer's data completely describing concrete repair materials for each type of product to be utilized in the concrete repair process. Include material descriptions; chemical composition, physical properties, test data, and mixing, preparation, and application

instructions. Submittals shall include a written statement from the Contractor that all products are compatible with each other, and consistent with the warranty requirements of the project.

- C. Concrete Rehabilitation Qualifications:
 1. Submit the name and experience record of the concrete rehabilitation Contractor. Include a list of at least 5 of the Contractor's previous utility or industrial installations rehabilitated, and identify the responsible officials, architects and engineers concerned with the project, contact information, and approximate contract price.
- D. Rehabilitation program: For each phase of the rehabilitation process, including protection of surrounding materials and site during operations, describe in detail the materials, methods, equipment and sequence of operations to be used for each phase of the work.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturer of the specified product shall have been in existence, for a minimum of 10 years.
- B. Installer Qualifications: Work must be performed by a firm having not less than 5 years successful experience in comparable concrete repair and rehabilitation projects, and employing personnel skilled in the restoration process and operations indicated.
- C. Source limitations: Obtain concrete patching and rebuilding materials, crack injection materials, corrosion inhibitors, sealants, all through one source from a single manufacturer.
- D. Construction Tolerances: Construction tolerances shall be as specified in Section 03 30 00 - Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.
- E. Mockups: Install mockups for each type of concrete removal and patching, concrete repair, crack injection, and joint sealing to demonstrate the quality of materials and execution for approval by the Owner.
 1. Approved mockups may become part of the completed work if undisturbed at time of substantial completion.
 2. The independent testing agency, or other inspection party representing the Owner, shall be present during the construction of the mockups.
 3. Quality Control testing, as required by this Specification, shall be performed on each mockup.
- F. Pre-installation conference: Prior to beginning any concrete repair or rehabilitation work, the Contractor shall meet with the Owner to thoroughly discuss the proposed work, techniques and schedule. Representatives of the Manufacturer and Installer of repair and rehabilitation materials, as well as the independent testing agency, shall attend the pre-installation conference.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.
- B. Store and condition the specified product as recommended by the Manufacturer.
- C. Store in a suitable location approved by the Owner at all times. Keep area clean and accessible. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.
- D. Handle materials carefully to prevent inclusion of foreign materials.
- E. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

1.07 PROJECT/SITE CONDITIONS

- A. Existing Conditions:
1. Hot Weather: ACI 305
 2. Cold Weather: ACI 306
 3. Do not place concrete repair mortar during precipitation, unless adequate protection is provided.
 4. Coordinate coatings application with other trades to assure adequate illumination, ventilation, and dust-free environment during application and curing of coatings.
 5. Maintain a safe work environment in accordance with Federal, State, Local and project site regulations and guidelines.

PART 2 PRODUCTS**2.01 REPAIR MORTAR**

- A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementitious, non-sag mortar, specifically formulated for the repair of surface defects.
- B. Provide the mortar with a penetrating corrosion inhibitor.
- C. Repair mortar shall have the following properties:

Physical property	Value	ASTM Standard
Compressive strength (min) at 1 day at 7 days at 28 days	3000 psig 6000 psig 7000 psig	C109
Bond strength (min) at 28 days	2200 psig	C882 (modified)
Freeze/Thaw resistance (min) 300 cycles	98 percent	C666

- D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.
- E. Repair Mortar Manufacturer, or Equal:
1. Sika Corporation, SikaTop 123 Plus

2.02 NON-SHRINK GROUT

- A. Provide non-shrink grout conforming to the requirements of Section 03 60 00 - Grouting.

2.03 CONCRETE MATERIALS CEMENT

- A. Cement:
1. Use Type II Portland cement unless otherwise indicated.
- B. Repair Concrete:
1. Where required, provide repair concrete composed of structural concrete with maximum one- inch coarse aggregate meeting the requirements of Section 03 30 00 - Cast-in-Place Concrete.
 2. Provide a minimum repair thickness of 3 inches.
- C. Cement Grout:
1. Provide cement grout that meets the requirements of Section 03 60 00 - Grouting.
 2. Provide a minimum repair thickness of one inch.

D. Miscellaneous Materials

1. For concrete construction materials not covered specifically in this Section, conform to the requirements of Section 03 30 00 - Cast-in-Place Concrete.

2.04 AGGREGATE

- A. Obtain the permission of the manufacturer and Owner before using aggregate to extend repair mortar and non-shrink grout products.
- B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in Section 03 30 00 - Cast-in-Place Concrete.

2.05 BONDING AGENT AND ANTI-CORROSION COATING

- A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.
- B. Bonding Agent Manufacturer, or Equal:
 1. Sika Corporation, Armatec 110 EpoCem.

2.06 EPOXY GROUT

- A. Provide an epoxy grout conforming to the requirements of Section 03 60 00 - Grouting.

2.07 EPOXY RESIN

- A. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.
- B. Provide a minimum bond strength of 2900 psig when tested per ASTM C 882 at 14 days, moist cured.
- C. Epoxy Resin Manufacturer, or approved Equal:
 1. Sika Corporation, Sikadur 35, Hi-Mod LV

2.08 PROTECTIVE COATING

- A. Waterproofing:
 1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.
 2. The waterproofing shall be certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.
 3. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.
 4. Waterproofing Manufacturer, or Equal:
 - a. Sika Corporation, Sika Top Seal 107

2.09 FORMWORK

- A. Where needed, provide formwork that meets the requirements of Section 03 11 00 - Concrete Forming.

2.10 REINFORCEMENT STEEL

- A. Where required, provide reinforcing steel that meets the requirements of Section 032100.

2.11 POLYURETHANE SEALANT

- A. Provide a 2-part polyurethane, gun-grade sealant, certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.
- B. Polyurethane Sealant Manufacturer, or approved Equal:

1. Sika Corporation, Sikaflex – 2C

2.12 POLYURETHANE CHEMICAL GROUT

- A. Use polyurethane chemical grout for non-structural crack repair
- B. Polyurethane Chemical Grout Manufacturer, or approved Equal:
 1. Sika Corporation, SikaFix HH

2.13 HYDROPHILIC WATERSTOP

- A. Provide hydrophilic waterstop conforming to the requirements of Section 03 32 00 - Construction and Expansion Joints.

PART 3 EXECUTION

3.01 GENERAL

- A. Repairs:
 1. Repair all defects immediately after form removal.
 2. Repair techniques will be reviewed during the pre-construction meeting between the Contractor and Owner.
 3. Contractor shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each particular repair.
 4. Choose repair materials to match the adjacent concrete surface in color and texture.
 5. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.
 6. Protect adjacent portions of the structure, including all pipes, and mechanical equipment, from debris generated by repair activities.
 7. For portions of the structure that are not identified to be repaired, maintain in their original condition.
 8. Dampen area to be patched and area at least 6 inches wide surrounding area to be patched for at least 24 hours to prevent absorption of water from patching mortar.
- B. Structural Stability:
 1. Use caution not to weaken the structural capacity of a beam, wall, slab, or other concrete member during concrete removal.
 2. For severely deteriorated concrete members, consult with the Owner before removing a major portion of any structural member.
 3. Shoring may be required in order to support the structure and to protect workers.
- C. Shoring:
 1. Contractor shall design the shoring to adequately distribute the load to the foundation in such a manner as to avoid damage to the structure.
 2. Maintain the shoring in place until all repairs are completed and structurally repaired areas have achieved their full 28-day design strengths.
- D. Provide off-site disposal of debris generated as a result of repair procedures.
- E. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

3.02 SUGGESTED REPAIR SEQUENCING

- A. Unless otherwise indicated, perform concrete repairs in the following sequence, with no activity in an area being started until previous activities in that area have been completed, including curing, cleanup, and the like:
 - 1. Removal of equipment, miscellaneous metals, and other surface features that would interfere with the repair;
 - 2. Surface preparation hydroblasting over the entire area to be repaired;
 - 3. Embedded metal repair;
 - 4. Crack repair;
 - 5. Spalled and delaminated concrete repair;
 - 6. Scaled concrete repair;
 - 7. Pop-out repair, and repair of other surface damage, deterioration, or defects;
 - 8. Patching of holes in concrete;
 - 9. New construction; and
 - 10. Application of protective coatings;
- B. For areas which require combinations of spalled and delaminated concrete repair, scaled concrete, and pop-out repair, perform these repairs at the same time.
- C. Limit the size of the repair area in order to permit the repairs to be performed together, without sacrificing the quality of the individual repairs.

3.03 EMBEDDED METAL REPAIR

- A. Unless otherwise indicated, repair anchor bolts, structural steel from temporary support system, and other embedded metal, except rebar, that are exposed at the concrete surface, as follows:
- B. Cut off or otherwise remove metal fastened at the surface:
 - 1. Burn back embedded metals to a depth of at least 1.5 inches beyond the surface of sound concrete. When removing hollow structural members, completely fill and patch the void over the entire member thickness;
 - 2. Chip away unsound concrete around the embedded metal.
 - 3. Apply epoxy grout to the repair area until level with the surface of the surrounding sound concrete.
- C. Unless otherwise indicated, repair embedded rebar that is exposed at the concrete surface following the procedures outlined in the appropriate concrete repair subsection, below.

3.04 CRACK REPAIR

- A. Structural versus Non-Structural Cracks:
 - 1. Cracks are defined by the Owner as non-structural cracks or structural cracks.
 - 2. Repair structural cracks with epoxy resin.
 - 3. Repair non-structural cracks with polyurethane chemical grout.
- B. Efflorescence:
 - 1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.
 - 2. Clean the efflorescence by light hydro-blasting or scrubbing.
- C. Pressure Injection:

1. General:
 - 1) The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the Contractor and Owner.
 - 2) In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.
2. Structural cracks are to be repaired to deliver a water tight hydraulic structure. Cracks greater than a minimum 0.01" are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's directions, and in accordance with the following basic procedure:
 - a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.
 - b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.
 - c. Install the injection ports in accordance with the manufacturer's directions.
 - d. Sealing:
 - 1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.
 - 2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden.
 - 3) Use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.
 - 4) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected polyurethane grout and to prevent wastage. Seal surface of crack with fast setting hydraulic cement or high strength epoxy gel; i.e., Denepox Rapidgel by De Neef Construction Chemicals, Inc. or equivalent. The floor surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work
 - e. Inject the repair materials, with consideration of the following items:
 - 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.
 - f. Cleanup:
 - 1) Remove the surface seal by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.

- 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.
3. Non-structural cracks are to be repaired to deliver a water tight hydraulic. All cracks greater than a minimum 0.01" are to be injected unless they do not accept grout. Perform non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:
 - a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.
 - b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.
 - c. Install the injection ports in accordance with the manufacturer's directions.
 - d. Moisture:
 - 1) For non-structural cracks, moisture must be present for the chemical grout to react.
 - 2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.
 - e. Inject the repair materials, with consideration of the following items:
 - 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that all voids are properly sealed off.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.
 - f. Cleanup:
 - 1) Remove excess surface material by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.
 - 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.05 SPALLED AND DELAMINATED CONCRETE REPAIR

- A. Repair spalls and delaminated concrete using repair mortar.
- B. Surface Preparation:
 1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.
- C. Boundaries:
 1. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one-inch deep.
 2. Layout boundaries to reduce boundary edge length.

3. Avoid excessive or complex edge conditions.

D. Sawcuts:

1. Perform sawcuts perpendicular to the surface or slightly undercut.
2. Construct sawcuts in maximum 1/4-inch increments.
3. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.
4. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the Owner.
5. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by patching material, whichever is greater.
6. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.

E. Removal:

1. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.
2. Hydroblast removal shall use a maximum pressure of 40,000 psig.
3. Sand blasting is not permitted.
4. Hydroblast concrete removal is recommended for large area of surface defects.
5. Remove water blasting debris daily in order to prevent it from setting up.
6. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.
7. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.

F. Reinforcement:

1. Remove concrete from around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, and if the concrete is unsound or honey-combed.
2. Remove concrete in order to provide a clear space of minimum one inch on each side of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.
3. Clean exposed reinforcement by water blasting or wire brushing.
4. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.
5. Consult with the Owner before adding or replacing rebar.

G. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

H. Repair Mortar:

1. Apply repair mortar in accordance with the manufacturer's recommendations.
2. Apply a minimum and maximum thickness of each lift of repair material in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.
3. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
4. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
5. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
6. Float-finish the repaired surface using wood or sponge floats.
7. For repaired surfaces to receive a protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.
8. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

I. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
 - a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
 - c. Ensure that edges are continuously held in place; and,
 - d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.06 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation:

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.
2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psig and maximum pressure of 40,000 psig.
3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.
6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.
7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
10. Float-finish the repaired surface using wood or sponge floats.
11. Provide strip joint in newly placed mortar at the location of repaired cracks.

D. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
 - a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
2. Ensure that edges are continuously held in place; and,
 - a. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
3. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
4. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

E. Repair: REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

1. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described herein.

3.07 PATCHING OF HOLES IN CONCRETE

A. General:

1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.

2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.
 3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.
 4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.
 5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude, and roughen larger holes to a minimum of 0.25-inch amplitude.
 6. At holes, coat the existing surface to be repaired with a bonding agent.
- B. Patching Small Holes:
1. For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout as required in Section 03 60 00 - Grouting.
- C. Patching Large Holes:
1. Fill holes which are larger than 12 inches in their least dimension with non-shrink grout.
 2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove, approximately 1/16 inch deep.
 3. Grind the groove into the interior edge of the hydrophilic waterstop.
 4. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.
 5. Install the waterstop in accordance with the requirements of Section 03 32 00 - Construction and Expansion Joints.
 6. Provide reinforcing steel in layers matching existing reinforcement location, except that concrete cover as required in the Contract Documents for the service condition shall be provided.
 7. For holes smaller than 48 inches, provide reinforcement consisting of a minimum of No. 5 bars at 12 inches on center in each layer required.
- D. At holes larger than 30 inches, drill the reinforcement and grout into the existing concrete.
1. For holes larger than 48 inches, refer to the Drawings for reinforcement details.

3.08 PATCHING OF LINED HOLES

- A. General:
1. This work applies to those openings which have embedded material over all or a portion of their inside edge.
 2. The requirements for repairing holes in concrete, as indicated above, apply as modified herein.
 3. Engineer will determine whether the embedded material is allowed to remain.
 4. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface.
 5. Roughen or abrade the embedded material in order to promote good bonding to the repair material.
 6. Remove substances that interfere with good bonding.
 7. Completely remove embedded items that are not securely and permanently anchored into the concrete.

8. Completely remove embedded items which are larger than 12 inches in their least dimension, unless they are composed of a metal to which reinforcing steel can be welded; where reinforcement is required, weld it to the embedded metal.
- B. The following requirements shall apply to concrete members which are in contact with water or soil:
1. Using epoxy grout, fill lined openings which are less than 4 inches in their least dimension;
 2. Using an epoxy bonding agent, coat lined openings which are greater than 4 inches but less than 12 inches in their least dimension, prior to being filled with non-shrink grout.
 3. Using an epoxy bonding agent, coat lined openings which are greater than 12 inches in their least dimension, and provide a hydrophilic waterstop bonded to the interior of the opening with epoxy adhesive, prior to being filled with approved repair material.

END OF SECTION

SECTION 03 11 00 CONCRETE FORMING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes formwork for cast-in-place concrete, complete with furnishing, preparation, installation, coating, protection, adjustment, removal and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 15 00 - Concrete Accessories
- B. Section 03 20 00 - Concrete Reinforcing
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 DESIGN STANDARDS

- A. The formwork shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Guide to Formwork for Concrete" ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. The design and construction of the formwork shall be the responsibility of the Contractor.
- B. The formwork shall be true in every respect to produce hardened concrete to the required shape, size, grade and alignment as indicated on the Plan, and of sufficient strength, bracing and rigidity to maintain their position and shape under the loads and operations incidental to placing and curing the concrete, as well as all other forces resulting from the movement of the forms.
- C. The forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surfaces of the finished concrete will be reasonably free from ridges, fins, offsets, or similar defects.
- D. Adequate and suitable means for removing the forms without injury to the surfaces or edges of the finished concrete shall be provided.

1.04 ALLOWABLE TOLERANCES

- A. Formwork shall be constructed such that the hardened surfaces shall conform to the tolerance limits of ACI 347R , except as modified below:
 - 1. Variation from plumb in lines and surfaces of piers, walls, or columns
 - a. In any 10 feet of length: 1/4 inch
 - b. Maximum for entire length: 1 inch
 - 2. Variation from the level or from the grades
 - a. In any 10 feet of length: 1/4 inch
 - b. Maximum for entire length: 3/4 inch
 - 3. Variation of distance between walls, columns and beams
 - a. In any 10 feet of distance: 1/4 inch
 - b. Maximum for entire distance: 1 inch
 - 4. Variation of the linear lines from established position as indicated on the Plan
 - a. In any 20 feet (6 m) of length: 1/2 inch
 - b. Maximum for entire length: 1 inch
 - 5. Variation in sizes and locations of sleeves, floor openings, and wall openings

- a. Minus: 1/4 inch
 - b. Plus: 1/2 inch
6. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls
- a. Minus: 1/4 inch
 - b. Plus: 1/2 inch
7. Variations of footing dimensions from plan dimensions
- a. Minus: 1/2 inch
 - b. Plus: 2 inch
8. Thickness \pm 5%, up to maximum of 1 inch

1.05 REFERENCE STANDARDS

- A. ACI 347R: Guide to Formwork for Concrete
- B. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field

1.06 SUBMITTALS

- A. Submit manufacturer's literature for form coating.
- B. Submit formwork layout plans, design data and procedures if requested by the Engineer.

1.07 STORAGE AND HANDLING

- A. Store and handle form coating to prevent contamination of coating in accordance with manufacturer's recommendations.

1.08 SEQUENCING

- A. Sequence installation of formwork with the Work of Section 03 20 00, Section 03 15 00, and Section 03 30 00.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Use lumber that is straight, uniform width and thickness, free from knots, offsets, holes, dents, warpage and other surface defects.
- B. Use plywood product of standard psi, waterproof, resin-bonded, exterior-type Douglas Fir, face adjacent to concrete shall be Grade B or better.
- C. Metal forms to be smooth metal plate free of surface irregularities.
- D. Chamfer Strips: Use clear white pine, surface against concrete planed, 1 inch bevel width or cant strip.

2.02 FORM COATING

- A. Use nonstaining form oil or other mineral oil which will neither discolor nor otherwise injuriously affect the concrete.

2.03 FORM TIES

- A. Use permanently embedded body type with removable end cones on outer ends, permanently embedded portion 1 inch back from concrete face.

2.04 FORMS - GENERAL

- A. Use forms that conform to ACI 347R. Fabricate with facing materials that produce the specified tolerance requirements outlined in Part 1 of this Section; produce true surfaces, sharp corners and true lines; and are free of offsets, ridges, bulging, waves and concave or convex areas.

2.05 LAYOUT

- A. Use regular and uniform pattern; long dimension of panels vertical; joints horizontal, vertical and aligned; form ties uniformly spaced and aligned in horizontal and vertical rows.

PART 3 EXECUTION

3.01 PREPARATION

- A. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material or water before coating is placed in them.
- B. Forms shall be coated in accordance with manufacturer's recommendations before the form or reinforcement is placed in final position. Surplus coating on form surfaces, or any coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.02 INSTALLATION OF FORMS

- A. Forms shall be sufficiently tight to prevent loss of mortar from the concrete, set true to the lines and elevations indicated on the Plans, tied and braced to remain true during and after concrete placement within tolerances outlined in Part 1 of this Section. The Engineer may at any time condemn any section or sections of forms found deficient in any respect, and such form shall be promptly removed and replaced.
- B. No wooden spreaders shall be allowed to remain in the concrete. No metal shall be within 1 inch of any surface.
- C. Place chamfer strips in forms to bevel all corners, edges, joints and other structural elements exposed to view, including use of dummy chamfer and false joints to provide neat and uniform appearance. Exposed corners and edges shall have 3/4 by 3/4 inch - 45 degree chamfers, unless otherwise indicated on the Plan.
- D. Provide temporary openings at the base of wall forms and at the other points when necessary to facilitate cleaning and inspection immediately before depositing concrete.
- E. Secure in position wedges used for final alignment and items to be embedded in concrete.
- F. Forms for keyways shall be prepared in advance of pouring concrete. Keyway forms in slab edges and vertical wall joints shall be rigidly secured in place before the concrete is poured. Forms for keyways for horizontal joints in walls may be placed at the conclusion of the pour, but proper provision shall be made for obtaining and holding the full depth and form of the keyway.

3.03 ADJUSTMENT OF FORMS

- A. Positive means of adjustment should be provided to permit realignment or readjustment of shores if excessive settlement occurs.
- B. A pair of wedges may be used at the top or bottom of shores, but not at both ends, to facilitate vertical adjustment, to correct uneven settlements, or to facilitate dismantling of the formwork.
- C. Screw jacks for pipe shores or scaffold-type shoring may be used at both top and bottom so long as they are secured by the shore or scaffold leg against loosening or falling out, to avoid lateral deflections.
- D. During and after concreting, but before initial set of the concrete, the elevations, camber, and plumbness of formwork systems shall be checked, using telltale devices. Appropriate adjustments shall be promptly made where necessary. If, during construction, any weakness

develops and the formwork shows any undue settlement or distortion, the Work shall be stopped, the affected construction removed if permanently damaged, and the formwork strengthened.

3.04 REMOVAL OF FORMS

- A. Forms, wedges or shoring shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all superimposed dead, temporary construction, and live loads. When forms or shoring are removed, there shall be no excessive deflection or distortion of the concrete. Forms shall be removed in an orderly fashion; with care to avoid surface gouging, corner or edge breakage, or other damage or injury to the concrete surface or physical property; and without impact or shock, to permit the concrete to carry its share of the loads gradually and uniformly. Form removal shall not impair the safety and serviceability of the structure or concrete members.
- B. Forms and shoring in the formwork used to support the weight of concrete in beams, slabs, and other structural members shall remain in place a minimum of 14 days or until the concrete has reached a minimum of 75% of the design compressive strength. The cylinder strength shall be based on test specimens cured in the field, as described in ASTM C31/C31M, under conditions which are not more favorable than the most unfavorable conditions for the portions of the concrete which the test specimens represent and shall be determined in accordance with Section 03 30 00.
- C. Formwork for columns, walls and other vertical members shall remain in place a minimum of five (5) days or until the concrete has attained a minimum of 75% of its design strength. Where such formwork also supports the formwork of beams and slabs, the removal times of the latter shall govern. Face and edge forms shall be removed as soon as practicable and permitted by the Engineer in order to facilitate effective repair of voids or broken corners before the surface has dried.
- D. Forms and shoring in the formwork shall not be removed without the approval of the Engineer. The minimum in-place times are for ordinary conditions and represent cumulative number of days, not necessarily consecutive, after the concrete was placed, during which the temperature of the air surrounding the concrete is above 50 degrees Fahrenheit. The times may be increased or decreased as directed by the Engineer, dependent on air temperatures, cement type, concrete additives or other conditions of the Work in accordance with ACI 347R.

3.05 RESHORING

- A. When removing forms before structural members are strong enough to carry dead load and/or construction loads, reshores shall be installed to assure safe distribution of loading. Reshoring operations shall be planned in advance and shall be subject to the Engineer's review. During reshoring, no construction loads shall be permitted on the new construction.
- B. Reshores shall be placed as soon as practicable after form removal, but in no case later than the end of the working day on which form removal occurs, and shall remain in place until the concrete has acquired the required strength.

END OF SECTION 03 11 00

SECTION 03 15 00 CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes joint fillers, joint sealants, waterstops, and miscellaneous embedded items in concrete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 11 00 - Concrete Forming
- B. Section 03 20 00 - Concrete Reinforcing
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

- A. ASTM A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- B. ASTM A194/A194M: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- C. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts
- D. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- E. ASTM D994/D994M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- F. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- G. ASTM D1752: Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- H. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- I. ASTM F436/F436M: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
- J. COE CRD-C 513: Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops
- K. COE CRD-C 572: Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.04 SUBMITTALS

- A. Submit certified manufacturer's affidavits for expansion joint filler, joint sealant and waterstops to verify compliance with the applicable Specifications.
- B. Submit a schedule of concrete pouring and indicate locations of proposed construction and expansion joints. This schedule is subject to approval of the Engineer.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Environmental requirements relative to temperature for placing joint sealants are specified in Part 3 of this Section.

1.06 SEQUENCING

- A. Contractor shall sequence installation of miscellaneous embedded items with the Work of Section 03 11 00, Section 03 20 00 and Section 03 30 00.

PART 2 PRODUCTS

2.01 JOINT FILLER

- A. Preformed Expansion Joint Filler for Concrete (Bituminous Type) ASTM D994/D994M.
- B. Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) ASTM D1751.
- C. Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete ASTM D1752.

2.02 JOINT SEALER

- A. Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements ASTM D6690 Type II.
- B. Joint Sealants, Hot-Poured, Elastomeric Type, for Portland Cement Concrete Pavements ASTM D6690, Type II or III.

2.03 WATERSTOPS

- A. PVC waterstops shall conform to COE CRD-C 572 polyvinyl chloride (PVC) or COE CRD-C 513 styrene-butadiene rubber (SBR). Flat ribbed type shall be used in joints in walls and slabs where shown on the plans. Center bulb type shall be used in expansion joints.
- B. Bentonite waterstops shall be a compound of 75% high swelling sodium bentonite and 25% butyl rubber. Bentonite waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.
- C. Hydrophilic rubber waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. Hydrophilic rubber waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

2.04 CONCRETE ANCHORS

- A. General:
 - 1. Select type and size to achieve required loading capacity using information provided by manufacturer. If required type is not indicated, select type appropriate to conditions and item being fastened.
 - 2. Maintain critical edge distance and spacing per manufacturer's recommendations for all anchors. Provide tamper proof hardware when called for on the plans.
- B. Adhesive Anchors:
 - 1. Combination capsule adhesive and insert system; chisel pointed threaded rod with hex nut/washer, reinforcing bar, or internally threaded insert, installed into pre-drilled anchor hole using rotary hammer drill, crushing glass capsule containing two part epoxy acrylate resin (vinyl ester) with quartz aggregate and hardening agent, forming adhesive mortar.
 - 2. Threaded rod: ASTM A193/A193M Grade B7, ASTM A194/A194M Grade 2H or ASTM A563/A563M Grade DH nuts, and ASTM F436/F436M washers; plated in accordance with ASTM B633, SC1, with Type II yellow chromate treatment or Type 304 stainless steel when specified on the plans.
 - 3. Threaded Insert: Carbon steel tubular insert, internally threaded, plated in accordance with ASTM B633, SC1.
- C. Wedge Type Anchors:
 - 1. One piece body with expansion mechanism installed in pre-drilled hole using matching tolerance bit.

2. Carbon steel anchor body, washers, nuts and wedges, plated in accordance with ASTM B633, SC1, Type III or Type 304 stainless steel anchor body, washers, nuts and wedges when so indicated on plans.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Inspect the locations and surfaces to receive joint filler, joint sealer, or miscellaneous embedded items and correct defects or conflicts which will affect the proper performance of the item to be placed.

3.02 PREPARATION

- A. All accessories to be embedded into concrete shall have contact surfaces free of dirt, curing compound, protrusions of hardened concrete or any other foreign material which would affect bond with concrete.
- B. Prime surfaces in accordance with manufacturer's recommendations.

3.03 INSTALLATION OF JOINT FILLERS

- A. Details, including materials and methods of installation of joint fillers shall be as indicated on the Plans and as approved by the Engineer.

3.04 INSTALLATION OF JOINT SEALANTS

- A. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees Fahrenheit. Bond breaker and backup material shall be installed where required as indicated on the Plans or manufacturer's recommendations.

3.05 INSTALLATION OF WATERSTOPS

- A. Waterstops shall be of maximum practicable length to minimize joints.
- B. Waterstops shall be positioned as indicated on the Plans in a manner to permanently retain flexibility.
- C. Splice in length or at intersections shall be performed by heat sealing and in accordance with manufacturer's recommendations.
- D. Reform splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. When cooled and bent by hand in as sharp an angle as possible, the splice shall show no sign of separation.
- E. Provide support and protection of the waterstops during the progress of the work. Any waterstop punctured or damaged shall be replaced or repaired at Contractor's expense. Concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.06 CONCRETE ANCHORS

- A. Do not begin installation until substrates have been properly prepared. Do not proceed with installation if substrate preparation is unsatisfactory.
- B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Install in accordance with manufacturer's instructions and recommendations and as required by applicable code. Anchor applied items neatly, with item mounted plumb and level unless otherwise indicated.
- D. Engineer reserves the right to require the anchor manufacturer's representative to demonstrate proper installation procedures for post-installed anchors and to observe Contractor's installation

procedures, at no extra cost to Owner. Engineer reserves the right to require pullout or shear tests to determine adequacy of anchors, at no extra cost to Owner.

3.07 MISCELLANEOUS EMBEDDED ITEMS

- A. Inserts and other embedded items required for adjoining Work or for its support shall be placed prior to concreting.
- B. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

END OF SECTION 03 15 00

SECTION 03 20 00 CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the furnishing, fabrication, placement and care of material used as concrete reinforcement.
- B. Latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein. Copies of standards can be obtained from the American Concrete Institute.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 11 00 - Concrete Forming
- B. Section 03 15 00 - Concrete Accessories
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 ALLOWABLE TOLERANCES

- A. Fabrication:
 - 1. Sheared length: ± 1 inch
 - 2. Depth of truss bars: +0, -1/2 inch
 - 3. Stirrups, ties, and spirals: $\pm 1/2$ inch
 - 4. Other bends: ± 1 inch.
- B. Placement:
 - 1. Concrete cover to form surfaces: $\pm 1/4$ inch
 - 2. Minimum spacing between bars: -1/4 inch
 - 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: $\pm 1/4$ inch
 - b. Members more than 8 inches but not 24 inches over deep: $\pm 1/2$ inch
 - c. Members more than 24 inches deep: ± 1 inch
 - 4. Crosswise of members: Spaced evenly within 2 inches of stated separation.
 - 5. Lengthwise of members: ± 2 inches
 - 6. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1-bar diameter, with approval from the Engineer.

1.04 SOURCE QUALITY CONTROL

- A. Reinforcing steel shall be subject to inspection at the source of supply, fabricator, or after delivery to the Project Site at the discretion of the Engineer.
- B. Contractor may be required to furnish additional test of reinforcing steel for each 100 ton or fraction thereof. Testing for bend, pull, elongation and weight to assure compliance with Specifications shall be in accordance with ASTM A370.

1.05 REFERENCE STANDARDS

- A. ACI SP-66: ACI Detailing Manual
- B. ACI 301: Specifications for Concrete Construction

- C. ACI 318: Building Code Requirements for Structural Concrete and Commentary.
- D. ASTM A184/A184M: Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- E. ASTM A370: Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- F. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- G. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- H. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- I. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- J. ASTM C55: Standard Specification for Concrete Building Brick.
- K. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- L. CRSI (DA4): Manual of Standard Practice
- M. 2020 MDOT Standard Specifications for Construction, Section 706. Structural Concrete Construction.

1.06 SUBMITTALS

- A. Contractor shall submit Shop Drawings indicating the size and dimensions for fabrication and placing of reinforcing steel, including bar schedules, stirrup spacing, and diameter of bend bars. Bar supports type and grade shall be indicated.
- B. Contractor shall submit test certificates of the manufacturer's laboratory, identifying chemical and physical analysis of each load of reinforcing steel delivered.
- C. Contractor shall submit test certificates of a qualified independent testing agency evaluation of the mechanical splice devices to assure compliance with ACI 318.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver reinforcement to Project site in bundles tagged and marked in accordance with CRSI (DA4).
- B. Reinforcing steel shall be stored above ground on platforms or other supports, in an orderly manner to facilitate inspection and checking, and be protected from physical injuries or contamination.

1.08 SEQUENCING

- A. Contractor shall coordinate placement of the reinforcing in a manner which will not prevent the proper and timely completion of dependent construction phases.

PART 2 PRODUCTS

2.01 REINFORCING BARS

- A. Reinforcement shall be of the grade and type as specified herein unless otherwise indicated on the Plans or Shop Drawing.
- B. Concrete & Steel Reinforcement specifications are found in the 2020 MDOT Standard Specifications for Construction, Section 706 Structural Concrete Construction.
- C. Bars:
 - 1. Deformed and Plain Billet-Steel Bars: ASTM A615/A615M, Grade 60.

2. Rail-Steel and Axle Steel Deformed and Plain Bars: ASTM A996/A996M, Grade 60.
3. Low Alloy Steel Deformed Bars: ASTM A706/A706M.

D. Mats:

1. Fabricated steel bar or rod mats of the clipped type shall conform to ASTM A184/A184M.

2.02 WELDED WIRE FABRIC

A. Welded wire fabric shall be in flat mats only.

B. Plain:

1. Conform to ASTM A1064/A1064M, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

C. Deformed:

1. Conform to ASTM A1064/A1064M, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

2.03 TIE WIRE

A. Plain:

1. Conform to Cold Drawn Steel Wire for Concrete Reinforcement ASTM A1064/A1064M, 16-gage minimum size.

B. Deformed:

1. Conform to Deformed Steel Wire for Concrete Reinforcement, ASTM A1064/A1064M, size D-4 minimum.

2.04 BAR SUPPORTS

A. Metal bar supports shall be fabricated from cold-drawn steel wire in accordance with current CRSI Standards.

B. Stainless steel supports shall be of Type 1, with stainless steel wire conforming to ASTM A493 attached to the tips of the support so the nonstainless wire will lie no closer than 1/4 inch from the form surface.

C. Plastic coated supports shall be of Type 1, with plastic coating of polyethylene conforming to ASTM D1248 on the legs and tips.

D. Precast concrete brick supports shall conform to ASTM C55, Type 1, Grade N.

2.05 FABRICATION

A. Bars shall be bent cold to the shapes and dimensions as indicated on the Plans, or as required by the current "Manual of Standard Practice" of the CRSI. Steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or improper bends shall not be used.

B. The diameter of bend measured on the inside of the bar for standard hooks, other than stirrups and tie hooks, shall not be less than the values of the following table.

Minimum Diameters of Bend	
Bar Size	Minimum Diameter
#3 through #8	6 bar diameters
#9, #10 and #11	8 bar diameters
#14 and #18	10 bar diameters

- C. Bends for stirrups and ties with number #5 bar and smaller shall not be less than four bar diameters. For bars larger than No.#5, shall be according to the "Minimum Diameter of Bend" table above.
- D. Bends for stirrups and ties for welded wire fabric shall not be less than 4-bar diameters for deformed wire larger than D-6 and 2-bar diameters for all other wires. Bends with inside diameter of less than 8-bar diameters shall not be less than 4-bar diameters from nearest welded intersection.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Contractor shall examine the areas in which the reinforcing steel is to be placed to assure proper lines and levels.

3.02 PREPARATION

- A. Remove dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete or splicing method.
- B. Ends of bars to be butt spliced shall be cut square and smooth.

3.03 INSTALLATION - GENERAL

- A. Reinforcing shall be placed as indicated on the approved Shop Drawings, within allowable tolerances. Bar supports, as indicated on approved Shop Drawings, or in Specifications, shall be used for proper separation and support of reinforcing steel.

3.04 MINIMUM COVER AND SPACING

- A. Unless otherwise indicated on the Plans, the minimum spacing of bars shall be the following:
- B. Footings and other principal structural members in which the concrete is deposited against the ground shall have 3 inches of concrete between the bar and the ground contact surface.
- C. Concrete surfaces which, after removal of the forms, are to be exposed to the weather or in contact with the ground or liquids, shall be protected with 2 inches of concrete.
- D. The concrete protective covering for any reinforcement at surfaces not exposed directly to the ground, liquids or weather shall be 3/4 inch for slabs and walls and 1-1/2 inches for beams and girders.
- E. Column spirals or ties shall be protected everywhere by a covering of concrete cast monolithically with the core and shall be at least 1-1/2 inches .
- F. Concrete protection for reinforcement shall in all cases be at least equal to the diameter of bars, except for concrete slabs as noted above.
- G. The minimum center to center distance between parallel bars shall be 2-1/2 times the diameter of the bars. In no case shall the clear spacing between bars be less than 1 inch nor less than 1-1/3 times the maximum size of the coarse aggregate. The maximum center to center distance in parallel bars shall be 18 inches.
- H. Where reinforcement in beams and girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1 inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.
- I. Welded wire fabric designated as load-carrying reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches. It shall be supported as required for reinforcing bars.

3.05 SPLICING

- A. Splices shall be avoided at points of maximum stress. Splicing of bars shall be in accordance with ACI 318.
- B. Splicing of bars shall be done by overlapping in accordance with ACI SP-66, and securely laced with wire unless indicated otherwise on the Plans or approved Shop Drawing.
- C. Lap adjoining wire mesh by no less than one (1) full mesh and lace securely with wire. Offset end laps in adjacent widths to prevent continuous splice.
- D. Welded wire fabric reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than one full mesh spacing plus 2 inches. The fabric shall extend across supporting beams and walls and to within four 4 inches of concrete edges. It may extend through contraction joints where alternate wires are field cut. It shall be adequately supported during placing of concrete to insure its proper position in the slab either by the methods of Part 3 of this Section or by laying the fabric on a layer of the fresh concrete of the correct depth before placing the upper layer of the slab.
- E. Vertical bars in columns shall be offset at least 1-bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.
- F. Bars of size #14 and #18 or larger, where size #11 bars are butt spliced to larger sizes and/or when approved by the Engineer shall be welded in accordance with ACI 301 by full penetration butt welds. Adequate jigs and clamps or other devices shall be provided by the Contractor to support, align and hold the longitudinal centerline of the bars in a straight line.
- G. Bars larger than #11 may be butt spliced by mechanical devices approved by the Engineer, in accordance with ACI 318. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories to support, align and hold the longitudinal centerline of the bars in a straight line.

3.06 SECURING REINFORCEMENT

- A. Reinforcement shall be securely laced with wire to supports or reinforcing to prevent displacement during the concrete placement, as required by the current CRSI (DA4).

3.07 FIELD QUALITY CONTROL

- A. Engineer shall inspect the reinforcing steel after it has been installed, and the reinforcing steel placement shall be approved by the Engineer prior to placement of concrete.
- B. Contractor shall avoid displacement of the reinforcing steel during concrete placement.

END OF SECTION 03 20 00

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes all monolithic cast-in-place concrete work complete with materials, mixes, installation and testing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 15 00 - Concrete Accessories
- C. Section 03 20 00 - Concrete Reinforcing
- D. Section 03 60 00 - Grouting
- E. Section 05 12 00 - Structural Steel Framing
- F. Section 07 10 00 - Dampproofing and Waterproofing
- G. Section 31 23 19 - Dewatering

1.03 REFERENCE STANDARDS

- A. ACI 312.3R: Report on Chemical Admixtures for Concrete
- B. ACI 301: Specifications for Concrete Construction
- C. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete
- D. ACI 305R: Guide to Hot Weather Concreting
- E. ACI 306R: Guide to Cold Weather Concreting
- F. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete
- G. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- H. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field
- I. ASTM C39/C39M: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- J. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
- K. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete
- L. ASTM C150/C150M: Standard Specification for Portland Cement
- M. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete
- N. ASTM C183: Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
- O. ASTM C231: Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- P. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete
- Q. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- R. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete

- S. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
- T. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- U. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars
- V. ASTM D75 / D75M - 19 Standard Practice for Sampling Aggregates

1.04 REFERENCE SPECIFICATIONS

- A. The latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein.
- B. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.05 TESTING AGENCY

- A. Inspections and tests required by this Section shall be performed by organizations acceptable to the Engineer.

1.06 ALLOWABLE TOLERANCES

- A. See Section 03 11 00 for the allowable tolerances for concrete surfaces.

1.07 DESIGN CRITERIA

- A. Mixes shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use. Design quantities and test results of each mix shall be submitted for review.
- B. Necessary construction joints are shown on the Plans. Modification of location or placement of construction joints not indicated on the Plans shall be subject to approval of the Engineer. In general, they shall be located within the middle one-third of the span of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam.
- C. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- D. Expansion joint locations and details shall be as shown on the Plans. In no case shall any fixed metal be continuous through a expansion joint.
- E. Keyways shall be provided in all joints where required to provide for either shear or watertightness. Unless otherwise required, the width of keys shall be at least one-third the thickness of the section at that point and their depth at least one-third their width.

1.08 SOURCE QUALITY CONTROL

- A. Furnish tests of cement and aggregates. Material sampling shall conform to the following ASTM Standards:
 - 1. Cement C183
 - 2. Aggregates D75
- B. Testing shall be in accordance with applicable ASTM Standards to assure compliance with Specifications.
- C. Make tests for the following quantities, or fraction thereof:
 - 1. Cement: 550 tons
 - 2. Fine Aggregate: 2,000 tons

3. Course Aggregate: 2,000 tons
- D. Use same brand cement for any given structure produced by a single mill unless otherwise provided by authorization of the Engineer.

1.09 SUBMITTALS

- A. Submit Shop Drawings showing the location of joints. Included shall be a schedule of the concrete pouring. The location of joints and pouring schedule shall be subject to approval by the Engineer.
- B. Contractor shall submit test reports for cement and aggregates to assure compliance with the Specifications.
- C. Concrete mixture designs and test data shall be submitted for review by the Engineer with a written request for approval. No concrete shall be placed until the Contractor has received such approval in writing.
- D. Each mixture report shall include:
 1. Slump on which design is based.
 2. Total gallons of water per cubic yard (l/m³).
 3. Brand, type, composition, and quantity of cement.
 4. Brand, type, composition, and quantity of pozzolan or other mineral admixtures.
 5. Brand, type, composition, and quantity of ground granulated blast furnace slag.
 6. Specific gravity and gradation of each aggregate.
 7. Ratio of fine to total aggregates.
 8. Weight (surface dry) of each aggregate, lbs./c.y. (kg/m³).
 9. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.
 10. Air content.
 11. Compressive strength based on 7-day and 28-day compression tests.
 12. Time of initial set.
- E. Submit manufacturer's literature of abrasive wear resistant floor finish and of chemical curing compound for review by the Engineer.
- F. Submit a sample concrete delivery ticket for review by the Engineer.
- G. Submit tickets collected at the site of concrete placement accompanying each load of concrete. A printout system for producing these tickets in connection with automatic batching will be permitted.
 1. Each ticket shall be serially numbered, show the charging time, quantity and grade of concrete, location of delivery and the signatures of inspectors at the plant and site. Transit mixed concrete tickets shall also include revolution counter reading at charging and mixing completion.
- H. Submit reports of the sampling and testing of slump, air content and strength performed.
- I. Submit reports of nondestructive, core and/or liquid retention testing required for acceptance of concrete in place.

1.10 MATERIAL STORAGE AND HANDLING

- A. Materials shall be stored and handled in accordance with ACI 304R and as specified below.

- B. When permission is given to store cement in the open, a floor at least 6 inches above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain.
- C. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by the Contractor by cleaning sacks mechanically or otherwise, or from discarded sacks of cement, shall not be used in the Work. The use of a fractional sack of cement will not be permitted unless the fractional part is measured by weight. At the time of its use in the Work, the cement shall be free from lumps.
- D. No aggregates which have become intermixed prior to proportioning shall be used. Sufficient aggregate shall be available at the site to preclude the possibility of damaging delays while placing the concrete.
- E. Cars used for shipping aggregates shall be clean and in good repair. The use of straw, marsh, hay or other similar materials for closing cracks or holes in cars will not be tolerated.
- F. Pozzolans and other cementitious materials shall be stored and handled in the manner of cement.
- G. Store and handle curing compound in a manner to prevent contamination.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Environmental requirements shall be in accordance with ACI 305R for hot weather concreting, and ACI 306R for cold weather concreting.
- B. Specific temperature requirements are contained in Part 2 of this Section for mixing and Part 3 of this Section for placing.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. The materials shall meet the requirements of ACI 301, ACI 318, and MDOT Specification, Division 9.
- B. Concrete materials shall be tested and inspected as the Work progresses. The review and/or check-test of the proposed materials, securing of production samples of materials at plant stockpiles and/or review of the manufacturer's reports for compliance will be performed at no cost to the Contractor.
- C. Testing and inspection required due to substitution or change of materials requested by the Contractor shall be at the Contractor's expense.

2.02 CEMENT

- A. Cement shall be the type as indicated on the Plans or as specified.
 - 1. Type I and IA, conforming to ASTM C150/C150M, air-entraining Portland cement when special properties are not specified.
 - 2. Type III and IIIA, conforming to ASTM C150/C150M , air-entraining Portland cement for use when high-early strength is specified.
 - 3. Type IS and IS-A, conforming to ASTM C595/C595M, air-entraining Portland blast-furnace slag cement for use in general concrete construction.
 - 4. Type IP and IP-A, conforming to ASTM C595/C595M , air-entraining Portland-Pozzolan cement for use in general construction. The addition of suffix (MS) signifies that moderate sulfate resistance is specified. The addition of suffix (MH) signifies that moderate heat of hydration is specified.

2.03 AGGREGATES

- A. Washing will be required to eliminate the dust, clay, or silt coating. Aggregates which have been washed shall not be used sooner than 24 hours after washing, unless approved by the Engineer.
- B. Coarse aggregate shall be gravel or crushed rock, conforming to MDOT Section 902.03. Class 17A for members 8 inches or less in thickness and Class 6AA for other construction.
 - 1. Gravel shall consist of hard, clean, durable particles of rock or pebbles and shall be free from lumps of clay.
 - 2. Crushed rock shall consist of angular fragments of crushed hard heads or boulders or crushed igneous rock free from weathered rock and of uniform quality.
 - 3. All sieve and screen analyses determination of clay, silt, and dust content and percentages of objectionable particles will be based on dry weights and conform to MDOT Section 902.03, Table 902-1, "Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open Graded Aggregates" and Table 902-2, "Physical Requirements for Coarse Aggregate, Dense Graded Aggregates and Open Graded Aggregates."
- C. Fine aggregate shall be sand size 2NS, MDOT, Section 902.08.
 - 1. Fine aggregates shall consist of sharp sand which shall be composed of clean, hard, durable grains and shall be free from lumps of clay and organic deleterious substances.
 - 2. Fine aggregates shall conform to MDOT Section 902.09 and Table 902-4, "Grading Requirements for Fine Aggregates."

2.04 ADMIXTURES

- A. Admixtures shall be used to achieve concrete as indicated on the Plans or specified herein. Calcium chloride shall not be used.
 - 1. Air-entraining, conforming to ASTM C260/C260M.
 - 2. Pozzolan and Fly Ash, conforming to ASTM C618, Class F.
 - 3. Water reducing, conforming to ASTM C494/C494M.
 - 4. Retarder, conforming to ASTM C494/C494M.
 - 5. Plasticizer, conforming to ASTM C494/C494M.
 - 6. Ground granulated blast furnace slag conforming to ASTM C989/C989M, grade 100.
- B. Abrasive wear resistant floor finish shall be packaged, dry combination of Portland cement, graded Quartz aggregate and dispersing agents formulated to produce an abrasive and wear resistant monolithic surface.

2.05 JOINT FILLER

- A. See Section 03 15 00.

2.06 WATER

- A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the Local Board of Health may be used without testing. Water from other sources shall be tested before using.

2.07 CURING COMPOUND

- A. Shall be adequate to prevent checking, cracking and loss of moisture, conforming to ASTM C309.

2.08 MIXES

- A. Concrete shall consist of a mixture of air-entraining Portland cement, coarse and fine aggregate, Class F Fly Ash, and water with admixtures if required. Admixtures shall not be used without the Engineer's review.
- B. The mixture, combined in proportions, shall meet the requirements of MDOT, Specification Section 701, and ACI 211.1.
- C. Concrete shall be classified and proportioned on the basis of minimum compressive strength at 28 days when cured in a moist room at a temperature within the range of 68 - 75 degrees F. The desired strength of the concrete shall be shown on either the Plans or in the Specifications.
- D. Table 1 shows for each grade of concrete the minimum compressive strength, cement content, and the modulus of rupture. Concrete shall be 3,500 psi, unless otherwise shown on the plans.

Concrete Grade	Coarse Agg	Type of Cement	Cement Content	Min Compressive Strength @ 28 days	Min Modulus of Rupture @ 28 days	% Air
4500 psi	6AA	I, IA, IS, IS-A	658 lbs/cyd	4500 psi	725 psi	4 - 6
4000 psi	6AA or 17A	I, IA, IS, IS-A	611 lbs/cyd	4000 psi	700 psi	4 - 6
3500 psi	6AA or 17A	IS, IS-A, IP, IP-A	564 lbs/cyd	3500 psi	650 psi	4 - 6

1. Maximum water cement ration shall be 0.45
 2. Structural concrete for walls and slabs shall be placed with a slump of 4 inches maximum.
 3. Ground granulated blast furnace slag (GGBFS) may be substituted for cement on a pound for pound basis from a minimum of 25% up to a maximum of 40% GGBFS and 60% cement
 4. Minimum fly ash content in the mix shall be 25%, additional fly ash may be substituted for cement on a pound for pound basis up to a maximum of 40% fly ash and 60% cement when approved by the Engineer.
 5. Maximum total replacement of cement shall not exceed 40%.
- E. Aggregates shall be proportioned by weight, except for small structures and for incidental Work requiring less than 10 cubic yards of concrete, in which case they may be proportioned by volume when approved by the Engineer.
 - F. Cement in bulk, when permitted, shall be proportioned by weight.
 - G. When proportioned by volume, the amount of each aggregate required for a single batch shall be measured separately and accurately. Shovel methods of measuring will not be permitted. The unit of volumetric measurement shall be 1 cubic yard.
 - H. When proportioned by weight, the amount of each aggregate required for a single batch shall be weighed in a separate container. The equipment for weighing shall be of an approved type, and of such accuracy that there shall not be an error of more than one (1) percent in any one (1) batch.

2.09 BATCHING ADMIXTURES

- A. The batching of admixtures to achieve and maintain production of the mix design of concrete shall be in accordance with ACI 212.3R.

- B. If the air content is found to be less or greater than the specified amount, the Contractor shall immediately discontinue Work and correct the air content.
- C. Decreasing the air content may be accomplished by blending air-entraining Portland cement with Portland cement, manufactured at the same mill, in a ratio which will reduce the air content to a value within the specified limits, this blending shall be reviewed by the Engineer.
- D. Increasing the air content may be accomplished by adding to each batch a sufficient amount of air-entraining admixture to bring the air content up to the designed amount.
- E. Pozzolan and ground granulated blast furnace slag shall be proportioned based on the mix design approved by the Engineer to produce watertight concrete.
- F. Water Reducer can be used to reduce the water requirement of concrete to obtain consistency of slump, modify workability, increase strength or any other approved use.

2.10 TEMPERATURE LIMITS OF MIXTURE

- A. The temperature of the cement, at the time of delivery to the mixer, shall not exceed 165 degrees F. The cement shall be stored at the Contractor's expense until cooled to that temperature.
- B. The temperature limits of aggregates and water entering the mixer shall be as follows:

Table 2 - Temperature Limits		
Component	Minimum	Maximum
Water	75°F (24°C)	140°F (60°C)
Fine Aggregate	65°F (18°C)	140°F (60°C)
Coarse Aggregate	65°F (18°C)	110°F (43°C)
Concrete (resulting)	60°F (15°C)	90°F (32°C)

2.11 MIXERS AND MIXING

- A. Concrete mixing operations shall be in accordance with ACI 304 and MDOT, Section 701, and shall be subject to random inspection during the progress of the Work at no charge to the Contractor.
- B. Central Mixed Concrete:
 1. Mixers shall be capable of quickly and completely discharging without segregation or loss.
 2. Efficiency of the mixers shall be maintained at all times through repair or replacement of worn parts when necessary.
 3. Mixers shall be provided with readily adjustable, automatic devices which will measure the cement and water within one (1) percent and admixtures within three (3) percent.
 4. The drum of the mixer shall be kept free from hardened concrete and shall be completely emptied before recharging.
 5. Retempering or remixing concrete that has partially set will not be permitted.
 6. Mixer shall be cleaned thoroughly each time when out of operation for more than 1/2 hour.
 7. Recommended mixing time is a minimum time of 1 cubic yard, with an additional 15 seconds for each additional 1 cubic yard.
 8. Concrete shall be delivered to the site in clean, tight truck bodies designed for this purpose and painted with paraffin if necessary for easy dumping.
 9. The concrete at the point of delivery shall have the proper consistency and shall be free from segregation.

10. Mechanical agitators in the truck bodies will be required if the period of time from the mixing plant to the point of dumping exceeds 30 minutes.
11. No concrete shall be dumped if the elapsed time from the mixing plant to the point of dumping exceeds 60 minutes.

C. Transit Mixed Concrete:

1. Transit-mix concrete shall be in accordance with ASTM C94/C94M. If transit-mix concrete is used, it shall meet all the foregoing requirements specified for central mixed concrete and, in addition, the following:
 - a. The batched materials shall be properly proportioned and in a dry state. The proper amount of water shall be added to the mixer on the trucks, and no additional water shall be added. No admixtures or accelerators shall be added except as herein noted, without the approval of the Engineer.
 - b. Trucks shall not be loaded beyond their rated capacity and shall have mixing drums cleaned of all set-up materials at frequent intervals while in use. Trucks with leaking water valves shall not be used.
 - c. Recommended mixing speed should be no less than 12 revolutions per minute, with a minimum of 90 revolutions or until the mix is satisfactory.
 - d. Mixing shall be continuous after water is added to the mix in the drum, but no concrete shall be placed in the forms more than 90 minutes after water is added to the mix.
 - e. Truck-mixed concrete shall be delivered to the site of the Work and discharged from the mixer within the maximum period of 1-1/2 hours from the first introduction of water to the mix. Any concrete which remains in the mixer after this period and any concrete which appears too stiff to be properly workable or which appears to have begun to take its initial set shall be rejected and removed from the site of the Work.
- D. Owner may employ an independent testing laboratory to provide a qualified inspector to be present at the plant where batching of concrete occurs. The inspector shall verify the compliance of the mix with the Specifications and shall sign a form indicating the quantity of concrete and the concrete mixture of each load.

2.12 CHANGE OF MIXTURE

- A. If Contractor requests a change or substitution of approved batch proportioning, mixing, or delivery operations additional testing and/or inspection shall be at Contractor's expense.

2.13 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers of abrasive wear resistant floor finish include: Master Builders Company "Mastercon Aggregate," Sonneborn Building Products "Harcol," or equal.

PART 3 EXECUTION

3.01 VERIFICATION OF FORMWORK, REINFORCING, AND SUBGRADES

- A. Contractor shall inspect formwork, reinforcement and subgrades to confirm compliance with the related Work specified elsewhere.

3.02 EMBEDDED ITEMS

- A. Contractor shall verify the location, from certified vendor or applicable engineering drawings, of all embedded items including anchor bolts, wall sleeves, wall casting, railing post sleeves and miscellaneous pipes and conduits and shall install the items accurately at the locations determined.

3.03 BUILDING IN OTHER WORK

- A. Contractor shall make all necessary provisions in concrete Work for other Work installed by this or other contractors, and build in all required steel beams, frames, curbs, expansion joints, inserts, hangers, pipes, floor drains, pipe trench covers and frames, anchors, sleeves, floor ducts, fiber and steel conduit, pipe hanger sockets, and all other Work furnished by either this or other contractors.
- B. Contractor shall build in all anchors, ties, etc., specified under brick and other Work, in faces of concrete Work which are to be faced with masonry, and any other Work shown or noted to be built into concrete. In addition, Contractor shall provide all openings and holes in concrete Work as shown or as needed to accommodate other Work.

3.04 SPECIAL CONCRETE

- A. Contractor shall verify the use and/or locations of watertight concrete and/or high-early strength concrete.

3.05 PREPARATION

- A. Contractor shall notify the Engineer two (2) working days prior to placement of concrete.
- B. Before depositing new concrete on or against existing concrete the existing concrete shall be roughened, thoroughly cleaned of foreign matter and laitance and saturated with water. The cleaned and saturated surface of the hardened concrete, including vertical and inclined surfaces, shall be coated with a bonding agent or slushed with a minimum 2 inch thick coating of concrete without coarse aggregate grout against which the new concrete shall be placed before the mixture has attained its initial set.
- C. Before concrete is placed in any unit, the forms and the placing and fixing of all steel and incidental items shall be complete, and the forms, steel and adjacent concrete shall be thoroughly cleaned and wetted down.
- D. Where indicated on the Plans, the Contractor shall bridge the subgrade with at least 2000 psi, 3 inch thick lean concrete before placing the reinforcement. This shall be at no extra cost.
- E. No concrete shall be deposited in any unit until the area has been completely dewatered in accordance with Section 31 23 19, and not until after the Contractor has made satisfactory provisions to eliminate all possibility of water entering or flowing through the concrete while it is being poured or is taking its set. No concrete shall be placed under or on water.

3.06 CONVEYING

- A. Concrete handling equipment shall be of such a nature and shall be so located that the concrete after leaving the mixer will reach its destination with a minimum lapse of time, with no segregation, and loss of slump. The use of drop chutes, except at or in the forms, is prohibited.
- B. The interior hopper slope of concrete buckets shall be not less than 60 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five (5) times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2 square feet.
 - 1. Maximum dimension shall not be greater than twice the minimum dimension.
 - 2. Bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards shall not be manually operated.
 - 3. Design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.
- C. Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points

and the point of placing.

- D. Concrete may be conveyed by positive displacement pump when authorized by the Engineer. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or heavy duty flexible rubber hose. The inside diameter of the pipe shall be at least three (3) times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. The maximum size coarse aggregate shall not be reduced to accommodate the pumps.
- E. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

3.07 PLACING

- A. Concrete shall be so deposited as to maintain the top surface level, unless otherwise shown on the Plans, and also as to avoid any appreciable flow in the mass.
- B. Where placing operations involve dropping the concrete more than 3 feet in the forms, it shall be deposited through sheet metal or other approved spouts or pipes. These spouts or pipes shall have suitable receiving hoppers at the upper ends, and the lower ends shall be kept within 6 inch of the newly placed concrete so as to prevent segregation and avoid spattering the reinforcing steel with mortar. Under no circumstances shall concrete that has partly hardened be deposited in the Work.
- C. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 2 feet per hour. Concrete vibrators shall penetrate the initial layer when placing the following layer. Vertical construction joints shall be provided as necessary to comply with these requirements.
- D. Concrete shall be placed and compacted in wall or column forms before any reinforcing steel is placed in the system to be supported by such walls or columns. The portion of any wall or column placed monolithically with a floor or roof slab shall not exceed 6 feet of vertical height. Concrete in walls or columns shall set at least two (2) hours before concrete is placed in the structural systems to be supported by such walls or columns.
- E. Concrete shall be set when top finished. All laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. Wherever the top of a wall will be exposed to weathering, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.
- F. No concrete shall be placed in contact with frozen ground. Time between charging and placement of concrete shall not exceed 1-1/2 hours.
- G. Concrete shall be compacted by continuous vibrating, tamping, spading or slicing. Care shall be taken to eliminate all voids and to provide full bond on reinforcing steel and embedded fixtures. Mechanical vibration shall be employed. Concrete shall be compacted and thoroughly worked with suitable tools combined with the use of vibrators applied internally and providing a frequency not less than 7,000 revolutions per minute. All such vibrating, including the methods and equipment, shall be subject to the review of the Engineer.
- H. The time of vibrating in any area shall only be sufficient to get efficient compaction, but shall in no case be carried to the point where there is segregation of the fine and coarse materials of the mix. There shall be an absolute minimum of direct vibration of the steel or forms during the process of vibrating. Vibrators shall be inserted and withdrawn from the concrete at numerous locations, from 18 - 30 inches apart, but shall not be used to transport concrete within the forms. Contractor shall have a stand by vibrator on the job site during all concrete pouring operations.

3.08 FINISHING UNFORMED SURFACES

- A. The unformed surfaces of all concrete shall be screeded and given an initial float finish followed by steel troweling.
- B. Screeding shall provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. All screeded surfaces shall be free of surface irregularities with a height or depth in excess of 1/4 inch as measured from a 10 foot straightedge.
- C. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface. Floating shall be performed with hand floats or suitable mechanical compactor floats.
- D. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks. The top surface of driveways, and sidewalks shall be given a broomed finish after troweling.
- E. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 1/4 inch corner radius.

3.09 FINISHING FORMED SURFACES

- A. After removal of forms, the finishing of all concrete surfaces shall be started as soon as its condition will permit.
- B. Grind all seams, fins or projections flush with the concrete surface.
- C. Fill and point all honeycomb, tie holes and voids.
- D. Dampen the surface with water and apply a cement and silica sand slurry to the entire surface to fill small defects and air voids.
- E. Remove excess slurry from concrete. Surfaces to be finished shall receive an application of dry Portland cement which shall be rubbed into the slightly dampened surface with a suitable cloth.
- F. After pointing and removal of projections as specified herein, exposed surfaces of concrete, including walls, columns, beams, pilasters and the undersides of slabs, shall be given a rubbed surface finish.

3.10 FLOORS

- A. Concrete floor finish shall be applied to all building floors not receiving further floor finish. At these locations, the concrete shall be brought to the proper elevation and screeded. The surface shall be given two (2) steel trowelings when the concrete has set sufficiently to finish smoothly. Floors shall be sloped uniformly toward floor drains at a slope of 1/8 inch per foot.
- B. The concrete finish on steps and loading platforms shall be wood troweled to true and uniform surface and then steel troweled. The surface shall then be slightly roughened with a broom or by dragging burlap across the surface.
- C. Concrete floors shall be finished with an abrasive resistant floor finish in the areas noted on the finish schedule on the Plans. Premixed floor hardener shall be applied to the surface of the freshly floated concrete floor, in strict accordance with the manufacturer's directions. Color to be selected by the Owner.

3.11 EXPANSION JOINTS

- A. Comply with the requirements of Section 03 15 00. Expansion joints shall have removable polystyrene joint caps secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces.

- B. Joint caps shall be of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant to the size shown on the Plans.
- C. Joint caps shall not be removed until after the concrete curing period.

3.12 CONCRETE CURING

- A. Concrete shall be cured for a period not less than seven (7) consecutive days. Contractor shall have adequate equipment and curing material on the job site before concrete placement begins, and it shall be adequate to prevent checking and cracking and loss of moisture from all the surfaces of the concrete. The concrete shall be protected from rain, flowing water, wind and the direct rays of the sun. Openings in concrete shall be sealed to prevent drying of the concrete during the curing period.
- B. Curing compounds shall not be used on surfaces to which additional concrete or other material are to be bonded.
- C. Curing compounds when used shall be applied in strict accordance with the manufacturer's recommendations.
- D. Concrete cured with water shall be kept wet by covering with ponded water or fog spraying to keep all surfaces continuously wet.
- E. Horizontal construction joints and finished surfaces cured with sand shall be covered a minimum thickness of 1 inch, uniformly, and kept saturated during the curing period.
- F. Burlap used for curing shall be treated to resist rot and fire and free of sizing or any substances that are injurious to Portland cement or cause discoloration. Strips shall be lapped by half widths. The burlap shall be saturated with water after placement and during the curing period.
- G. Straw or hay shall be in a layer no less than 6 inch thick and held in place by screens, wire or other means to prevent dispersion by the wind. Care shall be observed to avoid discoloration of the concrete surface from the vegetable fibers and for the flammability of the material. The straw shall be saturated with water after placement and during the curing period.

3.13 ENVIRONMENTAL CONDITIONS

- A. Contractor shall provide cold or hot weather protection in accordance with ACI and as specified herein. There shall be no additional cost for hot or cold weather protection of the concrete.
- B. Cold Weather Protection:
 - 1. When placing concrete in cold weather, the Contractor shall plan and prosecute his Work in a manner which shall assure results free from damage through freezing, contraction, and loss of concrete strength.
 - 2. No concrete shall be poured when the surrounding temperature is below 40 degrees F, unless the aggregates and water are properly heated. Concrete which has been poured at higher temperatures but has not attained a strength equal to 75% of the required strength of the class of concrete involved, shall be housed and protected in accordance with the provisions of this Section whenever the surrounding temperature falls below 40 degrees F.
 - 3. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.
 - 4. Aggregates may be heated only by steam coils or steam jets, except in the case of small quantities of concrete when other methods may be approved by the Engineer. A sufficient quantity of properly heated aggregates shall be on hand prior to starting the pouring of any unit.
 - 5. Concrete shall be properly housed with canvas, burlap, or other windproof material in such a manner that any necessary removal of the forms or finishing of the concrete can proceed without undue damage to the concrete from the elements. Heating of the housing shall be

done in a manner which will maintain a temperature between 50 - 70 degrees F, at all times for at least five (5) days after the pour is complete and 12 hours before the pour begins. All supplemental heating units shall have exhaust vented to the exterior and shall not cause deleterious reactions or deposits to occur to concrete.

C. Hot Weather Protection:

1. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than 90 degrees F.
2. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.

3.14 ADDITION OF WATER

- A. To increase workability, adding water to the mix shall be limited to a one time addition of 1 gallon per cubic yard and mixed with a minimum of 30 revolutions at a rate of 12 to 15 revolutions per minute. Addition of water shall be within the slump requirements.

3.15 CONCRETE DELIVERY TICKET

- A. A ticket system shall be used for recording the transportation of concrete from the batching plant to point of delivery. This ticket shall be issued to the truck operator at the point of loading and given to the Engineer upon delivery. The ticket shall as a minimum indicate the time of mixer charging, quantity of concrete, type of mixture including amount of cement, and the plant where the concrete was batched.

3.16 CONCRETE DELIVERY REJECTION

- A. Concrete not permitted for inclusion in the Work by the Engineer shall be removed from the site. Rejection of concrete will be determined through concrete testing and elapsed time from mixer charging to delivery.

3.17 CONCRETE TESTING AT PLACEMENT

- A. Tests shall be made of fresh concrete for each 50 cubic yards, or whenever consistency appears to vary. The sampling and testing of slump, air content and strength will be performed at no cost to the Contractor.
- B. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172/C172M.
- C. Slump Test:
1. Slump Test shall be in accordance with ASTM C143/C143M. Contractor shall use the least slump possible consistent with workability for proper placing of the various classifications of concrete.
 2. A tolerance of up to 1 inch above the indicated maximum slump shall be allowed for individual batches provided the average for all batches or the most recent ten (10) batches tested, whichever is fewer, does not exceed the maximum limit.
- D. Air Content:
1. Air content of normal weight concrete will be determined in accordance with ASTM C231, Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- E. Compressive Strength:
1. A set of cylinders for compressive strength tests will consist of four cylinders per each set. The temperature of concrete sample will be determined for each strength test.

2. Molding and curing specimens from each set shall be in accordance with ASTM C31/C31M. Any deviations from the requirements of this Standard shall be recorded in the test report.
3. Testing specimens will be in accordance with ASTM C39/C39M. One (1) specimen shall be tested at seven (7) days for information and two (2) shall be tested at 28 days for acceptance.
 - a. Acceptance test results shall be the average of the strengths of the two (2) specimens tested at 28 days. If one (1) specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result.
4. The strength level of the concrete will be considered satisfactory so long as the averages of all 28 day strength test results equal or exceed the specified 28-day strength and no individual strength test result falls below the specified 28-day strength by more than 500 psi.
5. If the strength test is not acceptable, further testing shall be performed to qualify the concrete.

3.18 TESTING OF CONCRETE IN PLACE

- A. Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements shall be at the expense of the Contractor.
- B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.
- C. When required by the Engineer, cores at least 2 inch in diameter shall be obtained and tested in accordance with ASTM C42.
 1. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 80°Fahrenheit (15° to 25°Celsius), relative humidity less than 60%) for 7 days before test and shall be tested dry.
 2. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.
- D. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Engineer so as to least impair the strength of the structure. If, before testing, one or more of the cores shows evidence of having been damaged subsequent to or during removal from the structure, it shall be replaced.
- E. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85% of and if no single core is less than 75% of the specified 28-day strength.
- F. Core holes shall be filled by low slump concrete or mortar.

3.19 RETENTION TESTING

- A. Tanks or structures designed to hold or retain water, wastewater or other liquids shall be retention tested.
- B. To test a tank or structure for leakage, the Contractor shall clean, disinfect (if required) and fill the tank or structure with water to its maximum level.
- C. The water shall be allowed to remain 24 hours with all associated valves and appurtenances tightly closed.

- D. During this 24-hour period, the water level as measured by a hook gage shall show no measurable loss.
- E. If this test fails, the Contractor shall dewater the tank or structure, make such repairs as necessary to achieve a watertight tank or structure, clean, disinfect (if required), and retest.
- F. Tests and repairs shall be repeated until the tank or structure is accepted by the Engineer.

3.20 DEFECTIVE CONCRETE

- A. If, in the opinion of the Engineer, the defects in the concrete are of such a nature as to warrant condemnation, that portion of the pour may be ordered replaced in its entirety and the Contractor shall promptly replace same without additional compensation.
- B. Defective concrete shall be repaired by cutting out the defective area and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely in place.

END OF SECTION 03 30 00

SECTION 03 32 00 CONSTRUCTION AND EXPANSION JOINTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A.

1.03 REFERENCE STANDARDS

A. The following is a list of standards and publications referenced in this Section:

1. American Society for Testing and Materials (ASTM) Publications:
 - a. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - b. ASTM C962 - Guide for Use of Elastomeric Joint Sealants.
 - c. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - d. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
 - e. ASTM D2835 - Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.
2. Corps of Engineers (COE):
 - a. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop.
3. Journal of the American Concrete Institute, June 1959: Waterstops for Joints in Concrete by B. Kellam and M.T. Loughborough.

1.04 SUBMITTALS

- A. Shop Drawings:
1. Product data for materials including location where product is to be used.
 2. Certification that materials meet the specifications.
 3. Testing laboratory data substantiating results of waterstop zero water leakage tests conforming to test arrangement in the 1959 Journal of the ACI.
 4. Manufacturer's application and installation instructions.
 5. Samples of waterstops and joint fillers.
 6. Color samples or charts for joint compounds.
 7. Submit record documents and shop drawings marked to record actual construction.

PART 2 PRODUCTS

2.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in the manufacturer's sealed bags, unopened containers and banded pallets.
- B. Store materials off ground on platform or skid supports, and protect with covers from snow, rain and ground splatter.

- C. Store plastic products under cover in a dry cool location out of direct sunlight.

2.02 JOINT COMPOUNDS

- A. In surface facilities, provide joint compound for joints in horizontal and inclined surfaces less than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade P, Class 25. Provide type T compound in pedestrian and vehicular traffic areas, and type NT in non-vehicular areas. Provide preformed joint seals where indicated.
- B. In surface facilities provide joint compound for joints in walls inclined surfaces greater than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade NS, Class 25.
- C. Provide compatible joint compounds as recommended by manufacturer when they abut each other.
- D. Provide compound made for continuous submergence in liquid containing structures.
- E. Provide preformed polychloroprene elastomeric joint seal (compression seal) made of vulcanized elastomeric compound using polychloroprene as the only base polymer. Provide in expansion joints where indicated and conform to ASTM D2628.
- F. Provide one-component polychloroprene compound conforming to ASTM D2835 as lubricant for installation of elastomeric joint seal.

2.03 BOND BREAKER FOR JOINT COMPOUNDS

- A. Provide polyethylene tape, coated paper, or metal foil.

2.04 BACK-UP MATERIAL FOR JOINT COMPOUNDS

- A. Provide 100 percent closed-cell material, compressible, nonshrink, nonreactive with joint compound, and nonabsorbent.
- B. Extruded butyl or polychloroprene foam rubber is acceptable.
- C. Material impregnated with oil, bitumen, or similar substances is not acceptable.
- D. Provide back-up material which is compatible with joint compound as recommended by manufacturer and has same expansion/contraction capability as compound.

2.05 PREMOLDED-JOINT FILLER

- A. Provide premolded-joint filler conforming to ASTM D1752, Type I or Type II.
- B. Provide joint filler having same thickness as expansion joint width indicated.
- C. Provide maximum length filler manufactured to minimize field cutting.

2.06 POLYVINYLCHLORIDE WATERSTOP

- A. Provide in accordance with COE CRD-C 572.
- B. Provide waterstops of type and size indicated with looped galvanized steel wire along both edges. Manufacture from virgin polyvinyl chloride plastic compound that has a minimum tensile strength of 1750 psi.
- C. Provide waterstops having zero water leakage when tested to 50 psi minimum water pressure conforming to test arrangement in the 1959 Journal of the ACI.
- D. Provide factory-made and tested crosses, tees, and ells, manufactured using thermostatically controlled electric heat source.
- E. PVC waterstops to be manufactured by:
 1. Catalog No. RB9-12 as manufactured by Vinylex Corporation, Knoxville, TN.
 2. Wirestop Waterstop Part #CR-9380 as manufactured by Paul Murphy Plastics, Roseville, MI.

3. No. 735 as manufactured by Greenstreak Plastic Products Company, St. Louis, MO.
 4. Or accepted equivalent product.
- F. Provide hydrophilic rubber gasket waterstops as manufactured by:
1. Duroseal Gasket Waterstop manufactured by BBZ USA, Southington, CT;
 2. Adeka Ultraseal MC-2010M manufactured by Adeka North America, Spearfish, SD;
 3. Swellseal 8 manufactured by de neef Construction Chemicals, Inc., Waller, TX;
 4. Approved equal.

2.07 HYDROPHILIC PASTE WATERSTOPS

- A. Provide hydrophilic rubber paste waterstops of urethane paster, thixotropic vinyl monomer or similar materials.
- B. Hydrophilic rubber paste shall be compatible with waterstop material.
- C. Hydrophilic paste shall be 100% solids.
- D. Provide hydrophilic paste waterstops which meet or exceed the criteria in the following table:

Property	Test Methods	Limit
Ultimate Elongation	ASTM D638	50% minimum
Tensile Strength	ASTM D638	25 psi [170 kPa]
Ozone Resistance	ASTM D1149	No Failure
Volatile Loss	ASTM D1203	0.50% maximum
Hardness, Shore A	ASTM D2240	20 to 60

- E. Provide hydrophilic rubber paste as manufactured by:
1. Duroseal Paste manufactured by BBZ USA, Southington, CT:
- F. Adeka Ultraseal P-201 manufactured by Adeka North America, Spearfish, SD;
1. Swellseal Cartridge manufactured by De Neef Construction Chemicals, Inc., Waller, TX;

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Do not omit, add, or relocate construction and expansion joints without acceptance of the Engineer.
- B. Cast slabs and beams monolithically without horizontal joints.
- C. Do not use horizontal joints within footings and foundation mats.
- D. Place waterstops in joints, in location indicated, before concrete placement.
- E. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.
- F. Reject before placing concrete, all waterstops bent around corners and remove from the construction or expansion joint and replace with factory-made pieces at no additional cost to the Owner.
- G. Spark test all waterstop splices before installation in accordance with manufacturer's instructions.
- H. Clean all expansion joint sidewalls before installing joint compound and compression seals.

3.02 JOINT PREPARATION

- A. General:

1. The joints shall be accurately located and constructed to produce straight joints; and shall be vertical or horizontal, except where walls intersect sloping floors.
2. The concrete pour shall not commence until after the joint preparation has been inspected by the Engineer.

3.03 PREPARATION OF CONSTRUCTION JOINTS

- A. Contractor shall terminate each day's pour with a construction joint, as shown on the Drawings or as approved by the Engineer, and a suitable bulkhead.
- B. Maintain on hand, at all times, sufficient keyway material, waterstops, and dowels for emergency use if a construction joint is required due to stoppage of concrete pour because of an emergency shutdown.
- C. Temporary stoppage of pouring concrete may result in a cold joint. Prior to resuming concrete placement on this plane, the surface shall be thoroughly cleaned of all laitance, loose or defective concrete, coatings, sand and other foreign material. The surface shall be prepared to a sufficient depth to expose sound concrete. Immediately prior to covering with fresh concrete the joint shall be wet sandblasted, washed with air-water jet and surface dried.

3.04 CONSTRUCTION JOINTS

- A. Prior to placing the abutting concrete, the contact surface shall be prepared according to this Section. The exposed portion of the reinforcing steel shall be cleaned of all concrete.
- B. Roughen the surface of the hardened concrete by one of the following methods:
 1. Sandblasting the foundation and reinforcing dowels after the concrete has fully cured to remove all laitance and spillage, and to expose sound aggregate.
 2. Water blasting the foundation and reinforcing dowels after the concrete has partially cured to remove all laitance and spillage, and to expose sound aggregate.
 3. In no case shall the roughening process cause microfractures on the treated surface.
- C. At least 2 hours must elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.
- D. Furnish key groove with key width one-third the thickness of the member in which the key is placed and a key depth of 1½-inch, unless otherwise indicated.
- E. Use tapered key groove forms, with taper being no greater than 2 inches per foot, to permit form removal without damage to groove after concrete has cured.
- F. Center waterstops in construction joints unless otherwise indicated.
- G. Secure waterstops in position by tie wire from loops to adjacent reinforcement every 12 inches along each edge both sides.
- H. Consolidate concrete during placement adjacent to key groove and around waterstop.
- I. Do not remove key groove forms until after concrete has been cured for 24 hours.
- J. Key groove forms left in place are not acceptable.
- K. Clean key groove of laitance, curing compound, foreign materials, protrusions of hardened concrete, roughen and blow out debris and dust with oil-free compressed air.
- L. Protect exposed key groove from damage.

3.05 EXPANSION JOINTS

- A. Provide expansion joints as indicated.

- B. Center waterstops in expansion joints unless otherwise indicated.
- C. Secure waterstops in position by tie wire form loops to adjacent reinforcement every 12 inches along each edge both sides.
- D. Consolidate concrete during placement adjacent to expansion joint and around waterstop.

3.06 POLYVINYLCHLORIDE WATERSTOPS

- A. Provide waterstops in continuous lengths to minimize field splices.
- B. Bending waterstops in forms is not permitted. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.
- C. Split waterstops are not permitted.
- D. Make all splices on a bench following manufacturer's splicing procedures and instructions.
- E. Maintain continuity through splice of characteristic features of waterstop cross-section, including ribs and center bulb.
- F. Remove looped steel wire along both edges of waterstop adjacent to saw-cut ends prior to splicing.
- G. Make splices by heat sealing adjacent surfaces using a thermostatically controlled electric heat source in accordance with manufacturer's printed instructions.
- H. Reform waterstop at splices using a remolding iron having pattern matching waterstop.
- I. After splice has cooled, spark test all splices in accordance with manufacturer's printed instructions. If splice shows any separation or lack of fusion reject the splice, recut back at least one inch from rejected splice each side, reweld and retest.
- J. Position and tie waterstop to form a continuous, watertight diaphragm in joint, to prevent leakage.
- K. Support and protect waterstop.
- L. Replace or repair, in accordance with manufacturer's printed instructions, damaged or punctured waterstop.
- M. Clean waterstop of curing compound, foreign materials, and protrusions of hardened concrete.
- N. Consolidate concrete during placement adjacent to waterstop.
- O. Maintain 2 inches minimum clearance between waterstop and reinforcement, and all embedded items.

3.07 PREMOLDED-JOINT FILLER

- A. Treat cut surface as recommended by manufacturer, when strips are cut.
- B. Place against the bulkhead form and fasten to the inside of the form with non-corrodible fasteners.
- C. Prevent disturbance of or damage to joint filler.
- D. Fill expansion joint completely.
- E. Secure wood strips to surfaces which are to receive joint compound.
- F. Use tapered wood strips with the smaller width being the same width as the expansion joint and of depth to install the joint compound and back-up materials as recommended by manufacturer.
- G. Use materials to secure joint filler and wood strips which will not harm concrete or affect the joint compound's bond to concrete.
- H. Do not remove wood strips until after the concrete curing period.

- I. Clean groove of laitance, curing compound, foreign materials, protrusions of hardened concrete; blow out dust with oil-free compressed air.

3.08 JOINT COMPOUND

- A. Seal, clean and dry concrete in accordance with manufacturer's printed instructions.
- B. Install back-up and bond breaker materials to prevent 3 sided bending.
- C. Prime concrete, fill flush with joint compound of required thickness, tool to concave joint and seal, all in accordance with the manufacturer's instructions, and ASTM C 962.
- D. Prevent spilling compound over adjoining surfaces. Use tape adjacent to joint if required. Remove all tape completely from concrete surface.
- E. Do not seal when compound, air, or concrete temperature is less than 40 F.

3.09 PREFORMED ELASTOMERIC JOINT SEAL

- A. Remove all joint fillers as recommended by manufacturer for installation of compression seal.
- B. Sandblast without damaging, the exposed joint faces until the surfaces are free of dust, dirt, curing compound, joint filler, and any other material that might prevent readily inserting and bonding of the joint seal to the concrete or stainless steel.
- C. Clean and dry expansion joints. The atmospheric and pavement temperatures must be above 40 F at the time of joint seal installation.
- D. After final cleaning and immediately prior to joint seal installation, blow-out the expansion joints with oil-free compressed air and leave completely free of sand and water.
- E. Lubricate and install the joint seal in accordance with the manufacturer's printed instructions.
- F. Install the joint seal in the upright position and free from twisting, distortion and stretching that exceeds 5 percent. Install the joint seal to a depth of 3/16-inch, $\pm 1/16$ -inch, from the finished surface.
- G. Make butt joints and intersecting splices with full contact. Use adhesive recommended by the seal manufacturer. Remove all dust, grease, or substances impeding the formation of the seal.
- H. When rain interrupts sealing operations, reclean and redry expansion joints prior to installing the joint seal.
- I. If joint seals in place fail to meet specified requirements remove them and install new seals at no additional cost to the Owner.

3.10 HYDROPHILIC WATERSTOP

- A. Use only where specifically shown in the Drawings or approved by the Engineer.
- B. Install in accordance with the manufacturer's written instructions.
- C. Locate the waterstop within the two curtains of vertical wall reinforcing bars as shown or provide a minimum of 2-1/2 inches of concrete cover over the waterstop.
- D. Apply adhesive to concrete surface and allow drying for specified time before applying waterstop strip.
- E. Butt ends of waterstop strip together at splices and corners and joins with sealant.
- F. For vertical and overhead applications, apply adhesive and secure waterstop with concrete nails as 12-inch maximum spacing.
- G. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.

END OF SECTION 03 32 00

SECTION 03 41 00 PRECAST CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes precast structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO - American Association of State Highway and Transportation Officials
 - 2. ACI - American Concrete Institute
 - 3. AWS - American Welding Society
 - 4. ASTM - American Society for Testing and Materials
 - 5. PCI - Precast and Prestressed Concrete Institute

1.04 QUALIFICATIONS

- A. Manufacturer shall be a company specializing in providing precast concrete products and services normally associated with the industry for at least five (5) years. When requested by the Engineer, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.
- B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.
- C. Welders shall have qualified within the past year in accordance with AWS D1.1.

1.05 DESIGN CRITERIA

- A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast concrete design.
- B. Use in the design, applicable codes, ACI 318, or AASHTO Standard Specifications for Highway Bridges. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.
- C. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16(HL-93) loading and installation conditions.
- D. Precast box culvert specifications are found in the 2020 MDOT Standard Specifications for Construction, Section 406: Precast Three-Sided, Arch, and Box Culverts.

1.06 REFERENCE SPECIFICATIONS

- A. All local codes plus the following Specifications, standards and codes are a part of these Specifications:
 - 1. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 2. AWS D1.1 - Structural Welding Code.
 - 3. AWS D1.4 - Reinforcing Steel Welding Code.

4. AASHTO Standard Specifications for Highway Bridges.
5. 2020 MDOT Standard Specifications for Construction, Section 406.

1.07 ALLOWABLE TOLERANCES

- A. Design deviations may be permitted only after the Engineer's review of the manufacturer's proposed design supported by complete design calculations and drawings.
- B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to the Owner.
 1. Length: +/- 1/8 inch per 10 feet (1 mm per meter), +/- 1/4 inch (5 mm) maximum
 2. Cross sectional dimensions:
 - a. Less than 24 inches (600 mm) +/- 1/4 inch, (5 mm) 24 to 36 inches (600 to 900 mm): +/- 3/8 inch (9 mm)
 - b. Over 36 inches (900 mm): +/- 1/2 inch (10 mm)
 3. Thickness: +/- 1/4 inch (5 mm)
 4. Position of anchors and inserts: +/- 1/2 inch (10 mm) of centerline location shown on the Plans.
 5. Horizontal alignment or sweep: 1/4 inch (5 mm) total or 1/8 inch per to-foot length (1 mm per meter), whichever is greater. Maximum of 1/2- inch (10 mm) gap between two (2) adjacent members due to sweep.
 6. End squareness: 3/8 inch (9 mm) maximum
 7. Blockouts: +/- 1/2 inch (10 mm) off centerline locations shown on the Plans.
 8. Out of square: 1/8 inch per six (6) feet (5 mm per 3 m) measured on the diagonal.
 9. Warpage, after installation: 1/8 inch per 6-foot (5mm per 3 m) length, or 3/8 inch (9 mm), whichever is greater.
- C. Vertical Alignment:
 - a. Bottom edges of members from line established at lower face: +/- 1/4 inch (5 mm).
 - b. Bottom surface from straight line between supports: 1/240 of clear span.

1.08 SOURCE QUALITY CONTROL

- A. Comply generally with applicable provisions of Prestressed Concrete Institute MNL-116, Manual for Quality Control for Plants and Production of Precast, Concrete Products.

1.09 SUBMITTALS

- A. The Contractor shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of of this Section.
- B. Submit erection or production drawings showing:
 1. Drawings and/or elevations locating and defining all material furnished by manufacturer.
 2. Sections and details showing connections, cast-in items and their relation to the structure.
 3. Description of all loose, cast-in and field hardware.
 4. Field installed anchor location drawings.
 5. Erection sequences and handling requirements.
 6. Elevation view of each member.

7. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, etc.
 8. Lifting and erection inserts.
 9. Dimensions and finishes.
 10. Method of transportation.
- C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.10 DELIVERY AND HANDLING

- A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

1.11 STORAGE

- A. Store all units off ground.
- B. Place stored units so that identification marks are easily discernible.
- C. Separate stacked members by battens across full width of each bearing point.
- D. Stack so that lifting devices are accessible and undamaged.
- E. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.12 SITE ACCESS

- A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

- A. Shall be Type I or Type III: ASTM C150.

2.02 AGGREGATES

- A. Lightweight aggregates for concrete: ASTM C330.
- B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33.

2.03 ADMIXTURES

- A. Air-entraining admixtures: ASTM C260.
- B. Water reducing, retarding, accelerating admixtures: ASTM C494.

2.04 WATER

- A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 REINFORCING STEEL

- A. Reinforcing bars and wire fabric: Per Section 03 21 00, Concrete Reinforcement.
- B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416.

2.06 GROUT

- A. Grout: Per Section 03 61 00 - Mortar and Grout and complying with the following:
1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.

2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 BEARING PADS

- A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 WELDED STUDS

- A. Shall be in accordance with AWS D 1.1.

2.09 CAULKING

- A. Shall be a nonstaining 1-part polymer acrylic base sealant.

2.10 CONCRETE MIXES

- A. Precast: The mixture and mixing of concrete shall be in accordance with ACI 304. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi (34.4 MPa)..

2.11 FABRICATION AND MANUFACTURE

- A. The fabrication and manufacture of precast products shall comply with the PCI Manual of Practice, and as specified herein.
- B. Provide for those openings ten (10) inches (250 mm) round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast products have been erected. Openings shall be approved by the Engineer before drilling or cutting. No tension reinforcement shall be cut.
- C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.
- D. The manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.
- E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.
- F. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 ACCEPTABLE MANUFACTURERS

- A. Precast concrete decks shall be as manufactured by Price Brothers Company; Concrete Components, Inc.; Precast/Schokbeton; or equal.
- B. Precast concrete steps shall be as manufactured by Unit Step Company; Michigan Precast Concrete; or equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Examine the substrates and conditions under which the precast concrete is to be installed and notify the Contractor 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.

3.02 PREPARATION

- A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.
- B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.
- C. Shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 INSTALLATION - GENERAL

- A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by the Contractor. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 ALIGNMENT

- A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Engineer.

3.05 FIELD WELDING

- A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 GROUTING AND CAULKING

- A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by the Engineer. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.
- B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 ATTACHMENTS

- A. Subject to the approval of the Engineer, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 FIELD QUALITY CONTROL

- A. Final inspection and acceptance of erected precast concrete shall be made by the Engineer to verify conformance with Plans and Specifications.

3.09 SCHEDULES

- A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

END OF SECTION 03 41 00

SECTION 03 60 00 GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide grout, complete and in place, in accordance with the Contract Documents
- B. The following types of grout are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout - Class I (cement-based)
 - 3. Non-Shrink Grout - Class II (cement-based)
 - 4. Non-Shrink Epoxy Grout
 - 5. Epoxy Anchor Grout for Post Installed Adhesive Anchors
 - 6. Topping Grout and Concrete/Grout Fill

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 318-19 - Building Code Requirements for Structural Concrete
 - 2. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
 - 2. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
 - 3. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 4. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 5. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, grouts, Monolithic Surfacing, and Polymer Concretes
 - 6. ASTM C648 - Standard Test Method for Breaking Strength of Ceramic Tile
 - 7. ASTM C695 - Standard Test Method for Compressive Strength of Carbon and Graphite
 - 8. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
 - 9. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 10. ASTM C882/C882M - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

11. ASTM C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
12. ASTM C1090 - Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
13. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
14. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete
15. ASTM C1339 - Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.04 SUBMITTALS

- A. Furnish the following submittals in accordance with Section 01 33 00:
1. Certified testing lab reports for tests indicated herein.
 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 3. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
 4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.
 5. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 6. Submit manufacturer's written warranty as indicated herein.
 7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.05 QUALITY ASSURANCE

- A. Field Tests:
1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Owner. The specimens will be made by the Owner or its representative.
 2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107/C1107M at intervals during construction selected by the Owner. As a minimum, a set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 30 00, at intervals during construction selected by the Owner.
 4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579 at intervals during construction selected by the Owner. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
 5. The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.

6. The Contractor shall assist the Owner in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.
- B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 30 00, unless indicated otherwise.
- C. Pre-Installation Demonstration and Training:
1. Cement and Epoxy-Based Non-Shrink Grouts:
 - a. The grout manufacturer shall give a demonstration and training session for the cement based non-shrink and epoxy grouts to be used on the project, before any installation of grout is allowed.
 - b. Training session shall use a minimum of 5 bags of cement-based non-shrink class I grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining grout shall be placed, and curing may be initiated on actual project placements such as baseplates and tie holes to provide on-the-job training for the Contractor and Owner. Contractor employees who will be doing the grouting shall participate in this training and demonstration session. The training session shall include methods for curing the grout.
 - c. The manufacturer shall mix enough cement-based non-shrink class II grout for a minimum of 15 tie holes and shall train the Contractor's employees in how to perform the Work and cure the grout. Contractor shall have the employees assisting in the mixing and sealing of the tie holes.
 - d. If the project includes patching, through bolt holes, epoxy anchors, and/or blockouts, the manufacturer shall also train the Contractor's employees in the mixing and curing of the epoxy grouts for each of these applications.
 - e. The Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the Owner.
 2. Epoxy Anchor Grout for Adhesive Anchors:
 - a. Special inspection for all adhesive anchor installations shall be provided:
 - 1) As recommended or required by the ICC-ES or IAPMO-UES report.
 - 2) As required by the enforceable building code.
 - 3) As otherwise indicated in the Contract Documents.
 - 4) The most stringent of the above requirements shall be used. The cost of special inspection of adhesive anchors shall be paid for by the Owner.
 - b. Before installing adhesive anchors in the Work, adhesive anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:
 - c. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading/torquing.
 - 1) Anchors installed in both the vertical and horizontal positions in a mock-up concrete panel of adequate size and thickness. Anchors shall be tested in tension. A minimum of 3 anchors shall be tested for each installation position.
 - 2) Anchors shall be tested at 2 times the published allowable tension load or 1-1/4 times the maximum design strength of the anchors in tension as indicated in the ICC-ES or IAPMO-UES report. The test load need not exceed 80 percent of the nominal yield strength of the anchor, based on steel strength, as determined by ACI

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- 3) If any of the 3 test bolts in any installation position fail to reach the test loads, the installer shall be re-tested with the same procedure. Re-testing is required only for the failed installation position.
- 4) An installer who has 3 consecutive successful bolt tests in the first or second trial is considered qualified for adhesive anchor installation for this project. The manufacturer's representative shall issue a certificate to the qualified installer, and a copy of the certificate shall be filed with the Contractor and be submitted to the Owner.
- 5) The test anchor size shall be the largest size adhesive anchor used on the project. The anchor embedment length and edge distances shall be adequate to resist the test loads listed above.
- 6) Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.
- 7) The certification of each qualified installer shall be available for verification at the Special Inspector's request.
- 8) Defective anchors noted by the Special Inspector shall be replaced and re-installed by the Contractor without any additional compensation.

1.06 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty:

1. Furnish one-year warranty for Work provided under this Section.
 - a. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Application:

1. Unless indicated otherwise, grouts shall be provided as listed in below whether indicated on the Drawings or not.

Application	Type of Grout
Anchor bolts, anchor rods, and reinforcing steel required to be set in grout	Epoxy Anchor Grout
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements	Non-Shrink - Class II
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout
Toppings and concrete/grout fill greater than 3-inches thick	Structural Concrete per 03 31 00
Surface repairs unless indicated otherwise	Cement Grout
Surface repairs less than 4" in their least dimension	Non-Shrink Epoxy
Repair holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I

Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II
Any application not listed above, where grout is indicated	Non-Shrink - Class I, unless specifically indicated otherwise

B. Cement Grout:

1. Cement grout shall be composed of one part of cement, 3 parts of sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland Cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4,000 psi.
2. Cement grout materials shall be as indicated in Section 03 30 00.

C. Non-Shrink Grouts (Cement-Based):

1. General:
 - a. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
 - b. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.
 - c. Grout shall not contain chlorides or additives that may contribute to corrosion.
 - d. Grout shall be formulated to be used at any consistency from fluid to plastic.
 - e. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - 1) Minimum tensile splitting strength of 500 psi per ASTM C496.
 - 2) Minimum flexural strength of 1,000 psi per ASTM C580.
 - 3) Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C882/C882M.
2. Non-Shrink Grout – Class I:
 - a. Non-Shrink Grout – Class I shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
 - b. Non-Shrink Grout – Class I shall meet the requirements of ASTM C1107/C1107M, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
 - c. Non-Shrink Grout – Class I shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M. The grout when tested shall not bleed or segregate at maximum allowed water.
 - d. Non-Shrink Grout – Class I shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
 - e. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
 - f. Non-Shrink Grout – Class I shall be Masterflow 713 Plus by BASF, Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, Duragrout by L&M Construction Chemicals; High-Flow Grout by Euclid Chemical Company, CG 200 PC by Hilti, or approved equal.

3. Non-Shrink Grout – Class II:

- a. Non-Shrink Grout – Class II shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
- b. Non-Shrink Grout – Class II shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M.
- c. Non-Shrink Grout – Class II shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
- d. Non-Shrink Grout – Class II shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827/C827M at temperature extremes of 45 to 90 degrees F in accordance with ASTM C1107.
- e. Non-Shrink Grout – Class II shall meet the requirements of ASTM C1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.
- f. The grout when tested shall not bleed or segregate at maximum allowed water content.
- g. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
- h. Non-Shrink Grout – Class II shall be Masterflow 928 by BASF, Five Star Fluid Grout 100 by Five Star Products, SikaGrout 212 by Sika Group, Crystex by L&M Construction Chemicals, or approved equal.

D. Non-Shrink Epoxy Grout:

1. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
2. Epoxy grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M , (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
3. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C531.
4. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, Method B.
5. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
6. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C1339 for bearing area and flow.
7. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
8. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:

- a. Minimum bond strength to concrete of 3,000 psi per ASTM C882/C882M, modified.
 - b. Minimum bond strength to steel of 1,700 psi per ASTM C882/C882M, modified.
 - c. Minimum flexural strength of 2,500 psi per ASTM C580.
 - d. Minimum tensile strength of 2,000 psi per ASTM C307.
9. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Masterflow 648 CP Plus by BASF, Sikadur 42 Grout-Pak by Sika Corporation, or approved equal.
 10. Epoxy Anchor Grout
 11. Epoxy anchor grout for use in concrete shall be certified for use in accordance with ICC-ES AC 308.
 12. Epoxy anchor grout shall conform to ASTM C881/C881M, Type IV, Class B & C, Grade 3 with the exception of gel time.
 13. Heat deflection temperature per ASTM D648 shall be a minimum 120 degrees F.
 14. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short-term temperature of 110 degrees F and 50 percent of its capacity up to a short-term temperature of 150 degrees F.
 15. Grout shall come in a two (2) chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
 16. Epoxy anchor grout shall be capable of being used in submerged applications once cured.
 17. Compressive strength per ASTM D695 shall be 10,000 psi minimum.
 18. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.
 19. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents. Embedment shall not exceed 67 percent of the member depth.
 20. Epoxy anchor grout shall be PE1000+ by Powers Fasteners; HIT-RE 500-V3 by Hilti, SET-XP by Simpson Strong-Tie, or approved equal.
- E. Topping Grout and Concrete/Grout Fill:
1. Where fill thickness is 3-inches or greater, structural concrete, as indicated in Section 03 30 00, shall be used. Omit the coarse aggregate in topping grout used in clarifiers.
 2. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 30 00, shall apply unless indicated otherwise.
 3. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.
 4. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
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1/2 inch	100
3/8 inch	90 - 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 - 10
No. 30	0

5. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00, except that drying shrinkage tests are not required.
 6. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 .
 7. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 5,000 psi.
 8. Topping grout used in clarifiers or where the fill thickness is 3 inches or greater shall contain synthetic fiber reinforcing, unless otherwise shown on the Contract Documents. Synthetic fiber reinforcing shall be in accordance with Section 03 30 00 and shall conform to ASTM C1116/C1116M , Type III.
- F. Curing Materials:
1. Curing materials shall be in accordance with Section 03 30 00, and as recommended by the manufacturer of prepackaged grouts.
- G. Consistency:
1. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
 2. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.
- H. Measurement of Ingredients:
1. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.
 2. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Owner.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

3.03 GROUTING PROCEDURES

- A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Owner, alternate grouting methods shall be submitted by the Contractor for acceptance by the Owner.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.
- C. Drilled Anchors and Reinforcing Bars:
 - 1. General:
 - a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions and applicable ICC-ES or IAPMO-UES report requirements. Holes shall be drilled, brushed and cleaned in accordance with the manufacturer's instructions. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has cured for the full cure time indicated by the manufacturer and reached its indicated strength in accordance with the manufacturer's instructions.
 - b. Contractor shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the Owner if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
 - c. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.

- d. Core drilling of holes is not allowed.
 - e. Relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the Work and shall be provided at no additional cost to the Owner.
 - f. Abandoned drilled holes shall be filled with Epoxy Anchor Grout.
2. Epoxy Adhesive Anchors:
- a. Grout shall be proportioned and mixed per the manufacturer's instructions.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
 - c. Holes shall be dry.
3. Cement Based Non-Shrink Grout used for Anchorage:
- a. In places of high temperature or fire hazard, anchor bolts and anchor rods shall be grouted in using cement based non-shrink grout, Class I.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor bolt, anchor rod or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
 - c. When the anchor bolt or anchor rod diameter is one-inch or less, the hole diameter shall be a minimum of 2-inches. When the anchor bolt/rod diameter is greater than one-inch, the hole diameter shall be at least twice the anchor bolt/rod diameter.
 - d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
4. The non-shrink grout shall be placed in the holes in a non-sag (trowelable) consistency. The grout shall be placed in the holes before the anchor bolt/rod and then the anchor bolt/rod inserted and vibrated to ensure proper coverage.
- D. Topping Grout and Concrete/Grout Fill:
- 1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the Owner, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
 - 2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
 - 3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) - Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated.

Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Owner, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.04 CONSOLIDATION

- A. Grout shall be placed in such a manner that the space to be grouted is completely filled.

3.05 CURING

- A. Cement-based grouts shall be cured per Section 03 30 00 and per the manufacturer's recommendations.

END OF SECTION 03 60 00

SECTION 03 61 00 MORTAR AND GROUT

GENERAL

1.01 REFERENCES

- A. ACI- American Concrete Institute
- B. ANSI- American National Standards Institute
- C. ASTM- American Society for Testing and Materials
- D. ODOT- State of Ohio Department of Transportation Construction and Material Specifications

1.02 REFERENCE SPECIFICATIONS

- A. The latest or current ACI Standards and Code Requirements for "Concrete Masonry Structures," ACI-531, shall govern all mortar and grout work except where otherwise specified herein.

1.03 SUBMITTALS

- A. Manufacturer's literature shall be submitted for premixed materials.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be stored and handled as recommended in ACI 304.
- B. When cement is stored in the open, a floor at least six (6) inches above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain. At the time of its use the cement shall be free from lumps. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by the Contractor by cleaning sacks mechanically or otherwise, or from discarded sacks of cement shall not be used.
- C. The aggregates are to be furnished, stocked and handled so that uniformity of grading will be obtained at the time of batching. The area on which stockpiles are to be built shall be thoroughly cleaned of all foreign materials and shall be firm, reasonably level, and well drained. No aggregates which have become intermixed prior to proportioning shall be used.
- D. The premixed mortar or grout shall be stored and handled in strict accordance with the manufacturer's recommendations.

1.05 JOB CONDITIONS

- A. Environmental requirements relative to temperature for mixing and placing mortar or grout shall be in accordance with Articles 2.8 and 3.8 of this Section.

PRODUCTS

2.01 PREMIXED MORTAR OR GROUT

- A. Premixed mortar or grout shall be a complete packaged mixture to which water is to be added at the job site. Mortar and grout shall be nonshrink, nonstaining.

2.02 CEMENT

- A. The type of cement to be used shall be as indicated on the Drawings or as specified below:
- B. Portland cement: Types I, IA or III: ASTM C150.

2.03 MASONRY CEMENT: ASTM C91.

- A. Mortar, Type M or S: ASTM C270.
- B. Hydrated lime, Type S: ASTM C207.

2.04 AGGREGATE

- A. Fine aggregate: Sand, per ODOT 703.03 Fine Aggregate for Mortar or Grout.

2.05 ADMIXTURES

- A. Integral waterproofing compounds, accelerators, retarders or other admixtures not definitely mentioned in the Specifications shall not be used in mortar or grout without the approval of the ENGINEER. Use no admixtures containing calcium chloride.

2.06 WATER

- A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the State Board of Health may be used without testing. Water from other sources shall be tested before using.

2.07 MIXES

- A. Water shall be added to premixed mortar or grout in strict accordance with manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.
- B. For job mixed mortar or grout, a mixture of cement, aggregate, water and admixtures, if required, shall be combined in proportions meeting the requirements of ODOT 705.20, 705.21, and 705.22 to produce mortar or grout for the use indicated on the Drawings and as specified herein.

2.08 FOR JOB MIXED MORTAR AND GROUT THE CEMENT AND AGGREGATE SHALL BE PROPORTIONED BY WEIGHT FOR CUBIC YARD BATCHES OR BY VOLUME FOR SMALL BATCHES. SHOVEL METHOD OF VOLUME MEASURING WILL NOT BE PERMITTED. WHEN MATERIALS ARE MEASURED BY VOLUME, WATER SHALL BE ADDED IN AMOUNTS NECESSARY FOR THE CONSISTENCY REQUIRED FOR THE WORK.

- A. Non Shrink – Non Metallic Grout
 - 1. Polyester, vinylester and epoxy grouts for anchoring bars, dowels, bolts, rods and other similar materials or where specified in the Drawings or specifications. Grout shall conform to ODOT 705.20.
- B. Quick Setting Concrete Mortar
 - 1. When called for in the Drawings or Specifications, quick setting concrete mortar shall be per the requirements of ODOT 705.21.
- C. Non Shrink Mortar
 - 1. When called for in the Drawings or Specifications, non-shrink mortar shall be per the requirements of ODOT 705.22.

2.09 MIXING

- A. The minimum mixing time shall be five (5) minutes. The consistency of mortar shall be adjusted to provide the best workability. If the mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be retempered by adding water and remixing. The consistency of the grout shall be such that at the time of placement, it will completely fill all spaces intended to receive grout.

2.10 MIX TEMPERATURE

- A. The temperature of the mix shall be between 40 degrees and 120 degrees F.

EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. The Contractor shall verify the elevation of structural member or equipment bases to be grouted, and/or location of anchoring devices as indicated on the Drawings or approved Shop Drawings.

3.02 PREPARATION

- A. Surfaces to receive mortar or grout shall be prepared as follows, unless otherwise specified:
 1. Remove laitance down to sound concrete.
 2. Surface shall be properly wet cured, being free of chemical curing compound, oil, grease, dirt and loose particles.
 3. Clean bolt and/or tie holes, anchor bolts and underside of bearing plates.
 4. Saturate concrete including holes prior to grouting.
 5. When a premixed mortar or grout is used, preparation of surfaces shall be in strict accordance with manufacturer's recommendations.

3.03 INSTALLATION - GENERAL

- A. All mortar and grout shall be used within 2 1/2 hours of initial mixing. No mortar or grout shall be used after it has begun to set.
- B. Premixed mortar or grout shall be used in strict accordance with the manufacturer's recommendations.

3.04 INSTALLATION OF MASONRY UNITS

- A. Mortar joints to bond brick or block shall be no less than 3/8 inch and no greater than 1/2 inch thick. The surface of the joint shall be struck to be flush with the masonry units.

3.05 SURFACE FINISHING APPLICATIONS

- A. Nonshrink mortar shall be thoroughly compacted into all voids, holes, honeycombs, or other defects in the finish surface of concrete. The mortar shall be flush with the surrounding concrete and matching in color and texture.

3.06 GROUTING ANCHORING DEVICES

- A. Nonshrink, nonstaining mortar or grout shall be placed in the hole provided, then the anchoring device or dowel shall be set into the grout filled hole. The surface shall be flush with the surrounding concrete. No pressures or loads shall be applied to the anchoring device until the mortar or grout has attained its ultimate strength.

3.07 GROUTING PLATES AND STRUCTURAL MEMBERS

- A. Thoroughly fill the area between the foundation and plate or member with nonshrink, nonmetallic grout. If required, immediately set shims and align plate or member as required. After the grout has set hard remove forms or shims and finish with a capping mortar.

3.08 COLD WEATHER WORK

- A. No masonry units, mortar or grout Work shall be placed in contact with frozen surfaces. No mortar or grout Work shall be performed when the mean air temperature is below 40 degrees F unless the materials are heated and/or the Contractor provides adequate protection of the Work. All Work shall be protected against freezing for no less than 48 hours after placement.
- B. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.
 1. Air Temperature 40 degrees F to 32 degrees F

- a. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Heating of either of the ingredients shall be to a minimum 30 degrees F and a maximum of 160 degrees F. The ideal mortar temperature should be 70 degrees F to 80 degrees F.
2. Air Temperature 32 degrees F to 25 degrees F
 - a. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 degrees F and maximum 160 degrees F
3. Air Temperature 25 degrees F to 15 degrees F
 - a. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F. Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of interior bearing walls under construction and on the inside of all exterior walls. Windbreaks shall be employed when wind is in excess of 15 mph.
4. Air Temperature 15 degrees F and Below
 - a. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees F and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall be not less than 20 degrees F.

END OF SECTION 03 61 00

SECTION 05 12 00 STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The extent of structural steel work is indicated on the Plans, including schedules, notes, and details to show size and location of members, typical connections, and type of steel required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 30 00 - Cast-in-Place Concrete
B. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
1. ASTM A6/A6M: Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 2. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 3. ASTM A194/A194M: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
 4. ASTM A307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 5. ASTM A500/A500M: Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 6. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
 7. ASTM A572/A572M: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 8. ASTM A992/A992M: Standard Specification for Structural Steel Shapes
 9. ASTM E164: Standard Practice for Contact Ultrasonic Testing of Weldments
 10. ASTM F436/F436M: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
 11. ASTM C1107/C1107M: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 12. ASTM F3125/F3125M: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
 13. SSPC-SP 2: Steel Structures Painting Council, "Hand Tool Cleaning"
 14. SSPC-SP 3: Steel Structures Painting Council, "Power Tool Cleaning"
 15. 2020 MDOT Standard Specifications for Construction, Section 704: Steel Sheet Piling and Cofferdams.

1.04 CODES AND STANDARDS

- A. Comply with the provisions of the following, except as otherwise indicated.

1. AISC - "Code of Standard Practice for Steel Buildings and Bridges."
 2. AISC - "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," including the "Commentary and Supplements" thereto as issued.
 3. RCSC (HSBOLT) - "Specification for Structural Joints Using High-Strength Bolts," approved by the Research Council on Structural Connections (RCSC) with the participation of AISC.
 4. AWS D1.1/D1.1M - "Structural Welding Code."
 5. ASTM A6/A6M - "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."
- B. Steel Sheet Piling specifications are found in the 2020 MDOT Standard Specifications for Construction, Section 704: Steel Sheet Piling and Cofferdams.

1.05 QUALIFICATIONS FOR WELDING WORK

- A. Qualify welding processes and welding operators in accordance with the AWS B2.1/B2.1M "Specification for Welding Procedure and Performance Qualification."
- B. Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months.
- C. If recertification of welders is required, retesting will be the Contractor's responsibility.

1.06 DESIGN OF MEMBERS AND CONNECTIONS

- A. All details indicated on the Plans are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the site whenever possible without causing delay in the Work.
- B. Connection details not shown on the plans shall be designed in accordance with the most current addition of the AISC "Manual of Steel Construction."
- C. Promptly notify the Engineer whenever design of members and connections for any portion of the structure is not clearly indicated.
- D. Steel Sheet Piling specifications are found in the 2020 MDOT Standard Specifications for Construction, Section 704: Steel Sheet Piling and Cofferdams.

1.07 ALLOWABLE TOLERANCES

- A. Overall Length:
 1. Members with both ends milled for contact bearing: $\pm 1/32$ inch.
 2. Members without ends milled for contact bearing which are framed to other members:
 - a. 30 feet or less in length $\pm 1/16$ inch.
 - b. Over 30 feet in length $\pm 1/8$ inch.
- B. Straightness:
 1. Structural members may vary from straightness within the tolerances allowed for wide flange shapes by ASTM A6/A6M, except that the tolerance on deviation from straightness of compression members is 1/1,000 of the axial length between points which are to be laterally supported.
 2. Completed members should be free from twists, bends and open joints. Sharp kinks or bends are cause for rejection of material.
- C. Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1:500.

1.08 SOURCE QUALITY CONTROL

- A. Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.
- B. Promptly remove and replace materials or fabricated components which do not comply.

1.09 SUBMITTALS

- A. For information only, submit two (2) copies of producer's or manufacturer's specifications and installation instructions for the following products including laboratory test reports and other data as may be required to show compliance with these specifications (including specified standards). Indicate by transmittal that copy of each applicable instruction has been distributed to fabricators, installers, and erectors.
 - 1. Structural Steel, including certified copies of mill reports covering the chemical and physical properties.
 - 2. High-strength bolts including nuts and washers.
 - 3. Unfinished bolts and nuts.
 - 4. Structural steel primer paint.
 - 5. Shrinkage-resistant grout.
 - 6. Slide bearings.
- B. Submit shop drawings, prepared by a professional engineer registered in the state of Michigan, including complete details and schedules for fabrication and shop assembly of members, connections, and details. Also include schedules, procedures, and diagrams showing the sequence of erection.
- C. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
- D. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed by the Engineer.

1.11 SEQUENCING WITH RELATED WORK

- A. Supply fabricated structural steel members and/or accessories to be installed by related Work. Bearing plates shall be furnished complete with anchor bolts, washers, nuts and setting diagrams or templates.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Allowances shall be made during erection of structural steel for ambient air temperatures.

PART 2 PRODUCTS

2.01 STRUCTURAL STEEL

- A. Rolled Steel Wide Flange and Tee Shapes: ASTM A992/A992M.
- B. Other Rolled Steel Plates, Shapes, and Bars: ASTM A572/A572M, G50, unless otherwise indicated on the plans.
- C. Hollow Structural Sections: ASTM A500/A500M, Gr B.
- D. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
- E. Anchor Bolts: ASTM A307, nonheaded type unless otherwise indicated on the Plans.

2.02 WASHERS, BOLTS, AND NUTS

- A. Washers: ASTM F436/F436M
- B. Bolts and Nuts:
 - 1. Standard: ASTM A307, Grade A, with nuts conforming to ASTM A563/A563M, Grade A.
 - 2. High Strength: ASTM F3125/F3125M, Grade A325, Type 1, with heavy hex nuts conforming to ASTM A563/A563M, Grade DH.
 - 3. Alloy Steel: ASTM F3125/F3125M, Grade A490, Type 1, with ASTM A194/A194M heavy hex nuts.

2.03 MISCELLANEOUS STRUCTURAL ITEMS

- A. Electrodes for Welding: Comply with AWS Code; Use E 70 XX Series.
- B. Structural Steel Primer Paint: Inorganic Zinc-Rich Epoxy Primer
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C1107/C1107M.

2.04 SHOP FABRICATION AND ASSEMBLY

- A. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the final shop drawings. Provide camber in structural members where indicated on the Plans.
- B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- C. Where finishing is required, complete the assembly, including welding of units before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

2.05 CONNECTIONS

- A. Weld or bolt shop connections as indicated on the Plans.
- B. Bolt field connections except where welded connections or other connections are specified.
- C. Provide high-strength threaded fasteners for all principal bolted connections, except where unfinished bolts are indicated on the Plans.
- D. Provide unfinished threaded fasteners for only the bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erections.
- E. Install high-strength threaded fasteners in accordance with RCSC (HSBOLT).

- F. Comply with AWS Code for procedures, appearance, quality of welds, and methods used in correcting welding work.
- G. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.06 HOLES FOR OTHER WORK

- A. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members as indicated on the Plans and/or final shop drawings. Provide threaded nuts welded to framing, and other specialty items as indicated on the Plans, and/or final shop drawings to receive other work.
- B. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.07 SHOP PAINTING

- A. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on portions which are exposed and initial two 2 inches of embedded areas only.
- B. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.
- C. After inspection and before shipping, clean all steel work whether painted or not. Remove loose rust, loose mill scale, spatter, slag, or flux deposits. Clean steel in accordance with SSPC-SP 2 and SSPC-SP 3.
- D. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness at 2 mils. Use painting methods which will result in full coverage of joints, corners, edges, and all exposed surfaces.

PART 3 EXECUTION

3.01 VERIFICATION

- A. Contractor and erector must examine the areas and conditions under which structural steel 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 in a manner acceptable to the Contractor and erector.
- B. The inspection and verification of construction in place shall be sufficiently in advance of steel erection to allow for possible correction of the construction in place or fabrication. If the construction in place is not inspected by the Contractor prior to erection, the Contractor shall be responsible for removing and resetting construction in place or revisions in fabrication to correct discrepancies.

3.02 ERECTION - GENERAL

- A. Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.

3.03 TEMPORARY SHORING AND BRACING

- A. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.

3.04 TEMPORARY PLANKING

- A. Provide temporary planking and working platforms as necessary to effectively complete the Work.

3.05 ANCHOR BOLTS

- A. Furnish anchor bolts and other connectors required for securing structural steel to foundations.
- B. Furnish templates and devices as necessary for presetting bolts and other anchors to accurate locations. Templates shall be 1/8 inch thick (min) steel plate.

3.06 SETTING BASES AND BEARING PLATES

- A. Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.
- B. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
- C. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.
- D. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's installations, or as otherwise required.

3.07 FIELD ASSEMBLY

- A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
- B. Level and plumb individual members of the structure as specified in Part 1 of this Section unless otherwise specified by AISC tolerances.
- C. Establish required leveling and plumbing measurements on the mean operating temperature of the structure. Make allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
- D. Splice members only where indicated on the Plans and/or final shop drawings.
- E. Erection bolts on exposed welded construction, shall be removed and holes filled with plug welds and ground smooth at exposed surfaces.
- F. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.
- G. Do not enlarge undersized holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.
- H. Do not use cutting torches in the field for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to the Engineer. Finish gas-cut sections equal to a sheared appearance when field cutting is permitted.

3.08 TOUCH-UP PAINTING

- A. Immediately after erection clean field welds, bolted connections, and abraded areas of the shop paint. Apply paint to exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2 mils.

3.09 FIELD QUALITY CONTROL

- A. General:
 - 1. Owner may engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports.

Inspections will meet the requirements of the current building code at the place of the Work.

2. The testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.
 3. Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.
 4. The testing agency may inspect structural steel at the plant before shipment; however, the Engineer reserves the right, at any time before final acceptance to reject material not complying with specified requirements.
 5. Contractor shall correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Performance of additional tests as may be necessary to reconfirm any noncompliance of the original work, and as may be necessary to show compliance of corrected work will be at the Contractor's expense.
 6. Work determined to be defective by the Engineer and/or local agencies regardless of all previous inspections, shall be corrected to the satisfaction of the Engineer at no extra cost to the Owner. Contractor shall be responsible for the cost and delay of replacing defective Work both in regard to his own Contract and as such cost or delay affects the Work of others.
- B. Connections:
1. Inspect shop bolted connections in accordance with AISC Specifications.
 2. Inspect and test not less than five (5) percent of the shop and field welds during fabrication and erection of structural steel assemblies as follows:
 - a. Certify welders and conduct inspections and tests as required.
 - b. Record types and locations of all defects found in the work.
 - c. Record work required and performed to correct deficiencies.
 - d. Perform visual inspection of all welds complying with ASTM E164.
 3. Inspection of field bolted connections will be in accordance with AISC Specifications.

END OF SECTION 05 12 00

SECTION 31 09 15
SOIL EVALUATION FOR TRAFFIC SIGNAL MAST ARM POLE

GENERAL

1.01 SCOPE OF WORK

1.02 THE WORK SPECIFIED IN THIS SECTION INCLUDES ALL LABOR AND MATERIALS REQUIRED TO CONDUCT A SOIL EVALUATION FOR THE SALVAGED MAST ARM POLE AND SIGNAL EQUIPMENT FOR THE TRAFFIC SIGNAL ON EUREKA ROAD AT THE CITY OF TAYLOR FIRE STATION DRIVEWAY.

- A. After culvert construction and restoration of the area around the protected mast arm foundation north of Eureka Road, the Contractor shall retain an MDOT-prequalified Geotechnical Engineer to evaluate soil conditions to determine if they are sufficient to accommodate the salvaged mast arm pole and signal equipment.
- B. The Work includes, but is not limited to, drilling soil borings (hand augering if necessary), field observations, backfilling and restoration of boring areas, soil testing, geotechnical analysis, documentation and record of results.

EXECUTION

2.01 GENERAL

- A. The soil and geotechnical evaluation shall be conducted in accordance with *MDOT Requirements for Preliminary Geotechnical Investigations for Signal Foundations*, MDOT's Standard Plan for Traffic Signal Mast Arm Pole and Foundation Design Table, the MDOT 2020 Standard Specifications for Construction, and as directed by Wayne County Department of Public Services.

MEASUREMENT AND PAYMENT

GENERAL

- A. Soil Evaluation for the traffic signal mast arm pole will be measured and paid for at the contract unit price under the Lump Sum pay item "Soil Evaluation".

END OF SECTION 31 09 15

SECTION 31 10 00 SITE PREPARATION

GENERAL

1.01 SCOPE OF WORK

- A. Section includes:
 - 1. Protection of existing fences, infrastructure, and associated improvements, streets and utilities within and near construction areas from damage due to boulders, trees, or other objects dislodged during the construction process.
 - 2. Labor, equipment, and materials necessary for existing tree relocation, protection and trimming.
 - 3. Providing temporary stabilized crushed rock for staging/laydown in accordance with the Contract Documents.
 - 4. All clearing and grubbing work indicated on the Drawings and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, and disposal of materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 32 13 - Construction and Schedule Constraints
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 57 13 - Temporary Erosion and Sediment Control

1.03 REFERENCE STANDARDS

- A. Except as specifically modified in this specification, paving and surfacing operations and materials shall comply with City of Cleveland standards, and applicable sections of the 2013 Ohio Department of Transportation (ODOT) Construction and Material Specifications, including current revisions thereto.
 - 1. Item 203 - Roadway Excavation and Embankment
 - 2. Item 304 - Aggregate Base
- B. Code of Standards of the American Association of Nurserymen and the American Standard for Nursery Stock and Tree Care Association Standards for Pruning and Guying of Shade Trees.

1.04 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials

1.05 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Name and location of plant providing aggregate.
- C. Type and composition of proposed materials, including aggregate gradation.
- D. Certificates of Compliance certifying compliance with the referenced specifications and standards.
- E. Submit documentation, if applicable, of permission from property owners, of any timber removal or salvaged timber with work occurring outside of property or right-of-way limits.
- F. Chain Link Protection Fencing: Submit proposed methods and sequence of site preparation to the Owner for review prior to start of Work.
- G. Copy of Arborist's certification.

PRODUCTS

2.01 MATERIALS

- A. Aggregate for Stabilized Staging/Laydown:
 - 1. Aggregate stabilized staging/laydown area base shall be in conformance with Item 304 of the referenced ODOT specifications and AASHTO No. 1, 2, and 57 stone/rock as referenced on the Drawings.

EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Contractor is responsible to provide equipment, workmanship, and materials required to achieve a finished product which meets these specifications for the stabilized staging/laydown area.
 - 2. Do not place aggregates on frozen subgrade or when air temperature is below 35°F.
 - 3. Do not place aggregate materials when natural light is not sufficient to properly observe work on operations.
 - 4. Do not place paving and surfacing material before subgrade is reviewed and accepted by the Owner. Do not place paving and surfacing materials on a frozen or muddy subgrade.
 - 5. Provide adequate drainage at all times to prevent water from standing on subgrade.
- B. Cleaning:
- C. Clean Site of rubbish, excess material, structures, and equipment. Restore damaged property.
- D. Overexcavation, Regrading, and Backfill Under Fill Areas:
 - 1. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level of 1-foot below the existing ground contours shall be backfilled.
- E. Soil Erosion and Sedimentation Control:
 - 1. Contractor, at Contractor's expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Drawings or as determined by Owner.
 - 2. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in waterways downstream of the Work.
 - 3. The measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.
 - 4. Comply with requirements of Section 01 57 13 - Temporary Erosion and Sediment Control.
- F. Seasonal Constraints:
 - 1. No tree or shrub removal can take place between the dates listed in Section 01 32 13 - Construction and Schedule Constraints, unless coordination and approval is given through by the Owner.
- G. Clearing:
 - 1. Trees, stumps, brush, hedges, and other vegetation occurring within the Contract limits, as defined on the Drawings or as directed by Owner, shall be cut off flush with the ground and

shall be completely removed.

2. Use every precaution to prevent damage to and provide protection as necessary of existing plant material. Repair or replace to original condition, as acceptable to the Owner and at no additional cost to the Owner, any material or Work damaged or destroyed while performing Work.
3. Vegetation protection fencing shown on Drawings are minimum required for Work. Contractor shall be responsible for providing additional temporary fencing during the Work as necessary to protect vegetation.
4. Flagging of Existing Trees: Flag trees to remain and to be removed with a bright and different colored ribbon. Notify the Owner at least 48 hours prior to commencing of Work to verify all trees that are flagged.
5. Do not park any vehicles or equipment, nor store any materials or stockpiled soil, nor dispose of building materials, chemicals, petroleum products or other detrimental substances within drip line of tree. Protect trees from flame, smoke and heat. Construction access to Site shall not occur beneath drip line of trees.

H. Clearing and Grubbing:

1. Trees, stumps, brush, shrubs, hedges, roots, corduroy, logs, matted roots, other vegetation and debris occurring within the Contract limits as defined on the Drawings or as directed by Owner, shall be completely removed. Depth of removal shall be in accordance with paragraphs 3.01.H thru 3.01.L of this Section.

I. Selective Clearing:

1. Selective clearing shall consist of removing and disposing of dead, diseased, poorly formed, or otherwise undesirable trees, undergrowth, stumps, uprooted trees and debris. The trees to be removed will be marked and the area where the undergrowth is to be removed will be indicated on the Drawings or designated by Owner.
2. Selective Clearing, Type I:
 - a. Trees and stumps shall be cut off at an elevation not more than four (4) inches (100 mm) above the existing ground level.
3. Selective Clearing, Type II:
 - a. Trees and stumps shall be chipped or ground down to an elevation approximately four (4) inches (100 mm) below proposed ground level.

J. Depth of Removal in Excavation Area:

1. For excavation areas within roadways, parking lots, and other paved areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the subgrade elevation.
2. In all other excavation areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the finish surface elevation, or as indicated on the Drawings or as designated by Owner.

K. Depth of Removal in Embankment Areas:

1. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is five (5) feet (1.5 m) or less in height above the existing ground, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the existing ground.
2. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is more than five (5) feet (1.5 m) in height above existing ground, the trees and stumps shall be cut off flush with the existing ground surface.

3. For embankment areas other than roadways, parking lots, and other paved areas, the trees and stumps shall be cut off flush with the existing ground surface, or as indicated on the Drawings or as designated by Owner.
- L. Removal of Trees, Stumps, and Other Vegetation:
1. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections.
 2. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of Owner.
- M. Removing Corduroy:
1. Logs, stumps, poles, brush, and other unsatisfactory material occurring in the Contract limits at or below the surface of the ground and within the depth of four (4) feet (1.2 m) below the proposed plan grade shall be removed and shall be disposed of by Contractor.
 2. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Drawings or as determined by Owner. Trees and stumps buried in these areas shall have a minimum cover of two (2) feet (0.6 m).
- N. Holes and Trenches:
- O. Holes and trenches remaining after the clearing or grubbing operations in embankment areas, shall have the sides broken down or leveled, and shall be refilled with acceptable material.
- a. The material shall be moistened and properly compacted in layers by tampers or rollers to the density required under roadways, parking areas, and other special areas, as determined by Owner.
 - b. The same construction procedure shall be applied to all holes and trenches remaining in excavation areas where the depth of holes exceeds the depth of proposed excavation.
- P. Salvaging Timber:
1. Trees required to be removed and having a diameter of four (4) inches (100 mm), or more, are classed as merchantable timber. On right of way, fee simple, merchantable timber shall become the property of Contractor, unless otherwise specified in the Contract Documents. When such material is placed outside of the right of way, Contractor shall obtain and provide Owner with written permission from Owner of the property on which the timber is to be placed.
 2. Merchantable timber to be removed from areas outside of right-of-way, fee simple, shall be cut and piled for the use of property owner, except where Contractor provides Owner with a written agreement from property owner that he does not desire the salvaged timber. Where property owner has signed such an agreement, the salvaged timber will become the property of Contractor.
 3. When such material is placed outside the Work limits, Contractor shall obtain and provide Owner with written permission from the of the property on which the timber is to be placed. Timber from 4 to 12 inches (100 to 300 mm) in diameter may be left in full tree lengths or cut to commercial lengths, at the option of the Contractor. Timber 12 inches (300 mm), or more, in diameter shall be cut into commercial lengths and piled separately from other timber.
- Q. Existing Trees to Remain:
1. General:
 - a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems.

- b. Individual trees and areas shown to remain shall be protected by six (6) foot high chain link fence. Install fencing before site preparation, grading, and clearing and grubbing operations.
 - c. Under no circumstances shall the Contractor remove existing trees designated to remain for his/her convenience or ease of construction.
 - d. Trees which are not to be removed and become damaged or die shall be replaced with trees of the same species and equal size.
 - e. Prior to installation, stake the location of protection fencing for approval by the Owner. Location stakes or marking shall be placed not greater than ten (10) feet on center.
2. Excavation Around Trees:
- a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems. Excavate within drip line of trees only where shown on the Drawings.
 - b. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots. Contractor shall notify the Owner prior to cutting roots over 6 inches in diameter. Roots up to and including 3/4-inch diameter shall be cut by hand saws. Do not leave roots exposed to sun or drying for more than 24 hours. Protect all exposed roots with moist organic mulch or burlap and backfill as soon as possible.
 - c. Where excavating for new construction is required within drip line of tree, excavate by hand to minimize damage to roots and perform as follows:
 - 1) Use narrow tine spading forks and comb soil to expose roots.
 - 2) If main lateral roots are immediately adjacent to location of new construction, cut roots three (3) inches from new construction.
 - 3) Do not allow exposed roots to dry out before permanent backfill is placed.
 - 4) Provide temporary earth cover, or pack with peat moss and wrap with burlap.
 - 5) Water and maintain in moist conditions until covered with backfill.

R. Trimming of Existing Trees:

- 1. General:
 - a. Tree pruning, tree repair, and tree removal shall be performed by competent workers, under the supervision of an arborist holding certification from the International Society of Arboriculture (ISA) or equivalent education and experience. No pruning shall be performed, unless approved by the Owner.
 - b. Coordinate with City of Cleveland Arborist when trimming or removing within public right of way to obtain approval.
- 2. Pruning:
 - a. Cut branches with sharp pruning instruments and do not break or chop.
 - b. Prune flush with trunk surface.
- 3. Trimming:
 - a. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch.
 - b. Spikes shall not be used for climbing live trees.

- c. Cuts over 1-1/2-inches in diameter shall be coated with an asphaltic emulsion material.

END OF SECTION 31 10 00

SECTION 31 11 00 CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This section includes clearing and grubbing work indicated on the Plans and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, and disposal of materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 57 13 - Temporary Erosion and Sediment Control
- C. Section 01 89 00 - Site Construction Performance Requirements
- D. Section 31 22 00 - Grading
- E. Section 31 23 13 - Subgrade Preparation

1.03 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor, at Contractor's expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.
- B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

- A. Trees, stumps, brush, hedges, and other vegetation occurring within the contract limits as defined on the Plans or as directed by the Engineer shall be cut off flush with the ground and shall be completely removed.

3.02 CLEARING AND GRUBBING

- A. Trees, stumps, brush, shrubs, hedges, roots, corduroy, logs, matted roots, other vegetation and debris occurring within the contract limits as defined on the Plans or as directed by the Engineer, shall be completely removed. Depth of removal shall be in accordance with the requirements specified below.
 - 1. Depth of Removal in Excavation Areas
 - a. For excavation areas within roadways, parking lots, and other paved areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches below the subgrade elevation.
 - b. In all other excavation areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches below the finish surface elevation.
 - c. Unless otherwise indicated on the Plans or as designated by the Engineer .
 - 2. Depth of Removal in Embankment Areas

- a. Within embankment areas for roadways, parking lots, and other paved areas where the top of finished grade is 5 feet or less in height above the existing ground, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches below the existing ground.
- b. Within embankment areas for roadways, parking lots, and other paved areas where the top of finished grade is more than 5 feet in height above existing ground, the trees and stumps shall be cut off flush with the existing ground surface.
- c. For embankment areas other than roadways, parking lots, and other paved areas, the trees and stumps shall be cut off flush with the existing ground surface,
- d. Unless otherwise indicated on the Plans or as designated by the Engineer.

3.03 SELECTIVE CLEARING

- A. Selective clearing shall consist of removing and disposing of dead, diseased, poorly formed, or otherwise undesirable trees, undergrowth, stumps, uprooted trees and debris. Trees to be removed will be marked and the area where the undergrowth is to be removed will be indicated on the Plans or designated by the Engineer.
- B. Selective Clearing, Type I:
 - 1. Trees and stumps shall be cut off at an elevation not more than 4 inches above the existing ground level.
- C. Selective Clearing, Type II:
 - 1. Trees and stumps shall be chipped or ground down to an elevation approximately 4 inches below proposed ground level.

3.04 REMOVAL OF TREES, STUMPS, AND OTHER VEGETATION

- A. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of the Engineer.

3.05 REMOVING CORDUROY

- A. Logs, stumps, poles, brush, and other unsatisfactory material occurring in the contract limits at or below the surface of the ground and within the depth of 4 feet below the proposed plan grade shall be removed and shall be disposed of by the Contractor.
- B. When material is disposed of outside of the contract limits, disposal shall be as specified in Section 01 89 00.
- C. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Plans or as determined by the Engineer. Trees and stumps buried in these areas shall have a minimum cover of 2 feet.

3.06 HOLES AND TRENCHES

- A. Holes and trenches remaining after the clearing or grubbing operations in embankment areas, shall have the sides broken down or leveled, and shall be refilled with acceptable material.
 - 1. Material shall be moistened and properly compacted in layers by tampers or rollers to the density required under roadways, parking areas, and other special areas, as determined by the Engineer.
 - 2. The same construction procedure shall be applied to all holes and trenches remaining in excavation areas where the depth of holes exceeds the depth of proposed excavation.

3.07 SALVAGING TIMBER

- A. Trees required to be removed and having a diameter of 4 inches or more are classed as merchantable timber. On right-of-way, fee simple, merchantable timber shall become the

property of the Contractor, unless otherwise specified in the Contract Documents.

1. When such material is placed outside of the right-of-way, the Contractor shall obtain and provide the Engineer with written permission from the property owner on which the timber is to be placed.
- B. Merchantable timber to be removed from areas outside of right-of-ways, fee simple, shall be cut and piled for the use of property owner, except where the Contractor provides the Engineer with a written agreement from the property owner that he does not desire the salvaged timber. Where the property owner has signed such an agreement, the salvaged timber will become the property of the Contractor.
- C. When such material is placed outside the contract limits, the Contractor shall obtain and provide the Engineer with written permission from the owner of the property on which the timber is to be placed. Timber from 4 to 12 inches in diameter may be left in full tree lengths or cut to commercial lengths, at the option of the Contractor. Timber 12 inches or more in diameter shall be cut into commercial lengths and piled separately from other timber.

END OF SECTION 31 11 00

SECTION 31 23 16 STRUCTURAL EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes excavation for structures, removal and disposal of excavated materials, backfilling, backfill materials and compaction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 57 13 - Temporary Erosion and Sediment Control
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 11 00 - Clearing and Grubbing
- D. Section 31 22 00 - Grading
- E. Section 31 23 19 - Dewatering
- F. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)
 - 2. American Association of State Highway Transportation Officials
 - 3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 SUBMITTALS

- A. The testing laboratory shall provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill. The testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.05 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.
- B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.
- C. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

- A. Granular material shall conform to the requirements for Class II, as specified in MDOT Section 902. Granular Material shall be natural bank run sand.

2.02 COARSE AGGREGATE

- A. Coarse aggregate shall conform to the requirements for 6A, as specified in MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

- A. The area within the vicinity of the new Work shall be dewatered in accordance with Section 31 23 19 prior to the excavation operation.
- B. Depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.02 SHEETING, SHORING, AND BRACING

- A. Contractor shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.
- B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.
- C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit Plans for this Work to the Engineer for informational purposes only.
- D. Sheeting, shoring, and bracing, and excavation shall conform to current federal or state regulations for safety.
- E. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to the Contractor for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.
- F. Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.
- G. Furnishing, placing, maintaining and removing of sheeting, shoring, and bracing materials shall be at the Contractor's expense unless otherwise indicated in the Proposal.
- H. Contractor shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads.
- I. Sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

3.03 COFFERDAMS

- A. A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work.
- B. Alternate methods, where used in lieu of cofferdams, will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for the alternate method.
- C. Stream diversion and earth dikes, where used in lieu of cofferdams or a well-point system will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for such construction.
- D. Interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.

- E. Cofferdams, caissons or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.
- F. Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion.
- G. No timber bracing shall extend into or remain in the finished concrete.
- H. Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.
- I. Furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at the Contractor 's expense.
- J. If the Contractor elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting therefrom.

3.04 EXCAVATION

- A. Excavation shall include the site clearing and grubbing, the excavating and disposing of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.
- B. Excavation shall also include the removal of existing structures, as shown on the Plans or as determined by the Engineer.
- C. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.
- D. Contractor shall keep the limits of excavation operations within a reasonable close conformity with the location and grade, of each structure.
- E. Excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. Excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.
- F. The excavation shall be of sufficient size to allow for the construction of the new Work, the placing and compacting of the backfill and for the dewatering operation.
- G. When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.
- H. Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by the Engineer.
- I. Excavated material, determined by the Engineer as suitable for backfill may be used.
- J. Excess materials shall be disposed by the Contractor, at Contractor's expense, as specified in Section 01 89 00.
- K. The elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by the Engineer prior to making the change.
- L. The surface of all rock or other hard material upon which concrete is to be placed shall be free of all loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.
- M. Unsound material underlying proposed structures shall be removed and replaced with granular material approved by the Engineer, in layers not exceeding 6 inches in depth. Each layer shall

be compacted to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 BACKFILL

- A. Backfill material shall be placed only after the new Work and backfill material have been inspected by the Engineer.
- B. Backfill shall not be placed against any portion of the new Work until the required curing, surface finishing and waterproofing of such portions have been completed. Backfill which will place an unequalized horizontal loading on the new Work shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.
- C. Granular material shall be used for backfilling within 3 feet of all manholes, chambers, valve wells, valve boxes, other pipeline structures, footings, piers, abutments, columns, walls, foundations, etc., unless otherwise indicated in the Contract Documents.
- D. Spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.
- E. After the backfill has been placed and compacted to the flow line elevation of any weep holes indicated on the Plans, the back end of each weep hole shall be covered with not less than 2 cubic feet of coarse aggregate.
- F. Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.
- G. Backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed earth grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by the Engineer.

3.06 COMPACTING BACKFILL

- A. All backfill behind and around the new Work shall be placed in layers, not more than 9 inches in depth, and shall be compacted to not less than 95% of the maximum unit weight.
- B. Areas where the density does not affect the construction, as determined by the Engineer, shall be compacted to not less than 90% of maximum unit weight.
- C. Backfill material shall be placed as specified in MDOT Section 206.03.B, except for the following modifications. The backfill material shall have a moisture content not greater than 3% above optimum, at the time of compaction. If the material contains an excess of moisture, it shall be dried to the required moisture content before being installed.
- D. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by the Engineer, before the succeeding layer is started.
- E. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

- A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the Contractor, at Contractor's expense, as specified in Section 01 89 00.
- B. The construction area shall be graded and left in a neat, workmanlike condition.
- C. At a seasonally correct time, the disturbed area shall be raked, having topsoil placed thereon, fertilized and restored per the requirements of Section 32 9219.

3.08 TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory approved by the Engineer.
 - 1. The cost for testing and sampling shall be at the expense of the Owner.
- B. The testing laboratory shall furnish the Engineer with two (2) certified copies of the results of all tests. Testing procedures shall conform to current MDOT's Standard Specifications for Construction.
- C. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method A, for Granular Materials, and Method C for all other soils.

3.09 DEFECTIVE WORK

- A. Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of the Engineer. Any extra testing or sampling required because of apparent deficiencies shall be at the Contractor's expense.

END OF SECTION 31 23 16

SECTION 31 23 33 TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes open trench construction for utility installation, complete with trenching, sheeting, bracing, bedding, bedding materials, backfilling, backfill materials, and compaction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 57 13 - Temporary Erosion and Sediment Control
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 11 00 - Clearing and Grubbing
- D. Section 31 22 00 - Grading
- E. Section 31 23 16 - Structural Excavation and Backfill
- F. Section 31 23 19 - Dewatering
- G. Section 32 92 19 - Seeding
- H. Section 33 14 00 - Water Utility Distribution Piping
- I. Section 33 41 00 - Storm Utility Drainage Piping

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
 - 2. ASTM C150/C150M: Standard Specification for Portland Cement
 - 3. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
 - 4. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - 5. ASTM C1479/C1479M: Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
 - 6. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 7. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 8. American Association of State Highway Transportation Officials
 - 9. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 TEST REPORTS

- A. Testing laboratory shall provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill.
- B. Testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.05 MIX DESIGN

- A. Submit mix designs for any concrete or flowable fill mixtures to be used on the Project. Include certified test results for seven day and 28 day strengths, together with any technical information for admixtures.

1.06 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor, at Contractor's expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.
- B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS**2.01 GRANULAR MATERIALS CLASS II**

- A. Granular Material Class II shall conform to the requirements for granular material Class II, as specified in MDOT Section 902 except as follows. The granular material shall be natural bank run sand with a maximum size of 1-1/2 inches.

2.02 CRUSHED STONE BEDDING

- A. Crushed, angular, natural stone material, meeting the requirements of 21AA coarse aggregate as specified in MDOT Section 902. Crushed concrete and slag are not allowed.

2.03 CONCRETE

- A. Concrete shall conform to MDOT Section 1004 ; use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

2.04 FLOWABLE FILL FOR BACKFILLING

- A. Materials
 - 1. Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).
 - 2. Water shall meet the requirements of ASTM C94/C94M.
 - 3. ASTM C150/C150M or ASTM C595/C595M, Type I or Type IA.
- B. Mixture (Strength 100 to 120 psi)
 - 1. Fly Ash: 2,000 lbs per cyd min
 - 2. Cement: 70 lbs per cyd min
 - 3. Water: Sufficient water to produce desired flowability 700 lbs per cyd
- C. The temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit.
- D. The flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

PART 3 EXECUTION

3.01 DEWATERING

- A. The area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 23 19 prior to the trenching operation.
- B. Depth of the dewatering shall be sufficient to allow the trench excavating operation including backfilling and compacting to proceed in a dry condition.

3.02 TRENCH EXCAVATION

- A. Open cut trench excavation shall include the site clearing and grubbing, the excavating of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.
- B. The trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by the Engineer.
- C. The trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by the Engineer.
- D. The excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.
- E. For rigid pipe, the trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches above the top of the pipe shall not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6 thru 12 inch pipe	30 inches wide
15 thru 36 inch pipe	outside diameter plus 16 inches
42 thru 60 inch pipe	outside diameter plus 20 inches
over 60 inch pipe	outside diameter plus 24 inches

1. To support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, the Contractor shall install, at Contractor's expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or 4 inches whichever is greater; or at Contractor's expense, install another type bedding, approved by the Engineer. The concrete encasement shall consist of 3,000 psi strength concrete.
- F. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches. The maximum trench width for flexible pipe shall not exceed the minimum width by more than 6 inches.
 1. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, the Contractor shall install, at Contractor's expense, crushed stone bedding material to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.
- G. When, through the Contractor's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, the Contractor, at Contractor's expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 3,000 psi (21 MPa) concrete as approved by the Engineer to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.

- H. Trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

3.03 SHEETING, SHORING, AND BRACING

- A. Contractor shall furnish, place and maintain sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, and conduits next to or crossing the trench; and for the protection and safety of pedestrian and vehicular traffic.
- B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions; and shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation; and shall effectively restrain movement of the adjacent soil.
- C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit plans for this Work to the Engineer for informational purposes only.
- D. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.
- E. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No additional compensation shall be paid to Contractor for sheeting, shoring or bracing left in place.
- F. Supports for pipes, conduits, etc. crossing the trench shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.
- G. Furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at the Contractor's expense.
- H. Contractor shall not remove the trench sheeting, shoring and bracing until the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads.
- I. Sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.04 PIPE BEDDING

- A. Install and compact in 6 inch layers. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe. Work in and around pipe by hand to provide uniform support.
- B. Rigid Pipe Bedding:
 - 1. Rigid pipe bedding shall conform to ASTM C1479, except as noted.
 - 2. Class R-A:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/4 of the outside diameter of the pipe, whichever is greater; and shall extend up the sides of the pipe to the horizontal centerline.
 - b. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least 4 inches or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown; and a minimum width equal to the outside diameter of the pipe plus 8 inches or 1-1/4 of the diameter of the pipe, whichever is greater.
 - 3. Class R-B:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline.

- b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.
 - 4. Class R-C:
 - a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe.
 - b. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.
- C. Flexible Pipe Bedding:
 - 1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
 - 2. Class F-I:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of 4 inches and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches.
 - b. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.
 - 3. Class F-II:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater; and shall extend up the sides of the pipe to the horizontal centerline.
 - b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.
 - c. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.
 - 4. Class F-III:
 - a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of the pipe.
 - b. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3.05 BACKFILLING TRENCHES

- A. Backfill material shall be placed on sections of bedded pipes only after such pipe bedding and backfill materials have been approved by the Engineer.

- B. The trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet, unless otherwise directed by the Engineer.
- C. Backfilling shall not be done in freezing weather except by permission of the Engineer. Frozen materials shall not be used in trench backfilling.
- D. The following trench backfill specifications are for use in that portion of the trench beyond the scope of the pipe bedding requirements which normally stops at a point 12 inches above the top of pipe. Backfill material to be placed above pipe bedding shall be free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other extraneous materials which in the opinion of the Engineer, are unsuitable. Rocks or stones having a dimension larger than 6 inches shall not be placed within three 3 feet of the top of the pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.
- E. The type and method of backfilling is dependent on its location and function and shall conform to the following requirements:
 - 1. Trench B:
 - a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three 3 feet of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.
 - b. Trenches under pavement to be constructed in the near future, as noted or shown on the Plans, shall be backfilled with natural bank run sand, meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.
 - c. Where a pipe is installed under an existing or proposed utility, the backfill between the two shall be natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans, constructed as herein specified.
 - d. The material shall be placed in uniform layers that can be adequately compacted and tested from the surface of that layer and shall be compacted to 95% of the materials maximum unit weight, unless otherwise specified on the Plans or by the Engineer.
 - 2. Trench A;
 - a. Trenches shall be backfilled with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of that layer.
 - b. Each layer shall be thoroughly compacted by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight, whichever is less.
 - 3. Unless otherwise specified on the Plans or as directed by the Engineer, the trench backfill shall be carried to the adjacent existing ground or proposed grade whichever is higher.
 - 4. Where any backfill or bedding as shown on the plans or specified is to be flowable fill, care shall be used to avoid displacing any pipes or structures due to fluid pressure. Pipes in backfill areas may need to be secured to avoid the buoyancy effect.

3.06 COMPACTING BACKFILL

- A. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of installation of the pipe and backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

- A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the Contractor, at Contractor's expense, as specified in Section 01 89 00. The construction area shall be leveled and left in a neat workmanlike condition.
- B. At a seasonally correct time, approved by the Engineer, the disturbed area shall be raked, having topsoil placed thereon and restored.
 - 1. Restoration with seed, fertilizer and mulch shall be the requirements of Section 32 92 19 .
 - 2. Restoration with sod shall be in accordance with Section 32 92 23.

3.08 FIELD TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory suitable to the Owner and approved by the Engineer.
- B. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method C.

3.09 DEFECTIVE WORK

- A. Any portion of the trench backfill which is deficient in the specified density shall be corrected by methods meeting the approval of the Engineer.
- B. Additional testing or sampling required because of deficiencies shall be at the Contractor's expense.

END OF SECTION 31 23 33

SECTION 31 35 20 STREAM CHANNEL STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. This Work shall consist of furnishing, transporting, installing and maintaining rock and log riffle structures and large woody debris habitat structures within the mitigation stream channel, as specified in the Contract, or as directed by the ENGINEER. Work includes, but is not limited to the following major items:
1. Excavation of stream bed for footer rocks.
 2. Backfill and aggregate placement of footers
 3. Rock and log placement.
 4. Constructing rock vane and cut-off sills.
 5. Excavation of downstream pools and backfill of logs with alluvial fill.

PART 2 - PRODUCTS

2.01 ROCK MATERIALS

- A. Furnish rock cross vane header and footer rock and pinch rocks for the mitigation stream channel meeting the size requirements of the plans and specifications. Rock boulders shall consist of angular rock obtained from an approved source and shall consist of natural hard stone. It shall be clean and free from earth, clay or refuse. The solid rock shall have a minimum density of at least 140 lb/CF with approximate dimension as indicated on the plans and details. Rock shall be a natural rock, limestone, quartzite or other hard stone. Footer rock consists of rock placed below the invert of the proposed channel to provide support for the vane rock and prevent downstream scour.
- B. Rock sizes can be variable within the ranges as specified in this section. Rock variability shall utilize the full range as specified, but rocks should be shaped at the edges such that rock placed on top or next to each other will be "locked" together. "Locking shall minimize the potential for movement and provide minimal space for water or solids to pass through the joint.

2.02 LOGS AND ROOTWADS

- A. Logs and rootwads should be from deciduous trees with a slow decay rate such as ash, oak, black walnut, or maple. Coniferous trees are preferred where they occur naturally. The side branches shall be removed. Where the trunk forks, the straighter, thicker trunk shall be kept and the other shall be cut within a foot of the fork. The bole of the rootwad should be cut to the appropriate length at an angle to allow the equipment to push the end of the bole into the bank. All branches and unused woody material shall be chipped or removed from the site and will be considered to be incidental to the Work.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

- A. All stream structures shall be constructed in accordance with the plans and details and these specifications. The location of the vane stream structures along the channel is critical to their success. Therefore, the preliminary layout and all adjustments to the structures shall be reviewed by the ENGINEER prior to installation. Some adjustment to the log and rock vane arms are common during installation. Refer to the structure table for critical design elevations of the structures. Upon completion of the specified structure, the CONTRACTOR shall remove all unsuitable and surplus wood and rock from the site.

3.02 INSTALLATION ROCK/LOG RIFFLE STRUCTURE

- A. The rock cross vanes shall be constructed in a "U" formation so that adjoining rocks taper up in elevation at a slope of 3% to 6% towards the stream bank in a downstream direction. Each side of the vane arm is to be angled 15 to 30 degrees from the stream bank towards mid-channel and the center portion of the vane is to be 1/3 of the active channel width (4.5 feet).
- B. The footer rocks shall be installed by excavating a trench to accommodate both the footer rocks and a 1 foot area upstream. In the event that bedrock is present in the area of installation, footer rock shall still be required unless approval for elimination of footer rock is obtained from the ENGINEER. For example, where bedrock is friable and weathered and can be trenched, footer rock will be required. In areas where bedrock is resistant and blasting would be required, the ENGINEER shall determine whether or not to eliminate footer rock.
- C. Footer rocks shall be placed at the bottom and downstream side of the trench and shall abut one another. Footer rocks shall be firmly embedded into the stream bottom substrate. The trench behind the footer rocks shall be backfilled with MDOT 22A aggregate before vane rocks are set, taking care to fill all voids between the footer rocks. Place log vane 1 across and through the footer rocks as shown on the detail. Place vane rocks over the log vane penetrating cross vane 1 and backfill with aggregate. Ensure the elevation of Node F is set at the elevation noted in the structure table.
- D. In the event where installation of the rock cross vane may damage tree roots, excavation shall be minimized. This may include reducing the length of the vane or eliminating trenching for footer rocks. This decision shall be field determined and authorized by the ENGINEER.
- E. Vane header rocks shall be placed so that they lean on the footer rocks and fit snugly against each other. Care should be taken when placing vane rocks that the seams between vane rocks do not line up with the seams between the footer rocks. The top elevation of the vane rocks placed at the thalweg (center of active channel) shall be equal to the elevation of the thalweg, as specified on the details and structure table. Starting at the thalweg, adjacent rocks shall taper up at a slope of approximately 2-5 percent to the end vane rocks, which shall extend to the bankfull channel elevation (the 15-foot wide dimension on the details).
- F. The downstream vane rock shall be installed with minimum of 1/2 the diameter of the rock keyed into the stream bank. The top of the vane rocks shall be flush with the proposed grade of the bankfull terrace and constructed as indicated in the Contract. The trench behind the vane rocks shall be backfilled with MDOT 22A, taking care to fill all voids underneath and between the vane rocks with the mix.
- G. The vane rock shall extend perpendicular to the active channel a minimum of 5 feet into the stream banks to create a rock sill to prevent stream flows from flanking the rock vane. The sill is to have to a minimum depth of 2 feet. The MDOT 22 A shall be placed as backfill to the sill at the proposed invert elevation shown in the Contract.
- H. Place log vanes at 15 to 30 degrees from the stream bank as shown on the details and plans. The intersection of the log crossing shall occur at the edge of the active channel width as shown on the details. Notch log vane 1 at the crossing point to accept 50% of the diameter of the crossing log. Place pinch boulders to secure the logs in place. Backfill around the logs and pinch boulders with the aggregate fill. Adjust log elevation to match the elevations of the nodes as shown on the structure table and details.
- I. Bury the rootwads into the bank at the bankfull channel elevation. Portions of the root bole may extend above the bankfull terrace as directed by the Engineer. Place pinch rocks as shown on the plans and details. Backfill with MDOT 22A and excavate pilot scour holes between the log vanes as shown on the plans and details.

3.03 CLEAN-UP

- A. Upon completion of work, reshape slopes and stream bottom to specified elevations.

- B. Remove unsuitable and surplus rocks and excavated materials to fill areas or approved off site locations.

END OF SECTION 31 35 20

SECTION 32 01 90 MAINTENANCE OF PLANTED AREAS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The work specified in this Section consists of the maintenance and establishment of the planted areas in accordance with these specifications. This is to include all the constructed wetland and upland planted areas as shown to be planted in accordance with the landscape planting Plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 32 71 00 - Constructed Wetlands
- B. Section 32 90 00 - Plantings
- C. Section 32 9220 - Native Seeding

1.03 QUALITY ASSURANCE

- A. Application of herbicides shall be done by a Michigan Department of Agriculture & Rural Development licensed pesticide applicator. For wetland applications, the applicator must be licensed in Category 5 (aquatic); other application can be done with a Category 2 (forestry) or Category 6 (right-of-way) license. Submit evidence of licensing for each applicator.
- B. A Michigan Environment, Great Lakes and Energy (EGLE) aquatic Nuisance Control Permit may be required for applications near or adjacent to water. Contractor shall be responsible for obtaining any necessary permit.
- C. Contractor is required to complete, as a minimum, one (1) maintenance event per month during the growing season, which is April 25 – October 26.
 - 1. Contractor shall notify the Owner at least 24-hours in advance that the Contractor will be onsite to perform maintenance activities.
 - 2. A written summary of the maintenance activities will be submitted to the Engineer with each invoice, including photographic documentation of the work performed.
 - 3. Invoices will be processed for the year at the end of the growing season.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 WORK TO BE PERFORMED

- A. Contractor shall ensure that the survival level of planted vegetation is maintained at 90% or greater during the maintenance period.
 - 1. Replanting of all herbaceous and woody plants, trees or shrubs shall conform to the requirements of the planting specifications.
 - 2. A summary of replants installed shall be submitted to the Engineer in the monthly maintenance report. The monthly maintenance report will be filed during the growing season of the maintenance and establishment period.
- B. Contractor shall effectively remove the undesirable species within the area to be maintained. At any time during the maintenance and establishment period, the Contractor shall ensure that the presence of the undesirable species in area coverage is contained at the 10 percent or less level. Undesirable species include the following invasive plants:
 - 1. Black Locust (*Robinia psuedoacacia*)
 - 2. Tree-of-Heaven (*Ailanthus altissima*)

3. Multiflora Rose (*Rosa multiflora*)
 4. Honeysuckle (*Lonicera japonica*)
 5. Japanese Knotweed (*Polygonum cuspidatum*)
 6. Giant Reed (*Phragmites australis*)
 7. Buckthorn (*Rhamnus cathartica-frangula*)
 8. Autumn Olive (*Elaeagnus umbellata*)
- C. Undesirable plant removal will be completed by hand whenever practical, or as specified in specific specification sections and permits. Contractor shall remove and properly dispose of all undesirable plant material at the Contractor's expense. No additional compensation shall be made for this item during the maintenance period.
 - D. If herbicides will be required within 50-feet of the Flint River or constructed wetland areas, only herbicides labeled for application in aquatic sites shall be applied.
 - E. Proper selective herbiciding procedures shall be performed by a trained and registered aquatic applicator, licensed in accordance with the applicable commercial laws/regulations of the State of Michigan.
 1. Herbicide shall not be applied during dormancy of the target plant.
 - F. No sooner than two (2) weeks from the date of application the herbicide the Contractor shall completely remove the dead vegetation of the undesirable species and properly dispose of the dead vegetation off-site.
 - G. Contractor shall furnish and apply other material, including water and accessory items as may be required to facilitate the continued establishment and success of grass, plants, trees, and shrubs specified to be maintained.
 - H. Contractor shall prune plants, trees and shrubs specified to be maintained, including removing and properly disposing of the pruned plan material at the Contractor's expense.
 - I. Once the seeded area(s) are well established, and at the direction of the Engineer or the Owner, the Contractor shall furnish and supply labor and equipment necessary to mow the seeded area(s) a minimum of one (1) time(s) per season.

3.02 CONDITIONS AND REQUIREMENTS

- A. Supplemental watering of the planted area(s) may be required depending upon weather conditions antecedent to, during, and after plant installation or seeding. Contractor shall plan for a minimum of four (4) supplemental watering events during the growing season.
 1. No additional compensation shall be provided to the Contractor for watering during the maintenance and establishment period unless the Contractor is specifically requested by the Engineer to provide additional watering.
 2. Supplemental watering shall be done with a slow-release hose or other device to allow the water to soak the soil at the root zone of the plant material and not runoff and cause erosion.
- B. Contractor shall be responsible for ensuring that, for the maintenance period, the presence of undesirable vegetation is maintained at or below 10 percent coverage of the landscaped area.
- C. Contractor shall seed the planted areas as indicated on the planting plan. Successful seeding shall be defined at two points: (1) initially within 14-days of seeding a healthy stand of cover crop has germinated, and (2) growing to provide cover over a minimum of 80 percent of the area seeded. Seeding success during the maintenance and establishment period will also be conditioned on permanent seed species germinated and growing at the end of the first-year growing season so that a uniform matrix of permanent plant material is established with minimal (i.e., less than 15 percent) non-established areas in the planting area. If at the end of either

period, the Contractor has failed to establish a uniform stand of the desired species, the Contractor shall re-seed and mulch the area at the direction of the Engineer at no additional cost to the Owner.

- D. Plant material - including grass, plants, trees, and shrubs - shall be warranted for one (1) year during the maintenance and establishment period. Warranted plant material shall be in satisfactory health at the end of the maintenance period as determined by acceptance of the project by the Engineer and final payment of the Maintenance and Establishment Period invoice. If 25 percent or more of the warranted plant material is dead or considered dead in the opinion of the EngineerProfessional prior to the end of the maintenance period, the Contractor shall replace the dead material at no charge. Replanting shall be done with live plant material during the appropriate season.
1. A tree shall be considered dead when the main leader has died back, or if 25 percent or more of the crown is dead.
 2. Predation from animals shall not relieve the Contractor from replacing the plant material. Contractor shall replant and provide protection to the plant material.

END OF SECTION 32 01 90

SECTION 32 11 23 AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes aggregate base courses complete with aggregate materials constructed in preparation for paving or aggregate surfacing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 23 13 - Subgrade Preparation
- D. Section 32 12 16 - Bituminous Paving

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM D98: Standard Specification for Calcium Chloride
 - 2. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 ALLOWABLE TOLERANCES

- A. The finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet.

1.05 TEST REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the thickness of the compacted aggregate. The core drilling, testing for thickness and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 STOCKPILING AGGREGATE

- A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.
- B. Stockpiling of aggregate, in excess of 4 feet in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified in Part 3 of this Section.

PART 2 PRODUCTS

2.01 DENSE-GRADED AGGREGATE

- A. Dense-graded aggregate gradation shall conform to Series 21 and 22, as specified in MDOT Section 902.05.

2.02 CALCIUM CHLORIDE ADDITIVES

- A. Calcium chloride additives shall conform to ASTM D98 and as specified in MDOT Section 922.12.

2.03 WATER

- A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Potable water from sources approved by Michigan State Department of Public Health may be used.

PART 3 EXECUTION**3.01 EXCAVATION VERIFICATION**

- A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work.
- B. Ascertain that excavation and compacted subgrades or subbases are adequate to receive the new Work.
- C. Correct defects and deficiencies before proceeding with the Work.

3.02 SUBGRADE CONDITIONS

- A. Prior to the placing of any aggregate material, examine the subgrade or subbase to ascertain that it is adequate to receive the aggregate to be placed.
- B. If the subgrade or subbase remains wet after all surface water has been removed, the Engineer may require the installation of edge drain.

3.03 EXISTING IMPROVEMENTS

- A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact. Necessary adjustments in line and grade, to align the new Work with the existing improvements must be approved by the Engineer, prior to any changes.

3.04 PREPARATION OF SUBGRADE OR SUBBASE

- A. Subgrade or subbase shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.05 INSTALLATION - GENERAL

- A. Width, thickness, and type of aggregate materials shall be indicated on the Plans or as directed by the Engineer.
- B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by the Engineer.

3.06 INSTALLATION OF AGGREGATE BASE COURSE

- A. Aggregate base course shall be placed by a mechanical spreader or other approved means in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Plans.
- B. The depth of any one layer, when compacted, shall not be more than 8 inches. If the required compaction cannot be obtained for the full depth of the aggregate base course, the thickness of each course shall be reduced, or, with the approval of the Engineer, adequate equipment shall be used to compact the aggregate to the required unit weight.
- C. Subgrade or subbase shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade or subbase, the hauling equipment will not be permitted on the subgrade or subbase, but shall be operated on the aggregate base course behind the spreader.

- D. Aggregate shall be compacted to at least 95% of maximum unit weight by the use of approved pneumatic-tired compaction equipment or vibratory compactors.
- E. Optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.
- F. When approved by the Engineer, additional water may be applied to the aggregate by an approved means to aid in the compaction and shaping of the material.
- G. Motor graders, trimmers or other approved equipment shall be used to shape the aggregate base course, and maintain it, until the surface course is placed.
- H. When hauling material over the base course, subbase or subgrade, the Contractor shall limit the weight and speed of Contractor's equipment to avoid damage to the subgrade, subbase or aggregate base course. If the subgrade, subbase or aggregate base course becomes rutted due to the Contractor's operation, the subgrade, subbase or base course shall be removed and replaced until acceptable to the Engineer, at the Contractor's expense.
- I. With the approval of the Engineer, chloride additives may be used by the Contractor to facilitate his compaction and maintenance of the aggregate surface. The amount and method of combining the chloride additives are at the option of the Contractor and are at Contractor's expense.

3.07 MAINTENANCE DURING CONSTRUCTION

- A. Aggregate base course and aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.
- B. Contractor, at Contractor's expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.08 TEMPERATURE LIMITATIONS

- A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the maximum unit weight is obtained.
- B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise approved by the Engineer.

3.09 TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to the Owner and approved by the Engineer. The cost for testing and coring shall be at the expense of the Owner.
- B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 feet per traffic lane. The lane width shall be as indicated on the Plans or as determined by the Engineer.
 - 1. If two (2) lanes are constructed simultaneously, only one test is necessary to represent both lanes.
 - 2. For areas such as intersections, entrances, cross-overs, ramps, widening strips, acceleration and deceleration lane, at least one depth measurement will be taken for each 1200 square yards of such areas or fraction thereof.
- C. Location of the depth measurement will be at the discretion of the Engineer.
- D. Maximum unit weight shall be understood to mean the maximum unit weight per cubic foot as determined by ASTM D1557, Method A.

3.10 DEFECTIVE WORK

A. Thickness:

1. Measurements of aggregate base course thickness will be made to the nearest 1/4 inch.
 - a. Depths may be 1/2 inch less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.
 - b. In determining the average in place thickness, measurements which are more than 1/2 inch in excess of the thickness indicated on the Plans will be considered as the specified thickness plus 1/2 inch.
2. Locations of the depth measurements will be as specified herein unless otherwise determined by the Engineer. Sections found to be deficient in depth shall be corrected by the Contractor using methods approved by the Engineer.

B. Weight

1. When the aggregate material is measured by weight in tons, the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than 6 percent .
 - a. Moisture tests will be made at the start of weighing operations and at any time thereafter when construction operations, weather conditions or any other cause may result in a change in the moisture content of the material.
 - b. If the tests indicate a moisture content in excess of 6 percent, the excess over 6 percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than 6 percent.

END OF SECTION 32 11 23

SECTION 32 12 16 BITUMINOUS PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes bituminous paving complete with bituminous materials; bituminous mixtures; installation of bituminous base course, bituminous wearing course, and bituminous curbs; construction of bituminous pavement, sidewalks, drive approaches, and tennis courts; cold milling; and pulverizing existing pavements.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 89 00 - Site Construction Performance Requirements
- D. Section 31 11 00 - Clearing and Grubbing
- E. Section 31 23 13 - Subgrade Preparation
- F. Section 32 11 23 - Aggregate Base Courses
- G. Section 32 17 23 - Pavement Markings

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO M 17: Standard Specification for Mineral Filler for Bituminous Paving Mixtures
 - 2. AASHTO M 29: Standard Specification for Fine Aggregate for Asphalt Mixtures
 - 3. AASHTO M 81: Standard Test Methods and Practices for Emulsified Asphalts
 - 4. AASHTO M 82: Standard Specification for Cutback Asphalt (Medium-Curing Type)
 - 5. AASHTO T 180: Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
 - 6. ASTM D244: Standard Test Methods and Practices for Emulsified Asphalts
 - 7. ASTM D692/D692M: Standard Specification for Coarse Aggregate for Asphalt Paving Mixtures
 - 8. ASTM D1073: Standard Specification for Fine Aggregate for Asphalt Paving Mixtures
 - 9. ASTM D2026: Standard Specification for Cutback Asphalt (Slow-Curing Type)
 - 10. ASTM D2027/D2027M: Standard Specification for Cutback Asphalt (Medium-Curing Type)
 - 11. ASTM D2028: Standard Specification for Cutback Asphalt (Rapid-Curing Type)
 - 12. American Association of State Highway and Transportation Officials
 - 13. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition
 - 14. Michigan Asphalt Paving Association

1.04 ALLOWABLE TOLERANCES

- A. Following the final rolling, the surface will be tested longitudinally using a 10 foot straightedge at locations selected by the Engineer. The variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the

following limits:

- B. For Bituminous Base Course Mixtures:
 - 1. Multiple Courses:
 - a. 3/8 inch for top course
 - b. 3/4 inch for lower courses
- C. For Bituminous Surface Course Mixtures:
 - 1. Multiple Courses:
 - a. 1/8 inch for top course
 - b. 1/4 inch for lower courses
 - 2. Single Course:
 - a. 1/4 inch
- D. Variations in excess of the specified tolerance shall be corrected as determined by the Engineer.

1.05 MATERIAL REPORTS

- A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.
- B. Contractor shall provide the Engineer, or his authorized representative, with the certified batch plant delivery tickets prior to the placing of the materials.
- C. Contractor shall supply the Engineer with a certified job mix design for each type of bituminous mixture proposed for use on this Project.

1.06 TEST REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the mix design and the thickness of the bituminous paving material.
- B. The core drilling, testing for mix design and thickness, and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under this Section.

PART 2 PRODUCTS

2.01 BLENDED AGGREGATE

- A. Blended aggregate shall conform to:
 - 1. AASHTO M29
 - 2. ASTM D692/D692M
 - 3. ASTM D1073
 - 4. MDOT Sections 501 and 902

2.02 MINERAL FILLER

- A. The mineral filler gradation shall conform to:
 - 1. AASHTO M17
 - 2. Mineral filler, 3MF, as specified in MDOT Section 902.11

2.03 ANTI-FOAMING AGENTS

- A. The anti-foaming agents shall conform to anti-foaming agents, as specified in:
 - 1. MDOT Section 904.

2.04 ASPHALT BINDER

- A. Asphalt binder for use in production of bituminous mixtures shall be performance graded asphalt binder:
 - 1. PG58-28 per MDOT Section 904 unless otherwise indicated on the Plans.

2.05 LIQUID ASPHALTS

- A. Liquid asphalts for use in pavement construction shall conform to:
 - 1. ASTM D2026
 - 2. ASTM D2027/D2027M
 - 3. ASTM D2028
 - 4. AASHTO M81
 - 5. AASHTO M82
 - 6. MDOT Section 904

2.06 EMULSIFIED ASPHALT (BOND COAT)

- A. Emulsified asphalt for use in pavement construction shall conform to:
 - 1. ASTM D244
 - 2. MDOT Section 904

2.07 COMPOSITION OF MIXTURES

- A. Bituminous mixtures shall be mixed and placed in accordance with applicable requirements specified in MDOT Section 501 except as otherwise specified in this Section.
- B. The blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.
- C. The aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture of the type as specified on the Plans.
 - 1. Superpave Hot Mix Asphalt Mixtures shall be in accordance with MDOT Section 501.
 - 2. Marshall Hot Mix Asphalt Mixtures shall be in accordance with MDOT Section Special Provision 20SP-501X-01 (latest edition).
- D. The bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT "Procedures for Mix Design Processing"), shall meet the requirements for stability, flow, voids in mineral aggregate (VMA), air voids, fines/binder ratio, fine aggregate angularity, L.A. Abrasion loss, and soft particles as specified for the type of mix.
- E. Mixtures failing to meet the requirements specified will be rejected and the Contractor will be required to submit additional samples of bituminous mixtures until a combination of material is found which will produce a mixture meeting the requirements.
- F. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.
- G. After the job-mix formula is established, the aggregate gradation and the asphalt binder content of the bituminous mixture furnished for the Work shall be maintained within the Range 1

uniformity tolerance limits permitted for the job-mix formula as specified in "Uniformity Tolerance Limits" table below.

1. If two (2) consecutive aggregate gradations on one (1), or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, the Contractor shall suspend all operations. Work days will be charged during the down time.
2. Before resuming any production, the Contractor shall make all necessary alterations to the materials or plant so that the Job Mix Formula can be maintained within the deviations permitted under the table below.

Uniformity Intolerance Limits						
Type of Course	Range (a)	(b)	Percentage Passing Designated Sieves			Asphalt Binder Content
			No. 8	No. 30	No. 200	
Top and Leveling	Range 1	± 5.0	± 5.0	± 4.0	± 1.0	± 0.40
	Range 2	± 8.0	± 8.0	± 6.0	± 2.0	± 0.50
Base Courses	Range 1	± 7.0	± 7.0	± 6.0	± 2.0	± 0.40
	Range 2	± 9.0	± 9.0	± 9.0	± 3.0	± 0.50
(a) This range allows for normal mixture and testing variations. The mixture shall be proportioned to test as loosely as possible to the Job Mix Formula						
(b) This includes all sieve sizes No. 4 and larger listed on the Job Mix Formula						

- H. Mixtures exceeding the maximum tolerances listed in the table, or exceeding the maximum limits specified for the master gradation range will be rejected and the Contractor may be required to remove and replace any bituminous pavements which the Engineer determines were constructed with mixtures in the excess of these tolerances.
- I. Contractor shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant.
 1. Feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.
- J. Contractor has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.
- K. Aggregate gradation tests will be made on aggregate extracted from samples of bituminous mixture taken from the trucks as directed by the Engineer.
 1. As a general guideline, samples will be taken at initial start of production and at other times when tests indicate that the aggregate gradation is fluctuating, truck samples will be taken at a frequency of one (1) sample per 250 Tons of mixture, but not more than four (4) samples per day.
 2. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one (1) sample per 500 Tons of mixture, but no more than two (2) samples per day.
- L. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans.

PART 3 EXECUTION

3.01 EXCAVATION

- A. Prior to the installation of bituminous concrete pavement, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades are adequate to receive the bituminous pavement to be installed. Correct defects and deficiencies before proceeding with the Work.

3.02 SUBGRADE AND BASE COURSE CONDITIONS

- A. Prior to the installation of any bituminous pavement, examine the subgrade and base course to ascertain that it is adequate to receive the bituminous concrete pavement to be installed. If the subgrade remains wet after all surface water has been removed, the Engineer may require the installation of edge drain.

3.03 EXISTING IMPROVEMENTS

- A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Adjustments in line and grade to align the new Work with the existing improvements must be approved by the Engineer, prior to any changes.

3.04 EQUIPMENT REQUIREMENTS

A. General:

1. Contractor shall furnish sufficient equipment for completing the Work in a timely and efficient manner.
2. Equipment shall be on the job site and ready for normal operation before the placing of material is started.
3. Equipment shall be in good working order. Equipment shall be subject to inspections and testing during construction.
4. Equipment shall be of sufficient capacity that the operation can be continuous and a rate of production obtained which insures good workmanship, and eliminates overloading of the equipment or frequent interruptions or delays.
5. Equipment shall conform to the requirements as specified in MDOT Section 501 and as specified herein.

B. Pavers:

1. Paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition, will not be permitted. Paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied shall be screeded by an oscillating or vibrating screed.
2. Paver shall at all times produce a uniformly finished surface, free from tearing or other blemishes that would require hand work. The screed shall be adjustable to provide for tilting to secure the proper drag or compressive action necessary to produce the desired surface texture.
3. Paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.
4. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent

segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.

5. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. The extensions shall also be equipped with a continuation of the automatically controlled spreading augers. The screed and any extensions shall be provided with an approved method of heat distribution.
 6. Unless specified otherwise, bituminous pavers shall be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control.
 - a. A manufacturer approved grade referencing attachment, not less than 30 feet in length, shall be used for all lower courses and the first lane of the wearing course.
 - b. After the first lane of the wearing course has been placed, a 10 feet or longer grade referencing attachment may be substituted for constructing subsequent adjacent lanes of wearing course mixture.
 7. A self-propelled mechanical spreader capable of maintaining the proper width, depth, and slope without causing segregation of the material, may be used for base courses and for surface courses less than 8 feet in width.
 8. When surfacing ramps or shoulders, or when the grade of a concrete gutter or other existing installation must be met, the manner of use of the automatic grade reference and slope control devices shall be as approved by the Engineer.
 9. Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day, provided this method of operation will produce results meeting the specification requirements.
- C. Crushing Equipment:
1. Crushing equipment for pulverizing existing bituminous base course shall be an approved rotary reduction machine having positive depth control adjustments in increments of 1/2 inch and capable of reducing material which is at least six 6 inches in thickness.
 2. The machine shall be of a type designed by the manufacturer specifically for reduction in size of pavement material, in place, and be capable of reducing the pavement material to the specified size. The cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control.
 3. The rate of forward speed must be positively controlled in order to ensure consistent size of reduced material. The machine must be equipped with an accurate tachometer which is mounted in full view of the operator.
 4. Crushing equipment shall meet the approval of the Engineer.
- D. Cold Milling Machine:
1. Cold milling machine for removing concrete or bituminous surfaces shall be equipped with automatically controlled and activated cutting drums that are capable of grade reference, transverse slope control, and produce a uniformly textured surface. An approved grade referencing attachment, not less than 30 feet in length shall be used.
 2. Equipment for removing the concrete or bituminous surface shall be capable of accurately removing the surface, in one or more passes, to the required grade and cross section.
- E. Joint Heaters:
1. Joint heaters shall be infrared or other approved heaters, equipped with an automatic ignition and extinguishing system to ensure that the heater operates only when the paver is moving. It shall be of sufficient length and heating capacity to adequately soften the edge of

the mat. The heater shall be oriented parallel to the joint edge.

2. Bituminous pavement shall not be heated by a direct open flame.

F. Rollers:

1. Steel-wheel rollers shall weight at least 8 tons and shall be self-propelled, vibratory or static, tandem rollers or shall be self-propelled static 3-wheel rollers.
 - a. Steel-wheel rollers shall be free from backlash, faulty steering mechanism, or worn king bolts. The steering device shall respond readily and permit the roller to be directed on the alignment desired.
 - b. Rollers shall be equipped with wheel sprinklers and scrapers.
 - c. Roller wheels shall be smooth and free from openings or projections which will mark the surface of the pavement.
2. Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph and shall have provisions to lock in the manufacturer's recommended speed, vibrations per minute, and amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.
3. The pneumatic-tired roller shall be of the self-propelled type with a total weight, including ballast, not greater than 30 tons.
 - a. It shall be equipped with a minimum of seven (7) wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 1/2 inch is obtained.
 - b. The tires shall be smooth and shall be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 psi.
 - c. The tire pressures shall not vary by more than 5 psi between individual tires. Contractor shall furnish a tire gage which shall be available at all times to enable the Engineer to check the tire pressures.
 - d. Contractor shall furnish the Engineer charts or tabulations showing the contact areas and the contact pressures for the full range of tire inflation pressures and tire loadings for the type and size roller used.
4. Roller shall be equipped with a mechanism capable of reversing the motion of the roller smoothly.
5. Roller shall be equipped with wheel sprinklers and scrapers or mats.
6. Rollers shall be of sufficient size to compact the bituminous mixture to the required density without tearing, displacing, or cracking the mat.

G. Chip Spreader:

1. Chip spreader shall be self-propelled and shall be equipped with pneumatic tires.
2. Spreader shall be equipped with a screen mounted below the metering gage.
3. Spreader shall be capable of spreading the cover material uniformly at widths of 3 to 12 feet, or separate spreaders shall be provided for the specific widths required.
4. Rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds/syd.

H. Bituminous Concrete Curbing Machine:

1. Bituminous concrete curbing machine shall be self-propelled and shall be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on

the Plans. It shall be equipped with templates for the cross sections required.

3.05 PREPARATION OF FOUNDATIONS

- A. For bituminous base course mixtures required to be placed directly on the subgrade, the density, grade and cross section shall meet the approval of the Engineer at the time of placement of any mixture.
- B. Prior to placing any bituminous mixture, the surface of any existing pavement, including joints and cracks, shall be thoroughly cleaned of all dirt and debris.
- C. Existing structures within the limits of the new Work shall be adjusted as specified in the Plans, or as determined by the Engineer.

3.06 PREPARATION OF AGGREGATE BASE

- A. Prior to the placing of prime coats or bituminous mixtures, density, grade and cross section of the aggregate base shall meet the approval of the Engineer.
- B. Surfaces that have become too wet or too dry shall be reworked to provide the required density.

3.07 PREPARATION OF EXISTING PAVEMENT

- A. This Work consists of preparation of the existing concrete road for resurfacing. Broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches shall be removed.
- B. Longitudinal and transverse joints and cracks shall be cleaned in accordance with Article 3.14 of this Section.
- C. Butt joints at the end of surfacing sections and at intersections of adjoining streets shall be made in accordance with Article 3.08 of this Section. The vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.08 BUTT JOINTS

- A. If butt joints are specified on the Plans, or by the Engineer, the old surface shall be cut back for at least 5 feet to a depth of at least 1 inch for the full width of the joint. The vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.09 EDGE TRIMMING

- A. Trimming and truing the edge of an existing bituminous surface shall be performed as required to give a straight, sharp edge at the proper elevations.
- B. The existing base under the bituminous surface shall be left undisturbed.

3.10 REMOVING BITUMINOUS SURFACING

- A. When removing existing bituminous surface course, the edges of the area to be removed shall be cut along straight lines, either perpendicular to or parallel to the direction of travel, for the full depth of the full depth of the surface course; with the cut edge a minimum of 18 inches back from the disturbed edge of pavement.
- B. The cutting of the edges and the breaking up of the bituminous material within the removal area; and the removing and disposing of the unsuitable material are included in the Work of removing bituminous surfacing.

3.11 REMOVING BITUMINOUS PATCHES

- A. Where the removal of bituminous patching material is specified on the Plans or as determined by the Engineer, it shall be saw cut along the edges of the patched area to prevent the tearing of adjoining pavement surfaces during the removal operation.
- B. The cutting, removing and disposing of bituminous surfacing and unsuitable materials are included in the Work of removing bituminous patches.

3.12 PULVERIZATION AND SHAPING OF EXISTING BITUMINOUS BASE COURSE

- A. This Work consists of scarifying, pulverizing, milling, crushing, adding new material if required, shaping, rolling, compacting, and proof rolling the crushed base to the proper elevation and slope.
- B. Additional materials required to fill holes and voids shall be furnished at the Contractor's expense. Additional aggregate, if required, shall be MDOT 20A or 22A aggregate.
- C. The material shall be scarified and uniformly pulverized to a maximum size of 2 inches, in addition, 95% to 100% of the material shall have a particle size of 1-1/2 inches or smaller.
- D. The material shall be scarified and uniformly pulverized, in one or more passes, to the depth specified on the Plans or as determined by the Engineer.
- E. The maximum length or width of roadbed to be scarified and pulverized at any one time shall be as specified on the Plans or as determined by the Engineer.
- F. The crushed material shall be rough graded to within 3/4 inch of the final grade as called for on the Plans or as determined by the Engineer. Additional aggregate shall be placed, if necessary, to attain the required cross sections.
- G. After the material has been balanced, it shall be thoroughly mixed. In restrictive areas, the material to be mixed may be bladed into a windrow to provide working room for the mixer.
- H. The mixed material shall be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by the Engineer. Excess material shall be removed and disposed of by the Contractor at Contractor's expense.
- I. Finished rolling shall be done with a vibratory steel wheel roller.
- J. Aggregate-bituminous pavement mixture shall be compacted to not less than 95% of the unit weight obtained by the AASHTO T 180 test method. The test shall be made on the aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density shall be maintained until the material has been surfaced.
- K. Prior to the placing of any surface courses, the pulverized material shall be proof rolled. Proof rolling shall be accomplished with an 18,000 lbs single axle load.
- L. Unstable areas shall be removed and backfilled.

3.13 HAND PATCHING

- A. Where the filling of holes and depressions in the base or the replacing of the patches is specified on the Plans or as determined by the Engineer, the filler material shall be an approved bituminous mixture. The mixture selected will be dependent on the depth and size of the patch and the type of mixture and performance grade of the asphalt binder required.
- B. The patches shall be compacted to the required grade by use of a machine vibrator or approved roller.

3.14 JOINT CLEANOUT

- A. Where joint cleanout is specified on the Plans or as determined by the Engineer, the joint sealants and foreign material shall be removed to a minimum depth of 1 inch by approved mechanical or hand methods.
- B. The removal and disposal of unsuitable materials and the removal and disposal of bituminous surface patches adjacent to joints are included in the Work for joint cleanout.

3.15 REPAIRING PAVEMENT JOINTS

- A. Where existing pavement joints and cracks are to be repaired, as specified on the Plans or as determined by the Engineer, the existing bituminous surface and any loose or spalled concrete around the joints and cracks shall be removed. Each joint or crack shall be cleaned and shall be

filled with an approved mixture and the mixture shall be compacted with a vibratory machine or by an approved method.

3.16 COLD MILLING CONCRETE OR BITUMINOUS PAVEMENT

- A. Where cold milling concrete or bituminous pavement is specified, the pavement shall be milled to the shape and cross section as shown on the plans. Immediately after cold milling, the surface shall be cleaned.
- B. Contractor shall remove and dispose of any resulting debris.
- C. When allowed by the Engineer, milling materials may be used for temporary wedging.
 - 1. Prior to placing pavement, temporary wedging materials shall be removed and disposed of. Wedging with milled materials is incidental to the Project.

3.17 GENERAL BITUMINOUS PAVEMENT INSTALLATION REQUIREMENTS

- A. The width, thickness and type of bituminous paving improvement shall be specified on the Plans, indicated in the Proposal or as determined by the Engineer.
- B. At street intersections, curb drops conforming to the current rules and regulations of Act 8, Michigan PA 1973, as amended, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalks and driveway approaches shall be provided in locations called for on the Plans or as determined by the Engineer.
- C. Existing improvements, including structures, shall be protected to prevent their surfaces from being discolored during application of bituminous materials.

3.18 BITUMINOUS PRIME COAT OR BOND COAT

- A. The prepared foundation shall be treated with bituminous material for prime coat or bond coat as specified. A bond coat shall be applied to each layer of bituminous mixture before the succeeding layer is placed.
- B. The bituminous material shall be applied uniformly by means of a pressure distributor. In areas inaccessible to the regular distributor operation, the bituminous material shall be applied by means of the hand spraying apparatus of the distributor.
 - 1. Where necessary to accommodate traffic, the surface shall be treated half-width or as recommended by the Engineer.
 - 2. The foundation shall be free from moisture when the treatment is applied.
 - 3. Under no circumstances shall pools of bituminous material be allowed to remain on the surface.
- C. The amount of prime coat to be applied per square yard shall be 0.05 gal/syd unless otherwise specified on the Plans or recommended by the Engineer.
- D. When prime coat is applied, the surface course shall not be placed until the prime coat has properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.
- E. The prime coat may be omitted or reduced when authorized by the Engineer.
- F. The bond coat shall be applied at the rate specified by the Engineer. This rate will be between 0 to 0.10 gal/syd on the bituminous or concrete foundation and between 0 to 0.05 gal/syd between subsequent courses.
- G. The bond coat material shall be applied ahead of the paving operation for a distance of at least 1500 feet depending on traffic conditions; or as determined by the Engineer. The surfacing shall not be placed until the bond coat has cured.

3.19 TRANSPORTATION OF MIXTURES

- A. The transportation of the mixtures as specified shall be in accordance with MDOT Section 501.

3.20 PLACING BITUMINOUS MIXTURES

- A. Pavers will be required to have an automatically controlled and activated screed and strike-off assembly except when placing mixtures for:
1. variable width sections;
 2. sections of pavement less than 1000 feet in length;
 3. placing the first course of a base course mixture on an earth grade or on a sand subbase;
 4. placing base course mixtures in widths less than 8 feet.
- B. Bituminous base course mixtures shall not be placed in lifts exceeding , unless otherwise approved by the Engineer. Approval to place lifts in excess of 3 inches will be based on the ability of the Contractor to place and compact the base course to the required cross section and within the specified tolerances.
- C. For lifts of 2-1/2 inches or greater, a berm of shoulder material shall be banked against the outside edge of each layer of mixture placed unless the sequence of operations is such that the edges of the material are adequately confined and supported in some other manner. The width of material placed shall be twice the height of the bituminous layer being placed but in no case less than a 6 inch width.
- D. When the application rate for a bituminous wearing course exceeds 220 lbs/syd, the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as authorized by the Engineer.
- E. The bituminous mixture shall be placed by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified.
1. The mixture shall be dumped into the center of the hopper and care shall be exercised to avoid overloading the paver and spilling the mixture upon the base.
 2. The paver speed shall be adjusted at the discretion of the Engineer to that speed which, in his opinion, gives the best results for the type of paver being used and which coordinates satisfactorily with the rate of delivery of the mixture to the paver to provide a uniform rate of placing the mixture without intermittent operation of the paver.
- F. When delays result in slowing paving operations such that the temperature of the mat immediately behind the screed falls below 170 degrees Fahrenheit, paving shall be stopped and a transverse construction joint placed.
- G. Bituminous mixture shall be placed in one (1) or more layers as called for on the Plans or as approved by the Engineer.
1. To take out irregularities in the existing road surface, wedging with bituminous mixture shall be done by placing several layers with the paver.
 2. Corrections to the foundation by wedging with bituminous material shall be made by placing, compacting, and allowing the material to cool prior to paving.
- H. Bituminous mixtures shall be placed using two (2) pavers in echelon or one (1) paver equipped with an approved joint heater. Engineer may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees Fahrenheit prior to placement of the adjacent course.
- I. Echelon paving will be permitted when allowed by the Engineer.
- J. Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped sections, and at transverse joints. The edges of the initial mat for cold

joints shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section.

- K. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.
- L. Connections with existing surfaces at the beginning and end of resurfacing sections, and at intersections shall be made by feathering out the mix, by constructing a butt joint, or as approved by the Engineer.
- M. When placing the bituminous mixture in a lane adjoining a previously placed lane, the mixture shall be placed such that it uniformly overlaps the first lane by 2 to 4 inches and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat.
 - 1. The overlapping material shall be bumped, back onto the hot lane so that the roller will compress the excess material into the hot side of the joint.
 - 2. If, in the opinion of the Engineer, the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness. The excess material shall be discarded, it shall not be spread across the surface course.
- N. If the lanes are being constructed with two (2) or more pavers in echelon, the loss depths of bituminous material from each paver shall match at the longitudinal joints.

3.21 ROLLING AND COMPACTING OF BITUMINOUS MIXTURES

- A. Each layer of bituminous mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 syd per hour.
- B. Steel 3-wheel rollers may be used for initial compaction immediately following the paver.
- C. The final rolling operation on each layer of bituminous mixture shall be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.
- D. Roller wheels shall be kept properly moistened with water.
- E. Pneumatic-tired rollers shall be operated in a competent manner and shall not mark or rut the surface or displace the pavement edges. The pneumatic-tired roller shall be ballasted to obtain the required ground-contact pressures as directed by the Engineer.
 - 1. To obtain a uniformly textured mat and the desired pavement density, the Engineer may recommend the Contractor to raise or lower tire pressures at any time during the rolling operations.
 - 2. The roller operations shall be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface.
 - 3. The number of passes made by the pneumatic-tired roller shall not be less than two (2) round trip passes over each area.
- F. Rolling of the mixture shall begin as soon after placing without undue displacement, picking up the mat, or cracking. Rolling shall start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the drive wheel of the roller.
 - 1. Alternate trips of the roller shall be of slightly different lengths.
 - 2. The maximum roller speed shall not exceed the manufacturer's recommended speed for the type of mixture or thickness of layer being placed.
- G. When compacting an adjoining lane, the longitudinal joint shall be rolled first with the roller supported mainly on the cold lane with only 3 to 6 inches of the roller extending onto the freshly placed bituminous material.

- H. Finish rolling shall continue until all roller marks are eliminated.
- I. Pneumatic-tired rollers will not be permitted on wearing courses.
- J. Areas too narrow to be rolled directly by standard 8 ton tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by the Engineer, and weighting not less than 300 lbs per inch of width.
- K. Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at the Contractor's expense.

3.22 WEATHER AND SEASONAL LIMITATIONS

- A. Bituminous mixtures shall not be placed nor the prime coat or bond coat applied when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding.
- B. Unless otherwise approved by the Engineer in writing, seasonal limitations for placing bituminous mixtures shall be in accordance with the following:
 - 1. Seasonal Limitations:
 - a. May 5 to November 15
- C. Unless otherwise approved by the Engineer in writing, minimum mixture temperature limitations at the time of placement for placing bituminous mixtures shall be in accordance with the following:
 - 1. Mix Temperature Limitations:

Temperature of Surface being Overlaid	Rate of Application of Bituminous Material		
	<120 lbs per syd	120 to 200 lbs per syd	>200 lbs per syd
35 to 39 degrees F			330 degrees F
40 to 49 degrees F		330 degrees F	315 degrees F
50 to 59 degrees F	330 degrees F	315 degrees F	300 degrees F
60 to 69 degrees F	315 degrees F	300 degrees F	285 degrees F
70 to 79 degrees F	300 degrees F	285 degrees F	270 degrees F
80 to 89 degrees F	285 degrees F	270 degrees F	270 degrees F
90 degrees F and over	270 degrees F	270 degrees F	270 degrees F

Bituminous paving will not be allowed when the mix temperature is below these minimum temperatures, nor when there is frost on the grade or existing surface.

3.23 HEATING BITUMINOUS MATERIALS

- A. Bituminous material which requires heating before application shall be heated in such a manner as to ensure a uniform temperature throughout the entire mass with efficient and positive control at all times. It shall be heated to a temperature consistent with the type of material used and only to such temperature as will ensure the necessary fluidity.
 - 1. Excessively high temperatures shall be avoided.
 - 2. A thermometer shall be provided to enable the Engineer to observe the temperature at any time.
 - 3. Any bituminous material which has been overheated will be rejected.
- B. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.
 - 1. Heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by

means of a circulating heater.

2. Any asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

3.24 PATCHING

- A. Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.
- B. The bituminous patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.
- C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight. An aggregate base material of not less than 12 inches compacted thickness, or a bituminous base of the specified thickness, shall be used. The top of the base shall be 2 to 2-1/2 inches below the surface of the adjacent pavement. Bituminous patching material shall be placed and compacted.
- D. The surface of the bituminous patch shall be smooth and shall not vary more than 1/4 inch from the crown and grade of the adjacent pavement. Any variations over 1/4 inch from the established grade shall be corrected as determined by the Engineer.

3.25 CHIP SEAL

- A. Seal coating shall consist of one (1) or more applications of bituminous material applied to the prepared surface and one (1) or more coverings of coarse or fine aggregate applied to the bituminous material.
- B. Asphalt emulsion shall be CSEA or CRS-2M and aggregate shall be MDOT 29A unless otherwise specified on the plans.
- C. Cover materials used for seal coating shall be sufficiently dry when it comes in contact with bituminous material. The moisture content shall not exceed three (3) percent by weight, dry basis. Satisfactory means shall be provided for the protection of the coating materials against excessive moisture by covering stockpiles, by aeration or through manipulation.
- D. The bituminous material specified for surface coat shall be uniformly applied by means of the pressure distributor in the number of applications provided and in the amount per square yard as determined by the Engineer. Each application of bituminous material shall cure sufficiently to prevent displacement or pickup by traffic or construction equipment before a succeeding application of bituminous material is made.
- E. Following the application of surface coat bituminous material, the cover material shall be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard as specified or as determined by the Engineer. Truck wheels shall ride on spread cover material and not on bituminous material.
- F. Any irregularities or deficiencies in the uniformity of the cover aggregate on the surface shall be corrected by hand spreading and dragging.
- G. Following the spreading of each course of cover material, the surface shall be rolled by means of approved rollers.
- H. Rolling shall immediately follow the placing of cover material before the bituminous material has set. At no time shall there be more than 300 feet of unrolled cover material. No cover material shall be left unrolled for more than five (5) minutes.
- I. Sufficient rolling shall be done to embed the cover material in the bituminous material without crushing the aggregate.

- J. For areas deficient in cover material after completion of the surface treatment, additional cover material shall be added. For areas with excessive cover material, the excess cover material shall be removed before the next seal is applied. The final application of cover material shall be swept with a power broom.
- K. The completed surface shall be maintained with a drag, broom or other approved equipment to keep the material well distributed on the road until all cover material possible has been embedded in the bituminous material. The length of time required for this maintenance will be from two (2) to five (5) days, as determined by the Engineer, depending on the weather and the materials used.

3.26 BITUMINOUS CONCRETE CURB

- A. The bituminous concrete curb shall be constructed to the design specified on the Plans or as approved by the Engineer and shall include the conditioning and treating of the surface on which the curb is to be placed.
- B. The materials used in the construction and installation of bituminous concrete curbing shall meet the requirements as specified in this Section, and as specified in MDOT Section 904.
- C. Bituminous concrete curb mixture shall be Marshall Mix MDOT 4C or 13A as specified in MDOT Special Provision 20_SP501X-XX and in accordance with MDOT Section 501, unless otherwise approved by the Engineer.
- D. The bituminous curb shall be constructed to conform to the Plans or as determined by the Engineer. The method of construction shall conform to MDOT Section 805, unless otherwise specified.
- E. The bituminous mixture shall be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by the Engineer. The curb shall be formed to the density to produce a tight surface texture. Curbs showing segregation, slumping, or misalignment shall be removed and replaced at the Contractor's expense.
- F. When specified on the Plans or as directed by the Engineer, an application of asphalt emulsion or other approved bituminous coating shall be applied to the finished curb at the joint of the curb and pavement, or to the inside face of the curb, or to both, as a protective seal.
- G. Backfilling behind the curb shall not commence until the bituminous mixture has cured.
- H. Backfill material shall be placed and thoroughly tamped and compacted to the satisfaction of the Engineer, without disturbing the curb, and shall be left in a neat and smooth finished appearance.

3.27 BITUMINOUS APPROACHES, SIDEWALKS, AND SHOULDERS

- A. This Work shall consist of constructing a bituminous surface course as specified on the Plans, or as approved by the Engineer. The bituminous surface course shall be placed on a prepared foundation.
- B. The bituminous materials used shall be as specified on the Plans, or as approved by the Engineer. Materials acceptable for use are specified in this Section, and as specified in MDOT Section 904.
- C. Bituminous approach mixture shall be in accordance with MDOT Section 501, unless otherwise approved by the Engineer.
- D. Existing pavement or aggregate base shall be prepared to receive the bituminous surface course as specified in this Section.
- E. Bituminous prime and bond coats used shall meet the requirements specified in this Section. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces. When approved by the Engineer, the prime coat may be omitted.

- F. Bituminous mixture shall be placed to the thickness specified on the Plans or as determined by the Engineer.
- G. Placing the bituminous mixture shall conform to this Section.
- H. When approved by the Engineer, the paver used for placing bituminous approaches and sidewalks will not be required to have an automatically controlled or activated screed or strike-off assembly or the corresponding grade referencing equipment. Also, with approval from the Engineer, only one (1) roller may be used with each paver.

3.28 CLEANUP

- A. The area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.
- B. The backfill shall be compacted, leveled and left in a neat, smooth condition. At a seasonally correct time the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, sodded in accordance with Section 32 9223, or _____.

3.29 MONUMENT BOXES

- A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by the Contractor and shall be East Jordan Iron Works No. 1570, or approved equal.
- B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.30 TESTING

- A. During the course of the Work, the Engineer may require testing for mix designs, aggregate gradation and physical properties, bitumen content, compaction or density, and thickness of material. The testing and coring required shall be performed by a testing laboratory approved by the Engineer.
 - 1. The cost for testing and coring shall be at the expense of the OWNER.
 - 2. The testing laboratory shall furnish the Engineer with two certified copies of the results of all tests.
- B. Testing procedures shall conform to current MDOT Standards.
- C. Testing of asphalt binders, liquid asphalts, asphalt emulsions, tars shall conform to MDOT Section 904.
- D. Rolling shall proceed until the required compaction is attained and the amount of rolling required shall be based on the test results of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 tons, the nuclear gage method will be used to govern the compactive requirements.
- E. The control density for the bituminous mixture to be placed, will be determined by use of a modified Marshall Test.
- F. Control Density
 - 1. During the Contractor's start-up operations, a rolling procedure to attain the control density will be established.
 - a. The rolling procedure will be based on the number and type of rollers used and the rolling pattern.

- b. The goal of the compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density.
 - c. Density values less than 98% will be sufficient cause for the Engineer to require an adjustment in the number or type of rollers being used or in the rolling pattern.
 2. Once the procedure has been established on the start-up section, the procedure shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.
 3. If difficulties are encountered or if there is a significant change in aggregate or bitumen content, the Engineer will determine the control density for the new mixture and require the Contractor to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density.
 - a. The compactive procedures thus determined shall be used when placing the remainder of that mixture.
 4. Density checks will be made at the discretion of the Engineer to determine if the compactive procedure being used is achieving the required density, or if a change in procedure is necessary.
 5. Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

3.31 PRICE ADJUSTMENTS

- A. Samples of asphalt binder may be taken prior to incorporation into the mixture and from the bituminous mixture. Where results of tests on these samples deviate from specification requirements, the affected material will be subject to price adjustments on the following basis:
 1. When the test results deviate from the limits specified in MDOT Table 904-1, "Performance Graded Asphalt Binder Specification", by ten (10) percent or more, the mixture produced will be evaluated by the Engineer and if in his judgment the defective pavement warrants removal, the Contractor shall remove and replace the affected area at his expense.
 - a. If it is determined that the removal is not required, the Contract unit price of the affected mixture will be reduced by ten (10) percent.
- B. Core samples may be taken on the completed Work. If the results from testing of the core samples indicates a deficiency in the completed Work, the Engineer will evaluate the test results and will recommend removal and replacement or a credit to the Owner.

END OF SECTION 32 12 16

SECTION 32 13 13 CONCRETE PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes both plain and reinforced portland cement concrete paving complete with concrete material admixtures, joints, forms, equipment requirements, field quality control and appurtenances required to complete the portland cement concrete paving Work indicated on the Plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 50 00 - Temporary Facilities and Controls
- C. Section 31 23 13 - Subgrade Preparation
- D. Section 31 23 19 - Dewatering
- E. Section 32 11 23 - Aggregate Base Courses
- F. Section 32 17 23 - Pavement Markings
- G. Section 32 92 19 - Seeding
- H. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications.
 - 1. AASHTO M 33M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
 - 2. AASHTO M 324: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
 - 3. AASHTO T 26: Standard Method of Test for Quality of Water to Be Used in Concrete
 - 4. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 5. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
 - 6. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 - 7. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 8. ASTM C33/C33M: Standard Specification for Concrete Aggregates
 - 9. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
 - 10. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete
 - 11. ASTM C150/C150M: Standard Specification for Portland Cement
 - 12. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete
 - 13. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete
 - 14. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

15. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete
16. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
17. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars
18. ASTM D98: Standard Specification for Calcium Chloride
19. ASTM D994/D994M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
20. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
21. ASTM D5893/D5893M: Standard Specification for Cold Applied Single Component Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
22. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
23. American Concrete Paving Association
24. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition.

1.04 MATERIAL REPORTS

- A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.
- B. The Contractor shall submit a list of his source of material supply to the for review prior to placing any order.
- C. The Contractor shall provide the Engineer, prior to the actual delivery of the ready-mixed concrete, the mix design as required by ASTM C94/C94M .

1.05 THICKNESS AND COMPRESSIVE STRENGTH REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive strength, and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 WATER QUALITY TEST REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the quality of water to be used in the concrete. The sampling and testing of water quality shall be in accordance with AASHTO T 26 requirements, and the certification of the tests' results shall be performed by a testing laboratory approved by the Engineer.

1.07 REQUEST FOR MATERIAL VARIANCE

- A. All requests for variances in the materials, as specified, shall be made in writing to the Engineer.
- B. Two (2) copies of the request shall be submitted for the Engineer's review and approval.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Part 3 of this Section.
- B. Comply with the requirements for protecting new Work against damage from rain, as specified under Part 3 of this Section.

- C. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 CEMENT

- A. Cement shall be low alkali, air-entraining Portland cement conforming to ASTM C150/C150M, Type IA or Type IIIA.

2.02 FINE AGGREGATES

- A. The fine aggregate gradation shall conform to ASTM C33/C33M and to fine aggregate, 2NS, as specified in MDOT, Section 902.08.

2.03 COARSE AGGREGATE

- A. The coarse aggregate gradation shall conform to ASTM C33/C33M and to coarse aggregate, 6A, or 6AA as specified in MDOT, Section 902.03.

2.04 WATER

- A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
- B. Waters from sources approved by the Michigan Department of Public Health as potable may be used without testing.
- C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T-26, and specified in MDOT, Section 911.

2.05 CONCRETE ADMIXTURES

- A. Air-Entraining Admixtures
 - 1. Air-entraining admixtures for concrete shall conform to ASTM C260/C260M and as specified in MDOT, Section 903.01.
- B. Concrete Accelerators
 - 1. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494/C494M, Type C or Type E.
 - 2. Calcium chloride in flake or pellet form shall conform to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form, and as specified in MDOT, Section 903.04.
 - 3. Calcium chloride in solution form shall conform to MDOT, Section 903.04.
- C. Water-Reducing and Water-Reducing Retarding Admixtures
 - 1. Water-reducing admixtures and water-reducing retarding admixtures shall conform to ASTM C494/C494M, Type A or Type D, except that neither type of admixture shall contain calcium chloride, and as specified in MDOT, Section 903.02.
- D. Pozzolanic Admixtures
 - 1. Fly Ash shall conform to ASTM C618, Type F, and as specified in MDOT, Section 901.07.
 - 2. Ground granulated blast furnace slag shall conform to ASTM C989/C989M, Grade 100, minimum

2.06 CONCRETE CURING COMPOUNDS

- A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.06.

- B. Transparent membrane curing compound for curing base course concrete shall conform to ASTM C309, Type 1-D, Class B Vehicle, and as specified in MDOT, Section 903.06.

2.07 LANE TIE BARS

- A. Bar reinforcement for pavement tie bars shall conform to ASTM A706/A706M, or ASTM A615/A615M, Grade 60, and as specified in MDOT, Section 914.09.

2.08 STEEL WELDED WIRE FABRIC

- A. Welded steel wire fabric for concrete mesh reinforcement shall conform to ASTM A1064/A1064M, and as specified in MDOT Section 905.06, and shall be fabricated as shown on the Plans.

2.09 DOWEL BARS

- A. Dowel Bars and basket assemblies for Transverse expansion and contraction joints shall be ASTM A615/A615M Grade 40 and conform to MDOT Section 914.07.

2.10 STEEL HOOK BOLTS

- A. Hook bolts shall conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts shall be 5/8 inch diameter. Along the edge of existing concrete, expansion anchored hook bolts shall be used.

2.11 JOINT FILLERS

- A. Fiber joint filler material for expansion joints shall conform to ASTM D1751, and as specified in MDOT, Section 914.03.
- B. Bituminous premolded joint filler material shall conform to ASTM D994/D994M and also AASHTO M 33M.
- C. Polyethylene premolded joint filler for pressure relief joints shall be a flexible, low-density, expanded, extruded polyethylene plank. The polyethylene plank shall be formed by the expansion of polyethylene base resin in an extrusion process and shall be homogeneous, closed-cell and multi-cellular.

2.12 JOINT SEALANTS

- A. Hot-poured type joint sealant shall conform to AASHTO M324 or ASTM D6690 Type II and as specified in MDOT, Section 914.04.
- B. Cold-applied, single component type, joint sealant shall conform to ASTM D5893.

2.13 CONCRETE MIX

- A. Concrete shall yield a minimum compressive strength of 3500 PSI when cured in a moist room at a temperature within a range of 65 to 75 degrees F for a period of 28 days.
- B. Mixes shall be a nominal 564 lbs/cyd mix except that a minimum of 25% Type F Fly Ash shall be used in the mix. Contractor shall provide documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3500 PSI when tested under field conditions.
 - 1. Water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans, may be used when approved by the Engineer. The fly ash quantity may not exceed 40%; GGBFS quantity shall be not less than 25% not more than 40%.
 - 2. Maximum total replacement of cement shall not exceed 40%. GGBFS and Fly Ash must replace cement on a pound for pound basis.
- C. Cement shall be air-entraining Portland cement ASTM C150/C150M, Type IA. If high-early strength concrete is desired, Type IIIA is required.

- D. High early strength concrete shall be 4500 PSI, 658 lbs/cyd with a water reducer. Water cement ratio shall be between 0.38 and 0.39.
- E. The air content of the concrete shall be dependent on the maximum size aggregate as follows:

Maximum Size of Aggregate	Air by Volume (%)
1-1/2 to 2-1/2 inch	5
3/4 to 1 inch	6
3/8 to 1/2 inch	7-1/2

- F. The slump of the concrete shall be between 1-1/2 to 2-1/2 inch where machine methods are used for striking off and consolidating the concrete. If the Engineer permits hand finishing, the slump may be increased to 3-1/2 inch.
- G. Ready-mixed concrete shall be in accordance with ASTM C94/C94M, Alternate 2, and shall yield a minimum compressive strength of 3500 PSI when cured in a moist room at a temperature within a range of 65 to 75 degrees F for a period of 28 days.
- H. The Engineer shall be provided with the mix design for review and approval, prior to the actual delivery of the concrete.

PART 3 EXECUTION

3.01 VERIFICATION OF EXCAVATION AND FORMING

- A. Prior to the installation of any concrete, examine the excavation and forms for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.
- B. Correct all defects and deficiencies before proceeding with the Work.

3.02 VERIFICATION OF SUBGRADE CONDITIONS

- A. Prior to the installing of any concrete, examine the subgrade to ascertain that it is adequate to receive the concrete to be installed. If the subgrade remains wet after all surface water has been removed the Engineer may require the installation of edge drain.

3.03 EXISTING IMPROVEMENTS

- A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Make necessary adjustments in line and grade to align the new Work with the existing improvements after approval by the Engineer.

3.04 BATCH PLANT

- A. An adequate site for the batch plant shall be obtained by the Contractor, at his expense. The site shall be maintained, and the plant operated in accordance with the conditions and requirements established by the community in which the plant is located.

3.05 FINE GRADING

- A. The subgrade shall be fine graded to the cross section shown on the Plans and shall be thoroughly compacted prior to the placing of forms or concrete.

3.06 INSTALLATION - GENERAL

- A. The width, thickness, and type of concrete pavement shall be specified on the Plans or as approved by the Engineer.
- B. At street intersections, curb drops, conforming to the current rules and regulations of Act 8, Michigan PA 1973, shall be provided for the construction of sidewalk ramps.

- C. Curb drops for sidewalk ramps and driveway approaches shall be provided as specified in locations called for on the Plans or as approved by the Engineer.
- D. Construction operations shall be restricted to the existing right-of-way. If additional area is required, the Contractor shall furnish the Engineer with written permission from the property owner for any part of the operation he conducts outside the established right-of-way.
- E. Contractor shall maintain traffic access at all intersections. Vehicle access shall also be maintained to all commercial and public properties and elsewhere as designated by the Engineer.

3.07 FORMS

- A. Except when paving with a slip-form paver, forms shall be used and shall be made of metal, having an approved section, which shall insure their rigidity under impact, thrust and weight of the heaviest machine carried on them. The thickness of the metal shall be not less than 1/4 inch, except that a minimum thickness of 3/16 inch will be permitted if the form is a trapezoidal cross section.
- B. Forms shall have a minimum length of ten 10 feet and a depth not less than the edge thickness of the Work prescribed, except the subgrade may be a maximum of 1 inch lower than the bottom of the forms when approved by the Engineer. The width of the base in direct bearing on the soil shall be not less than 0.75 of the form depth except that a width of less than 8 inches will not be permitted.
- C. Each 10 feet section of form shall have at least three (3) stake pockets. The forms shall be straight, free from distortion, and shall show no vertical variation greater than 1/8 inch in 10 feet lengths from the true plane surface on the top of the form when tested with a 10 feet straightedge; and shall show no lateral variation greater than 1/4 inch from the true plane surface on the vertical face of the form when tested with a straightedge.
- D. Approved wood or flexible forms and hand finishing will be required on all pavement where the radius for the edge of the pavement is less than 200 feet.
- E. The method of connection between form sections shall be such that a locked joint is formed free from vertical movement in excess of 1/8 inch and from horizontal movement in excess of 1/4 inch under the impact, thrust and weight of the heaviest machine carried on the forms.
- F. Sufficient forms shall be provided so that it will not be necessary to remove them in less than 12 hours, or longer if required, after the concrete has been placed.

3.08 EQUIPMENT REQUIREMENTS

- A. Approved, mechanical concrete placing and finishing equipment shall be used for concrete paving except for gapped areas or where otherwise approved by the Engineer.
- B. The Contractor shall furnish sufficient equipment for the placing of concrete pavement. The equipment shall be on the job site and ready for normal operation before the paving operation is started. All equipment shall be in good working order. The equipment shall be subject to inspections and testing during construction.
- C. The equipment shall be of sufficient capacity that the paver can operate continuously and obtain a rate of production that insures good workmanship and eliminates overloading of equipment or frequent interruptions or delays.
- D. Equipment operating on or near the pavement shall be equipped with rubber-tired wheels.
- E. Subgrade Roller or Compactor:
 - 1. This equipment shall be self-propelled steel-wheeled or a pneumatic-tired roller weighing not less than 8 tons or a self-propelled vibratory compactor of adequate size to compact the subgrade to the required density.

F. Subgrade Planer:

1. A steel-shod subgrade planer supported by two (2) flanged wheels resting on the side forms may be used for trimming the subgrade in small areas when approved by the Engineer.
2. The steel-shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connection to a rigid frame to maintain the crown.
3. The planer shall be of sufficient weight to plane off all high spots encountered.

G. Base Trimmer:

1. For slip-form construction, a powered, self-propelled base trimmer will be required. This base trimmer shall be capable of trimming the base to the required cross section.

H. Water Supply Equipment:

1. The pumps and pipe lines shall be such capacity and nature as to insure an ample supply and adequate pressure of water, simultaneously, for all the requirements of machinery, mixing, sprinkling subgrade, and all other requirements of the Work.
2. Water may be supplied in tank wagons to augment inadequate pipe lines or to replace them entirely if a sufficient number of units are employed.

I. Finishing Machine:

1. The finishing machine shall be power driven and of an approved type which will strike off and compact the concrete with a screeding and troweling action. The machine shall be capable of finishing the concrete in the manner specified herein, and shall provide a minimum of two (2) oscillating screeds.
2. A combination concrete spreader/finishing machine (i.e., Pav-Saver®) may be used for residential streets not exceeding 100 feet in length and 18 feet in width or when approved by the Engineer.
 - a. The combination type machine must have suitable automatic vibrators, strike-off bars, augers, screeds, finishing pan, etc., in accordance with the requirements of this section, to produce a densely compacted, homogeneous concrete slab, true to line, grade and cross section.

J. Concrete Spreader:

1. An approved concrete spreader with a strike-off board or a separate strike-off shall be used to level each layer of concrete, before placing of reinforcement, and before finishing the concrete.
 - a. It shall have sufficient weight and rigidity to retain its shape under working conditions to properly strike off the concrete.
 - b. Two separate spreaders are not required where an approved mesh depressor type machine is used.
2. A concrete spreader is not required for the construction of residential street concrete pavement when approved by the Engineer.

K. Vibratory Screed:

1. An approved hand-propelled vibratory screed shall be provided for use in gapped areas at driveways and intersections, and where machine methods are not feasible to screed and consolidate the concrete.
 - a. Gaps finished by this method shall be limited to one (1) joint spacing in length and one (1) single lane width.

2. The screed shall consist of a steel-shod strike board having a minimum thickness of two 2 inches and equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute.
 3. Other vibratory screeds may be approved by the Engineer.
- L. Membrane Sprayer:
1. A mechanically-pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required.
 2. The equipment shall provide adequate stirring of the compound during application.
- M. Slip-Form Paving Equipment:
1. When pavement is placed by the slip-form method, the slip-form paving equipment shall spread, consolidate, screed, and mechanically float the freshly-placed concrete in such a manner that only a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement.
 2. The machine shall be equipped to vibrate the concrete for the full width and depth of the pavement being placed.
- N. Floats:
1. The mechanical float shall be a combination float finisher. Where a mechanical float is an integral part of a slip-form paver, a separate mechanical float will not be required.
 2. A float finisher shall consist of a machine having two (2) screeds and be equipped with a suspended pan float. The second screed and the pan float shall be suspended in such a manner that they operate independently of the side forms.
 3. A mechanical float will not be required for the construction of residential street concrete pavement.
- O. Footbridge:
1. A movable bridge shall be provided when necessary to satisfactorily finish the pavement or construct joints. The bridge shall be designed and constructed so that it will not come in contact with the concrete.
- P. Transverse Float:
1. This float shall be made of metal and shall be at least 10 feet in length and of the box or channel type with a floating face at least 6 inches in width. It shall be constructed so as to be light in weight, rigid and free from warps.
- Q. Vibrator:
1. The vibrator for consolidating the concrete along the faces of the forms and adjacent to joints shall be an approved electric or mechanical vibrator of an internal type, not less than 2 inches in diameter. It shall have minimum frequency of 5,000 vibrations per minute for a tube 2 inches in diameter, 3,600 vibrations per minute for a tube 4 inches in diameter, or a proportionate frequency for an intermediate size.
 2. At least two (2) vibrators shall be provided for each concrete paving unit on the project.
 3. The vibrators used adjacent to the forms in conventional paving shall be connected with the equipment on which they are mounted such that vibration of the concrete will start automatically with the forward movement of the equipment and stop automatically whenever forward movement stops.
- R. Form Tamper:

1. A mechanical form tamper of approved design will be required on all projects. It shall be capable of thoroughly and uniformly compacting the soil under the forms.

S. Strike-Off for Reinforcement:

1. An approved strike-off shall be used to level the concrete before placing the pavement reinforcement. It shall be adjustable and shall be supported by two (2) flanged wheels on each end which rest on the side forms.
2. It shall have sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.
3. An approved hand strike-off resting on the forms shall be used for irregular areas.
4. The strike-off may be a part of the concrete spreader or a finishing machine.

T. Lane Tie Bar Installer:

1. When not placed on approved chairs, lane tie bars shall be installed by use of an approved mechanical device.

U. Reinforcement Carrier:

1. Reinforcement not placed on chairs shall be transferred from the hauling equipment to a movable bridge which spans the pavement being cast or placed by other approved means which will not result in contamination of the concrete.
2. The bridge shall be capable of carrying the reinforcement load without appreciably deflecting the forms.

V. Joint Filling and Sealing Equipment:

1. The equipment for filling and sealing joints shall be available for inspection and testing at least 48 hours prior to its use.
2. The sealing machine shall include a mechanical mixer capable of mixing the sealing components into a uniform, homogeneous mass.
3. The heating kettle for hot poured sealing material shall be of the indirect-heating or double boiler type, using oil as the heat transfer medium.
 - a. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.
 - b. Contractor shall demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.
4. The hot-poured sealing material shall be applied directly from the heating kettle; the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint.
 - a. The rate of application shall be controlled so as to completely fill the joint and not spill the material on the surface of the pavement.
 - b. The hose and nozzle shall maintain the temperature of the sealing materials so that the loss in temperature is not more than 10 degrees F between the nozzle and the heating tank.
 - c. Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material.
 - d. The heating equipment shall be mounted on rubber-tired wheels, and only rubber-tired equipment shall be used to move the heating equipment on the pavement.

5. Cold applied sealing compound shall be applied by means of pressure equipment that will force the material to the bottom of the joint and completely fill the joint without overflowing onto the surface of the pavement.

W. Preformed Neoprene Joint Sealing Equipment:

1. Equipment for applying the lubricant and installing the preformed joint seal may be either power or hand operated equipment suitable for installing the joint seal as recommended by the manufacturer.

X. Sandblasting Equipment or Power Wire Brush:

1. Sandblasting equipment shall be of proper size and capacity to obtain the cleaning specified and shall operate at a nozzle pressure adequate for the performance of the Work.
2. Nozzles shall be of proper diameter in relation to the width of joint and shall be replaced as necessary due to enlargement by wear.
3. A power wire brush may be used in place of sandblasting equipment.

Y. Air Compressors:

1. Air compressors shall be portable and capable of furnishing sufficient air to maintain a nozzle pressure adequate to remove all loose fragments of concrete and foreign material from the joints.
2. Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

Z. Power Broom:

1. A mechanical broom with pickup suitable for cleaning the pavement will be required.

AA. Concrete Saw:

1. Two (2) self-propelled concrete saws which are adequately powered to cut hardened concrete to a minimum depth as shown on the Plans will be required. The minimum thickness of the saw blade shall be 3/16 inch.
2. Saws shall be equipped with suitable guards.

BB. Miscellaneous Equipment:

1. All other small tools to completely and satisfactorily finish the Work, including straightedges for testing pavement and forms, shall be provided by the Contractor.

3.09 PLACEMENT OF FORMS

- A. Forms shall be placed and checked for line and grade at least 500 feet in advance of placing concrete.
- B. Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.
- C. Forms shall have uniform bearing on the subgrade throughout their entire length and width.
- D. After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.
- E. Forms shall be thoroughly cleaned before they are placed.
- F. Forms shall be neatly and tightly joined, and shall be securely staked by at least three (3) stakes per form.
- G. Forms shall be oiled before concrete is placed against them.
- H. Forms shall be checked for line and grade, after being set.

- I. Forms showing a variance from the staked line by more than 1/4 inch or from the staked grade by more than 1/8 inch in 10 feet shall be adjusted.
- J. Where the use of flexible forms are required, sufficient back bracing shall be provided to prevent undue deflection of the forms during placement of the concrete.

3.10 PLACING CONCRETE

- A. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by the Engineer.
- B. The concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of re-handling to avoid segregation and separation of materials. The concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required finished grades.
- C. Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.
- D. Forms shall not be vibrated to consolidate the concrete.
- E. When the pavement is placed in two (2) layers, the first layer may be cast 3 to 6 inches narrower on each side than the proposed pavement slab, so that the full depth of pavement, at the edges, will be cast with the second layer.
- F. The equipment shall vibrate concrete placed full depth for the complete width and depth of the pavement being placed. For concrete placed in two (2) layers, only the second layer will be required to be vibrated.
- G. The placing of concrete shall be continuous as much as possible between transverse joints.
- H. Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.
- I. If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet or more from the last joint for reinforced pavement and at least 10 feet or more from the last joint in plain concrete pavement.
 - 1. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at the Contractor's expense.
- J. Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. The curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.
- K. Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. The curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.
- L. After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having one part of Portland cement and two parts fine aggregate, and shall be applied with a wooden float.
- M. Where adjacent pavement lanes are constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the project, or until the pavement is 14 days old, at the option of the Engineer.
- N. Any equipment wheels operating on the pavement, shall operate at least 1 foot from the edge of the pavement. The equipment wheels shall be rubber-tired.

- O. The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to insure that the pavement will not be marked or structurally damaged.
- P. Pavers are not permitted to operate on residential streets.
- Q. If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.
- R. The filler strip on pavement widening projects shall be poured as soon as possible but not later than the first working day following the placing of the slab.
- S. At all intersections and where access is required to property along the Project, construction shall be completed by gapping the proposed pavement. Load transfer, contraction, or end-of-pour joint devices shall be placed at the gapped ends of the pavement.
- T. In lieu of pavement gapping, the Contractor may elect to place a temporary bridge, of a design approved by the Engineer, to provide access. Furnishing, placing, maintaining, and removing the bridge shall be at the Contractor's expense.

3.11 PLACING PAVEMENT REINFORCING

- A. Where reinforcement is required, the sheets or mats shall be placed at the depth below the surface of the finished pavement, as shown on the Plans.
- B. Pavement reinforcement shall be shipped and delivered to the Work in flat sheets or mats.
- C. Adjacent sheets or mats shall be lapped, as indicated on the Plans, and shall be fastened to each other in no less than two (2) places in each pavement lane.
- D. Where the width of pavement varies, the reinforcement requirements shall be the same as called for on the Plans. Split sheets or mats may be used to conform to the particular pavement configuration. Side laps shall not be less than the spacing of the longitudinal wires or bars.
- E. On widening Projects where the pavement slab is less than 6 feet in width, 1/2 inch diameter longitudinal reinforcing bars may be substituted for standard reinforcement, providing the bars are spaced not more than 12 inches center-to-center. The first bar shall be not more than 3 inches from the edges of the widened slab, and the bars shall be lapped a minimum of 12 inches.
- F. Reinforcement shall be installed by one of the following methods:
 - 1. Chairs upon which reinforcement is to be mounted shall support the reinforcement and shall have such bearing on the base that there will be no undue penetration of the base. The maximum spacing of the chairs shall be sufficient to maintain the reinforcement at the specified depth. The reinforcement shall be placed directly from the hauling unit unto the chairs.
 - 2. When reinforcement is placed between two (2) layers of concrete, the first layer shall be mechanically spread and struck off to the required depth below the proposed finished surface. The reinforcement shall be placed directly from the carrier onto the struck off concrete.
 - 3. Any area where the use of the mechanical spreader or mechanical strike-off is not feasible, the reinforcement shall be mounted on chairs.

3.12 JOINTS

- A. All longitudinal and transverse joints shall conform to the details and shall be constructed at the locations shown on the Plans or as directed by the Engineer.
- B. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement.

- C. Transverse joints shall be constructed at right angles to the centerline of the pavement, unless otherwise called for on the Plans or as determined by the Engineer. The joints shall not vary more than 1/4 inch from a true line.
- D. The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Plans, joints shall be edged to the radius shown or a minimum 1/4 inch radius. The surface across the joints shall be tested with a 10 foot straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.
- E. When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab. In the case of widening existing pavements, transverse joints shall be placed as shown on the Plans, or as directed by the Engineer.
- F. Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.
- G. Longitudinal Joints:
 - 1. Longitudinal joints shall be a longitudinal lane tie joint with tie bars or a bulkhead construction joints with hook bolts. Where called for on the Plans a keyway shall be constructed in the bulkhead construction joint.
 - a. Longitudinal Lane Tie Joint (D):
 - 1) Longitudinal lane tie joints with tie bars shall be planes of weakness formed by sawing a groove in the hardened concrete according to the alignment, width and depth shown on the Plans.
 - 2) Tie bars of the type, diameter and length called for on the Plans, shall be placed at the required depth parallel to the finished surface, at right angles to the joint and at the uniform spacing also called for on the Plans or as approved by the Engineer.
 - 3) Bar chairs shall be used to support the lane tie bars or the lane tie bars may be installed by use of a mechanical device, approved by the Engineer. The placing of lane tie bars in the concrete by hand methods will not be permitted.
 - 4) The joint shall be sawed as soon as the concrete will not spall or not more than three (3) days after placement, and shall be completed before traffic of any kind uses the pavement. Immediately following the sawing of the joint, the slurry resulting from the sawing operation shall be completely removed from the joint, and the immediate area by flushing with a jet of water under pressure.
 - 5) The joint shall be blown out with a jet of compressed air to remove the flushing water.
 - (a) After the joint is dry it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi and then shall be sealed in accordance with these specifications with an application of an approved hot or cold applied type joint sealing compound.
 - (b) The sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 inch.
 - b. Longitudinal Bulkhead Construction Joint (D):
 - 1) Longitudinal bulkhead construction joints with hook bolts shall be used in part-width construction of concrete pavement and elsewhere as shown on the Plans, or as approved by the Engineer. The size, spacing, and depth of the hook bolts below the surface of the pavement shall be as shown on the Plans.

- 2) For slip-form paving, lane ties of an approved type may be substituted for hook bolts and shall be spaced at 30 inch centers, unless otherwise indicated on the Plans.
 - (a) Lane ties for slip-form paving shall be placed in the concrete with a pneumatic powered installer or equipment producing equal results.
 - (b) Lane ties, which are not set with adequate consolidation of the concrete or are not within 30 degrees of being perpendicular to the pavement edge in a horizontal plane, shall be replaced with drilled-in expansion-anchored lane ties.
- 3) Where a bulkhead joint is to be constructed, hook bolts and couplings shall be attached to the forms and shall be held in position during the placing and finishing of the concrete so as to permit the removal of the pavement forms without damage to the concrete or hook bolt assembly. The ends of the couplings shall be protected so that the concrete, dirt or other materials cannot enter the couplings and prevent a satisfactory connection with either hook bolt.
- 4) Where hook bolts or lane ties are installed for use in future pavement widening, in curb, or curb and gutter construction, a rust preventive oil shall be inserted into the open end of the couplings immediately after removal of the pavement forms by means of a hand operated pump in sufficient quantity to completely cover the internal threads.
 - (a) After application of the protective oil a neoprene or plastic plugs shall be inserted into the ends of the couplings to completely seal the opening without protruding outside of the couplings more than 3/8 inch.
- 5) The concrete shall be edged with a tool having the radius of curvature and depth of lip shown on the Plans. The second pour of concrete shall be edged with a longer lipped edging tool than that used on the first concrete pour.
- 6) After the concrete has cured for the required time, all extraneous material shall be removed from the joint and the joint then sealed with an approved hot-poured or cold-applied elastic-type compound. The use of sandblasters and a jet of compressed air will be required to clean the joint before sealing.

H. Transverse Joints:

1. Transverse joints shall be contraction joints, plane of weakness joints, dummy joints, expansion joints, construction joints, end-of-pour joints and pressure relief joints.
 - a. Contraction Joints (C):
 - 1) Contraction joints shall consist of a load transfer unit and a joint groove formed by sawing. Contraction joints shall be constructed as indicated on the Plans and shall be spaced a maximum of every 57' - 3" or as provided for elsewhere.
 - 2) The load transfer unit shall be epoxy coated dowel bars, spaced and arranged in the positions indicated on the Plans, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a depth from the surface equal to 1/2 the thickness of the slab.
 - 3) This device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 inch per foot of length from its designated line and grade. The device shall permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the subgrade as a unit.

- 4) One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands.
 - (a) To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar.
 - (b) The asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint.
 - (c) The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.
- b. Plane of Weakness Joints (WT):
 - 1) Plane of Weakness joints shall be placed in plain concrete pavements only and is to be constructed immediately after the finishing operation has been completed. A groove shall be formed in the plastic concrete with a metal forming bar to the depth indicated on the Plans.
 - 2) A premolded bituminous filler strip shall be placed in the groove formed by the metal bar, from a bridge operating on the pavement forms.
 - 3) The concrete shall then be floated against the sides of the filler, and the joint edged to a 1/8 inch radius.
- c. Plane of Weakness Joint for Concrete Base Course (WTB):
 - 1) Dummy joints shall be placed in reinforced concrete pavements only where called for on the Plans.
 - 2) They shall be constructed immediately after the finishing operation has been completed by forming a groove in the plastic concrete with a metal forming strip into which expanded polystyrene or other approved temporary filler is placed.
 - 3) The material shall be installed flush with the surface of the pavement and the area on both sides of the joint shall be finished. Transverse joints with a temporary filler shall not be edged.
 - 4) The pavement reinforcement shall be continuous through this joint.
- d. Expansion Joints (E) and (E1):
 - 1) Expansion joints (E1) shall consist of a load transfer unit and a premolded fiber filler and shall be used on reinforced concrete pavements or where shown on the plans.
 - 2) Expansion joints (E) shall consist of a premolded fiber filler without the load transfer unit and shall be used for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other places where shown on the Plans or where installation of the load transfer unit is not feasible; as approved by the Engineer.
 - 3) The load transfer units shall be assembled and the epoxy coated bars lubricated with liquid asphalt. The liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap.
 - 4) The fiber filler shall extend the full depth and width of the joint.
 - (a) After installation, the top shall be not less than 1/2 inch and no more than 1 inch below the finished surface.
 - (b) It shall be furnished in lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and premolded fiber filler shall be sufficient to span two (2) dowel

- bar spacings.
- (c) Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.
 - 5) For expansion joints in curb lanes with integral curb or separate curb and gutter, the fiber filler used in the pavement shall extend completely through the curb section. The fiber filler placed in the curb above the slab shall be 1 inch in width.
 - 6) During installation, the joint shall be held in place by an approved installing device which shall be securely staked.
 - (a) The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10-gage material having flanges not less than 1-1/2 inches in depth.
 - (b) The channel cap shall be shaped to the proposed crown of the pavement and shall extend over the full length of the filler.
 - e. Pressure Relief Joints (PR):
 - 1) The method of constructing a pressure relief joint shall be as indicated on the Plans.
 - 2) The pressure relief joint material shall be a flexible, low-density, expanded, extruded polyethylene plank. This joint material shall be cut off to 1/2 inch below the top of the pavement surface and shall extend entirely through and to within 1/2 inch of the face and top of the curb.
 - f. End of Pour Joints and Construction Joints:
 - 1) End of pour joints in reinforced pavement shall be formed by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except that the ends of the dowel bars shall not be lubricated. The load transfer device shall be so installed that each dowel bar will be embedded in the concrete for 1/2 of its length.
 - 2) When the next pour is made, a space for hot-poured rubber joint filler shall be provided by placing a temporary filler in the fresh concrete.
 - 3) End-of-pour joints shall be constructed using 2-piece dowels and a bulkhead, and shall be placed where it is anticipated that three (3) days or more will elapse between the casting of adjacent pours.
 - 4) Construction joints and end-of-pour joints shall be sealed as specified for transverse contraction joints.
 - 5) End of pour joints in plain concrete pavements shall be formed by placing a bulkhead, fiber keyway, and installing 1/2 inch diameter deformed bars, 30 inches in length, at 18 inch intervals across the end of the pavement.
 - 6) The pavement across the end of both slabs shall be thickened and the joint shall be edged and sealed.
 - 2. All transverse joints in a concrete pavement shall extend entirely through the integral curb or separate curb and gutter. The material used to construct the joint in the curb shall be of the same kind as provided for the pavement.
 - 3. Bituminous fiber filler shall be used to construct the expansion joints in the integral curb of reinforced concrete pavements.
 - a. The thickness of the fiber filler material in the curb above the gutter shall be 1 inch.

- b. The joint material shall be precut so as to conform to the geometric shape and cross-sectional area of the curb, and shall be placed in intimate contact with the filler material in the pavement.
- I. The edges of all transverse joints in the integral curb shall be rounded with an approved finishing tool, having a radius of 1/4 inch.

3.13 CONSOLIDATING AND FINISHING

- A. The sequence of operations after the placing of concrete shall be:
 - 1. Striking off and consolidating
 - 2. Floating
 - 3. Edging
 - 4. Final finishing with burlap drag
- B. Mechanical methods shall be employed to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width will not permit the use of machine methods. Gaps less than one (1) joint opening in length may be finished by hand methods, provided they are finished in single-lane widths.
- C. Strike off, consolidate and compact the concrete to such an elevation that when all finishing operations are completed, the surface will conform to the required finished grade and cross section.
 - 1. At least 4 inches of concrete above the finished pavement grade shall be maintained ahead of the screed for its entire length.
 - 2. In consolidating the surface of the pavement, on residential street construction when a single screed finishing machine is used, it shall operate over each section of the pavement twice.
 - 3. Only sufficient mortar shall be worked to the surface to provide a dense smooth finish.
 - 4. Excessive operation of the machine over a given area will not be permitted. Segregated particles of coarse aggregate which may collect in front of the screed shall be thoroughly mixed by hand with the mass of concrete already on the subgrade.
- D. If it is not possible to use mechanical equipment on irregular areas, an approved, self-propelled vibratory screed shall be employed to strike off and properly consolidate the concrete surface to the required finish grade.
 - 1. The entire area of the pavement shall be consolidated to insure an absence of voids.
 - 2. Where it is not possible to use a vibratory screed, a hand strike board of an approved design, will be permitted.
 - a. Strike-off boards shall be moved forward with a combined longitudinal and transverse motion, with neither end raised from the side forms during the process.
 - b. A slight amount of excess concrete shall be kept in front of the front edge at all times.
 - c. When striking off and consolidating by hand, pours will be limited to single lanes or 1/4 of intersections.
- E. After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating by a mechanical method unless the pavement is permitted to be constructed in single lane widths.
- F. Where mechanical floating is an integral part of the operation of a slip-form paver, separate mechanical floating methods will not be required.
- G. Mechanical longitudinal floating will not be required for residential street construction.

- H. When mechanical equipment is not used for floating, a transverse float at least 10 feet in length shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved ahead 1/2 of its length and the operation repeated.
- I. Care shall be taken to preserve the crown and cross section of the pavement.
- J. The float finishing operation shall not proceed until the concrete has attained a consistency so that no excess concrete is carried ahead of the float but the entire surface can be floated and sealed.
- K. Immediately following the float finishes and while the concrete is still plastic, the Contractor shall test the slab surface for trueness by means of a 10 foot straightedge or acceptable float.
 - 1. The straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. This operation shall be repeated until the surface of the concrete is free from irregularities and makes contact at all points with the bottom of the straightedge. The straightedge shall then be moved forward 1/2 its length and the operations repeated.
 - 2. Depressions found in the surface shall be filled with fresh concrete and consolidated by floating with a long-handled float not less than 10 foot in length. This float may also be used to smooth sections of the surface that may have become rough or torn by dragging with the straightedge.
- L. For pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Edge settlement in excess of 3/8 inch shall be corrected before the concrete has hardened.
 - 1. When edge settlements in excess of 1/4 inch persist, paving shall be suspended and operational corrections made before the Engineer will permit the resumption of paving. If the Contractor consistently fails to construct pavement within these tolerances, the use of slip-form methods shall be discontinued and pavement placed by means of conventional forms.
 - 2. When paving is accomplished by the slip-form paving method, all mortar paste shall be wiped from the sides of the slab.
 - 3. The surface shall then be tested for smoothness with the straightedge. During this operation, the contact of the straightedge with the concrete shall be uniform over the entire length tested. At the time of testing, the surface shall be free from soft mortar or excessive water. The testing straightedge shall be used for this purpose only.
- M. Where the float finisher method is not utilized, as soon as the hand floating is completed, all laitance, surplus water, and inert material shall be worked entirely off the pavement and the surface made smooth by dragging with a rigid straightedge 10 foot in length and the surface shall be tested.
- N. As soon as all excessive moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric, not less than 5 feet nor more than 6 feet in width, over the full width of the pavement.
 - 1. The burlap or cotton drag shall be pulled by a bridge supported on a pavement forms. The fabric shall be renewed as often as necessary to obtain the required texture.
- O. Immediately after the initial finishing with burlap, the edges of the slab and all specified joints shall be finished with an edging tool to the radii indicated on the Plans. The pavement shall then be given a final finish by dragging the damp burlap or cotton fabric over that portion of the pavement disturbed by the edging operation.

3.14 SURFACE REQUIREMENTS

- A. High spots in the surface, exceeding 1/8 inch from the straightedge but not more than 1/2 inch in 10 feet shall be removed or reduced by rubbing with a carborundum brick and water until contact with coarse aggregate is made. If contact with coarse aggregate is made before reaching an acceptable tolerance, such high spots shall be removed by an approved surface-grinding machine before acceptance of the pavement.
- B. High spots in excess of 1/2 inch in 10 feet will be evaluated by the Engineer and if the Work is rejected, it shall be removed and replaced at the Contractor's expense.
- C. Contractor shall take immediate steps to eliminate the cause of the defective surface.

3.15 CURING

- A. After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound.
- B. The compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at a rate of 1 gallon per 200 sft of surface. The curing compound shall not be thinned.
- C. The equipment shall provide adequate stirring of the compound during application. The equipment for applying the compound must be on the Project and approved by the Engineer before Work is started.
- D. Hand-spray equipment will be permitted only for the application of the curing compound over the sides of the slab, and for any minor damaged areas.
- E. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of material to the affected areas.
- F. The treated surface shall be protected by the Contractor from injury for a period of at least seven (7) days. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the Work including the removal of any high spots, provided any damage to the film is immediately repaired by the application of a second coat of the compound.
- G. Immediately after the forms are removed, the entire area of the side of the slab shall be coated with the curing compound at the rate specified for the pavement surfacing.
- H. The Contractor shall provide on the Project sufficient burlap or polyethylene coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

3.16 REMOVAL OF FORMS

- A. Forms may be removed from freshly placed concrete after it has set for 12 hours, provided it can be done without damage to the pavement or curb edge. If during form removal the pavement or curb edge is being damaged, the form removal shall cease until the concrete has attained greater strength.
 - 1. The period of time for removing forms may be increased or decreased when approved by the Engineer.
- B. Immediately after removal of the forms, the ends of all joints shall be cleaned, and any visible areas of honeycomb or minor defects shall be filled with mortar, composed of 1-part Portland cement and two (2) parts fine aggregate from the same source as used in the pavement, applied with a wooden float.

1. Immediate steps shall be taken by the Contractor to correct the conditions contributing to these defects.
- C. The sides of the pavement shall be sprayed with curing compound immediately upon removal of the forms, except where honeycombed areas are to be pointed, and then immediately cured.
- D. Forms and pins shall not be placed on new pavement that is being cured with membrane.

3.17 SAWING JOINTS

- A. Contraction joints, longitudinal lane-tie joints with tie bars, and end of pour joints shall be sawed.
- B. Joints shall be sawed before any traffic is permitted on the pavement.
 1. The concrete saw will be permitted on the pavement to saw the joints, but the water supply truck will not be permitted on the pavement until the compressive strength is not less than 3,000 psi.
 2. When permitted on the pavement, the water supply truck must be kept a minimum of 50 feet behind the sawing operation.
- C. At least two (2) approved concrete saws shall be available for use at all times, and one saw shall be capable of sawing a joint groove 2-1/2 inch deep.
- D. The saw cut for transverse end-of-pour joints shall be made to receive the joint sealing material.
- E. Longitudinal lane-tie joints with the tie bars shall be sawed in accordance with the alignment and dimensions indicated on the Plans.
- F. For joints formed in one operation, the joint groove shall be sawed before any transverse cracks develop. Raveling or spalling along the joint shall be repaired as specified elsewhere in this Section.
- G. Transverse contraction joints shall be sawed in two stages:
 1. Stage 1 Sawing:
 - a. The first stage shall be a relief cut directly over the center of the load transfer assembly. The initial relief cut shall be made as soon as the saw can be placed on the freshly poured concrete, and the sawing shall continue as long as the pavement can support the saw without making or appreciably raveling of the joint.
 - b. When water is not used in the sawing operation, membrane curing compound shall be applied immediately.
 - c. When water is used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the cut and from the immediate area by flushing with a jet of water. Additional membrane curing compound shall be applied within 12 hours after the relief cut has been made.
 2. Stage 2 Sawing:
 - a. Second stage sawing of joints shall not start until the concrete has cured for a minimum of 48 hours. The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans plus any increase in width of the relief cut due to shrinkage or contraction. Groove width tolerance shall be $\pm 1/16$ inch.
 - b. Joints sawed without the use of water shall be blown clean of all foreign material by a jet of compressed air.
 - c. If water was used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the groove and the immediate area by flushing with a jet of water and then blown dry with compressed air.

- H. Transverse joint grooves shall receive a final cleaning with a jet of compressed air adequate to remove all foreign material, just prior to permanent sealing.
- I. If the specified seal is not installed within seven days of final sawing, the joint groove shall be temporarily sealed with a suitable material or device to prevent the infiltration of foreign material.
- J. Traffic shall not be permitted over the full width joint grooves prior to the installation of either the permanent seal or temporary seal.

3.18 PATCHING JOINTS

A. General:

- 1. After the joints have been sawed and cleaned, they shall be inspected for spalls and voids.
- 2. Loose, unsound or damaged concrete shall be removed to the satisfaction of the Engineer.
- 3. Spalls and voids will be classified as minor, intermediate or major spalls and shall be repaired accordingly.

B. Minor Spalls:

- 1. Spalls or voids which have increased the specified size of the joint groove beyond any of the following limits, but less than 36 square inches, shall be repaired by patching with an approved epoxy mortar before the seal is installed.
 - a. Spalls which extend more than 1/4 inch from the joint face and over 1/2 inch below the surface of the pavement.
 - b. Spalls which extend more than 1/4 inch from the joint face and 2 inches or more in length, regardless of the depth of spall below the surface of the pavement.
 - c. Void areas larger than 1/2 inch in diameter in the upper 1 inch of the joint face or larger than 1 inch in diameter regardless of location.
- 2. The spalled concrete surface shall be thoroughly cleaned by sandblasting, power-wire brushing, or hand-wire brushing. The patch area shall then be blown clean with a jet of compressed air.
- 3. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.
- 4. Concrete shall be clean and dry when the epoxy resin mortar is placed. The surface shall be made free of frost by heating with a clean source of heat, approved by the Engineer, until dry. Care shall be taken not to damage the concrete by heating.
- 5. Epoxy binder will be a mixture of two (2) parts epoxy resin to one (1) part curing agent by volume, or as approved by the Engineer.
- 6. Epoxy resin compound shall be mixed in a clean metal or polyethylene container with approved stirrer operating at 250 to 500 rpm. While the epoxy resin is being mixed, the curing agent compound shall be gradually added. The mixture shall then be stirred for a minimum of three (3) minutes until it is uniform.
- 7. After the epoxy binder is thoroughly mixed, a small portion shall be reserved for priming.
 - a. Dry MDOT 2NS sand shall be uniformly blended into the balance of the mixture to give an epoxy mortar of stiff or trowelable consistency. One part of mixed binder to about 3.5 parts of dry sand, by volume, will usually give a workable mix.
- 8. The spalled surface shall be primed with the freshly mixed epoxy binder scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the epoxy mortar must bond.
- 9. Immediately after priming, the epoxy mortar shall be placed in the spalled area and finished to the shape of the original pavement surface. If the bond coat is not tacky when the mortar

is placed, a second application shall be made. The edge of the patch shall conform with the rest of the joint groove.

10. Dry MDOT 2NS sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently so that it will not be damaged during sealing operations, the polyethylene insert shall be carefully removed.
11. Joints shall receive a final cleaning with a jet of compressed air to remove foreign material.
12. When the temperature of the air and the pavement is above 50 degrees F, the hot poured elastic type joint seal may be placed on the day following the placing of the epoxy resin mortar patch. When the temperature of the air and the concrete is below 50 degrees F, the time of curing required for the epoxy mortar shall be as determined by the Engineer.

C. Intermediate Spalls:

1. Spalls larger than 36 square inches, but not extending below the reinforcing mat, shall be repaired by sawing and chiseling out the unsound concrete and patching with Portland cement mortar.
2. A saw cut at least 1 inch deep shall be made parallel to the joint groove at the outer extremity of the spalled area. The concrete shall be chipped out to the saw cut so that a vertical face is present at the back of the repair area, and the two ends of the repair area shall be trimmed to approximately vertical faces.
3. The area to be repaired shall be sandblasted to remove all loose particles and then blown clean with a jet of compressed air to remove the sand and all other foreign materials.
4. The repair area shall be flushed with clean water and the excess water shall be blown out with compressed air.
5. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.
6. Bottom and vertical faces of the repair area shall be primed with a grout of creamy consistency made with a 1:1 mixture of Portland cement and MDOT 2NS sand with water.
7. The prime coat will be scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the Portland cement mortar must bond.
8. Cement grout shall be carefully applied to the rough surfaces of the spall area and shall be applied immediately prior to placing of fresh mortar so that the prime coat is wet when covered by mortar.
9. Portland cement patching material shall be tamped into the repair area and finished level to the pavement surface.
 - a. Portland cement mortar shall consist of 1-part Portland cement to two (2) parts MDOT 2NS sand with a water content of not more than 4 gallons per sack of cement.
 - b. A liquid air-entraining agent to maintain an air content of 8% to 11% shall be added.
 - c. Calcium chloride in an amount of one (1) percent of the cement content may be added as an accelerator, if approved by the Engineer.
10. The edge of the patch at the joint face shall conform with the rest of the joint groove.
11. White membrane curing compound shall be sprayed on the patch surface immediately after the mortar is cast and finished.
12. After 72 hours the polyethylene form shall be carefully removed and all patched joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

D. Major Spalls:

1. When a joint is damaged beneath the depth of the reinforcing mat, it shall be considered a major repair. These major repairs shall be handled on an individual basis under the direction of the Engineer.

3.19 SEALING JOINTS

- A. Transverse expansion, contraction, construction, and longitudinal bulkhead construction joints shall be filled and sealed with an approved hot-poured elastic type compound.
- B. Longitudinal lane-tie joints shall be pressure filled and sealed with either an approved hot-poured or cold-applied elastic type compound. These sealing compounds shall not be placed when the atmospheric or pavement temperatures are less than 50 degrees F or when the weather is rainy or foggy.
- C. After the shoulders are completed and the pavement has cured, the joints and pavement surfaces on each side of the joints shall be cleaned of all extraneous matter.
 1. The cleaning shall be done by sandblasting or other methods approved by the Engineer that will be equally effective in cleaning the concrete.
 2. The dust and sand present after the sandblasting or cleaning shall be removed by a jet of compressed air. Hand tools shall be used to remove stones and other foreign materials from the joint groove.
- D. Immediately after the joints are cleaned with the compressed air, and with the surface of the concrete in the joint dry, the joint shall be sealed with an approved hot-poured elastic type compound.
- E. The hot-poured compound shall be melted in an approved double boiler type kettle. Direct heating will not be permitted. Also, any sealing material heated in excess of the safe heating temperature shall not be used in the Work.
- F. During the process of pouring the joints, the Engineer may, at his discretion, require that sufficient compound be taken from the melting unit to make flow tests.
- G. Engineer may require the Contractor to modify his method of heating or of charging the heating unit with compound that will produce satisfactory results.
- H. Pouring shall be from the melting kettle equipped with an approved pressure pump hose and nozzle.
- I. When authorized by the Engineer, the sealing compound may be poured with a hand-type pouring pot for curbs and short miscellaneous joint lengths, provided a satisfactory joint is obtained.
- J. Pouring of the sealing compound shall be done so as to fill the joint to 1/4 inch below top of pavement. Any sealing compound spilled on the surface of the pavement shall be removed immediately.
- K. After the first pour has cooled to the temperature of the pavement and settled, a second pour shall be made to bring the sealing compound to 1/4 inch of the surface of the pavement.
- L. Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to resist pickup.
- M. To protect hot-poured and cold-applied sealing compound while it is curing and to prevent pickup by traffic, the sealed joint shall be covered with a strip of paper, 1-1/2 inches wide, or other approved means, immediately following application of the compound. The paper strip shall be left in place until worn off by traffic.

3.20 TRAFFIC CONTROL

- A. Provide measures necessary to protect and maintain traffic and to protect the Work in accordance with Section 01 5000, Temporary Facilities and Controls, and with the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

3.21 PROTECTION AGAINST RAIN

- A. Contractor shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened.
- B. For this Work, the Contractor shall have available on the job site at all times enough burlap or 6 mil thick polyethylene film to cover and protect one day's Work.
- C. When rain appears eminent, all operations shall stop and personnel shall begin covering.
- D. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.
- E. Curing compound shall be applied to any areas where the compound has been disturbed or washed away. Protection of the new concrete against rain shall be at the Contractor's expense.

3.22 COLD WEATHER PROTECTION

- A. Any time there is a danger of freezing temperatures, the Contractor shall have available on-site a sufficient amount of clean, dry straw or hay or polyethylene film or other approved materials to cover at least one (1) day's production. Cold weather protection shall be at the Contractor's expense. The source of the temperature shall be taken from forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau for the area the new Work is being constructed. The predicted low temperature shall be that forecast to occur during the next 24 hours.
- B. Frozen material shall not be charged into the mixer at any time.
- C. Frost or ice shall be removed from the forms and any steel used in the pavement, prior to placing concrete.
- D. Concrete shall not be placed directly upon a frozen subgrade. The subgrade shall be covered with a layer of straw or hay 12 inches in thickness to protect it against freezing. The straw or hay shall be removed from the finished subgrade immediately ahead of paving operations and piled along the line of construction for use in covering the finished pavement. Prior to the placing of concrete, the subgrade shall be cleaned of loose straw and otherwise prepared in a manner satisfactory to the Engineer. Other covering materials as approved by the Engineer may be used to prevent subgrade freezing.
- E. To accelerate hardening of the concrete when the temperature of the air in the shade and away from artificial heat is between 40 and 45 degrees F, calcium chloride shall be added to the mix at the rate approved by the Engineer. The calcium chloride shall be spread on the materials immediately before discharging into the drum of the mixer. A method approved by the Engineer, shall be used for measuring the amount of dry calcium chloride to be added to each batch of concrete. The calcium chloride shall not be placed in contact with the cement.
- F. Immediately after finishing of the concrete and as soon as hardening of the concrete will permit, the pavement shall be covered and the protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi or for a minimum period of 14 days or as approved by the Engineer.
- G. The protective covering shall be placed around and over the forms and it shall extend beyond the edge of the pavement for a distance at least equal to the depth of covering required.
- H. When removing forms, the protective covering should be removed for as short a time as possible and should be replaced promptly to prevent loss of heat.
- I. The mixing and placing of concrete shall stop in sufficient time each day to permit finishing of the concrete and the placing of the required protective covering during daylight hours.

- J. The requirements specified herein for the curing and protection of concrete in cold weather are minimum requirements, and the Contractor shall be responsible for the quality and strength of the concrete placed. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.
- K. Between October 15 and May 15, when the predicted low temperature is to be below 35 degrees F at any time within 72 hours after placing the pavement, the pavement shall be protected and such protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi, or for a minimum period of 14 days, unless otherwise authorized by the Engineer.
- L. Special Protection:
1. No pavement may be placed between October 15 and May 15, unless it is specifically provided for in the Contract Documents, or authorized by the Engineer, except that in no case shall concrete be placed when the predicted high temperature is to be below , without written permission of the Engineer. When paving is permitted during the period, the following requirements shall apply:
 - a. The temperature of the concrete at the time it is placed on the subgrade shall be not less than 50 degrees F, nor more than 85 degrees F.
 - b. In order to maintain a mix temperature between 50 and 85 degrees F the mixing water or the aggregates, or both, shall be heated as required by the Engineer. The water and the aggregates shall be heated to a temperature of not more than 150 degrees F.
 - 1) The heating of aggregates shall be done by the use of steam pipe under the aggregate piles, or by free steam discharged into the aggregate piles, or by steam pipe in the batching bins.
 - 2) The heating of the water and the aggregates shall be controlled so that there will not be any large differences in temperature from batch-to-batch.
 - c. When there is any danger of the predicted low temperature dropping below 35 degrees F all the necessary materials for covering and protecting the concrete, equipment for heating the water and aggregates, when required, and calcium chloride shall be on the Project and available for immediate use for the required method of curing and cold weather protection before any pavement is placed.
 - d. For predicted low temperatures from 35 to 25 degrees F either 1-layer of waterproof paper blankets or 12 inches of loose dry straw or hay shall be placed.
 - e. For predicted low temperatures of 25 to 20 degrees F 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay shall be placed.
 - f. For predicted low temperatures less than 20 degrees F the minimum requirement for cold weather protection will be 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay overlaid with a waterproof protective covering consisting of tarpaulins, paper blankets, polyethylene sheeting or other approved material.
 2. When temperature are such that special protection is required as specified above, all concrete placed within the proceeding 72 hours shall be similarly protected.
 3. When special protection is started, it shall be continued until design strength is reached in accordance with the above requirements unless warmer temperatures prevail for a period of at least 48 hours. Permission to eliminate special protection for such a period shall be as approved by the Engineer.
- M. Protection of the new concrete against cold weather including ordinary and special protection shall be at the Contractor's expense.

3.23 CONCRETE TEMPERATURE LIMITATIONS

- A. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F.

3.24 CURB DROP

- A. Curb drops shall be provided for existing and future sidewalk ramps, for approaches for existing driveways and at other locations as determined by the Engineer.
- B. Curb drops for sidewalks shall be in accordance with the current rules and regulations of Act 8, Michigan PA 1973, as amended. Curb drops for drive approaches shall be centered with the existing driveway at the property line.
- C. The width of the residential curb drop shall be equal to the width of the driveway determined at the property line plus four feet. Unless otherwise approved by the Engineer, the minimum width of the residential curb drop shall be 14 feet.

3.25 SHOULDERS

- A. The shoulders shall be constructed according to the lines, grades, and cross section shown on the Plans and as specified for the particular type of shoulder material required. The shoulders shall be done in such sequence with the surfacing operations that they will be completed not more than seven (7) days after the expiration of the curing period, unless otherwise directed by the Engineer.
- B. Aggregate shoulders, when called for, shall be constructed according to the requirements specified under Section 32 1123, Aggregate Base Courses.

3.26 CLEANUP

- A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality.
- B. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- C. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, and fertilized and seeded per the requirements of Section 32 9219, Seeding, sodded in accordance with Section 32 9223, Sodding, or _____

3.27 OPENING PAVEMENT

- A. Engineer reserves the right to require that curing operations be discontinued when the concrete has reached 85% of the design strength, and to require that the shoulders be completed and the slab be opened to traffic.

3.28 MONUMENT BOXES

- A. Government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes.
- B. Monument box castings shall be furnishing and installed by the Contractor.
- C. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation.
- D. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place.
- E. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition and kind of construction, unless otherwise provided.

3.29 TESTING

- A. During the course of the Work, the Engineer may require the taking of standard test cores and cylinders, by a testing laboratory acceptable to the Owner and approved by the Engineer.
- B. The making of cylinders, the drilling of cores and testing shall be at the expense of the Owner.
- C. For each lane of Work:
1. A minimum of one (1) cylinder for testing compressive strength shall be made for each 500 feet, or fraction thereof, or as determined by the Engineer.
 2. A minimum of two (2) cores for testing compressive strength and for checking thickness shall be drilled each 500 feet, or fraction thereof.
- D. Slump tests for consistency of Portland cement concrete shall be made in accordance with ASTM C143/C143M and ASTM C172/C172M.
- E. In the event the test results on a core indicates a deficiency in either thickness or compressive strength or in the event the test results on a cylinder indicates a deficiency in compressive strength, the following adjustments in the unit price for concrete shall be made based on the average of three (3) cores:
1. Thickness

Under Required Thickness	Percent of Reduction in Unit Price
0 to 1/4 inch	None
by more than 1/4 but not exceeding 1/2 inch	20
by more than 1/2 but not exceeding 1 inch	50
by more than 1 inch	Remove & Replace

2. Compressive Strength

Under Required Compressive Strength	Percent of Reduction in Unit Price
0 to 150 psi	None
by more than 150 but not exceeding 300 psi	20
by more than 300 but not exceeding 500 psi	50
by more than 500 psi	Remove & Replace

3. Reduction in the unit price are additive, that is if an area is deficient by 3/8 inch and is under strength by 200 psi, the total reduction is 20% plus 20% or a reduction of 40%.
4. The area of a deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it, when possible.
5. The extra core drilling and testing shall be at the Contractor's expense.

END OF SECTION 32 13 13

SECTION 32 13 15 SIDEWALKS AND DRIVEWAYS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes sidewalks, sidewalk ramps, driveways, and drive approaches complete with concrete materials, concrete curing compounds, joint materials, field quality control and appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 31 11 00 - Clearing and Grubbing
- D. Section 31 23 13 - Subgrade Preparation
- E. Section 32 92 19 - Seeding
- F. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
 - 2. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 - 3. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
 - 4. ASTM C150/C150M: Standard Specification for Portland Cement
 - 5. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 6. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
 - 7. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
 - 8. AASHTO T 26: Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
 - 9. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition.

1.04 SUBMITTALS

- A. Written permission for the use of all local disposal sites shall be obtained and copies shall be furnished to the Engineer.
- B. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the ASTM Standards referred to in the Specification.

1.05 TEST REPORTS

- A. Engineer shall be provided with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive

strength and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Part 3 of this Section.

1.07 PROTECTION

- A. Comply with the requirements for protecting new Work against damage from rain, as specified under Part 3 of this Section.
- B. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 CONCRETE

- A. Concrete shall conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.
- B. Ready-mixed concrete in accordance with ASTM C94/C94M, Alternate 2 shall be used unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by the Engineer.
- C. Contractor shall provide documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3,500 psi when tested under field conditions.
- D. Mixes shall contain a minimum of 25% Type F Fly Ash.
 - 1. Water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans, may be used when approved by the Engineer.
 - a. The fly ash quantity may not exceed 40%;
 - b. GGBFS quantity shall be not less than 25% nor more than 40%;
 - c. Maximum total replacement of cement shall not exceed 40%;
 - d. GGBFS and Fly Ash must replace cement on a pound for pound basis.
- E. Cement shall be air-entraining Portland cement ASTM C150/C150M, Type 1A. If high-early strength concrete is desired, Type IIIA is required.
- F. High-early concrete can be obtained for small areas by the addition of one sack of cement, Type 1A, per cubic yard of concrete (94 lbs/cyd).
- G. The air content of the concrete shall be 6.5%± 1.5% by volume.

2.02 WATER

- A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
- B. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without test.
- C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T 26, and as specified in MDOT, Section 911.

2.03 CONCRETE CURING COMPOUNDS

- A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 911.

2.04 PREMOLDED JOINT FILLER

- A. Fiber joint filler for expansion joints shall conform to ASTM D1751. Filler shall be of the thickness, as specified herein, or on the Plans, or as approved by the Engineer.

2.05 STEEL HOOK BOLTS

- A. Hook bolts shall conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts shall be 5/8 inch (16 mm) diameter.

2.06 JOINT SEALANT

- A. Hot-poured type joint sealant shall conform to ASTM D6690, Type II, and as specified in MDOT Section 914.04.

PART 3 EXECUTION**3.01 VERIFICATION OF EXCAVATION AND FORMING**

- A. Prior to the installation of any concrete, examine the excavation and forms for the proper grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.
- B. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING IMPROVEMENTS

- A. Investigate and verify location of existing improvements to which the new Work is to be connected.
- B. Adjustments in line and grade to align the new Work with the existing improvements must be approved by the Engineer, prior to any change.

3.03 FORMING

- A. The forms shall be of wood or metal, straight and free from warp, clean, and of sufficient strength to resist springing during the process of depositing concrete against them.
- B. The forms shall be the full depth of the concrete.

3.04 SIDEWALKS, SIDEWALK RAMPS, DRIVEWAYS, AND DRIVEWAY APPROACHES

- A. Unless otherwise noted in the Contract Documents, all sidewalks and sidewalk ramps shall be 4 inches thick except at driveways, where the thickness of the sidewalks shall be 6 inches.
- B. Sidewalks shall be 5 feet wide unless otherwise noted on Plans, and shall slope 1/4 inch/ft towards the surface drainage side which in general will be towards the center of the road. Normally sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1 foot from the property line.
- C. Driveways and approaches shall be 6 inches thick. The width of driveways and driveway approaches shall be as specified on the Plans or as determined by the Engineer.

3.05 REMOVE CURB FOR CURB DROP

- A. Construction of sidewalk ramps within street intersections where curbed pavement exists shall conform to the current rules and regulations of Act 8, Michigan PA 1973.
- B. Where there is no proper curb drop for the sidewalk ramp or driveway approach, the Contractor shall saw cut, to full depth of pavement, and remove a minimum of an 18 inch wide curb and gutter section. When mountable curbs are present, the Contractor shall remove a 24 inch wide curb and gutter section for the construction of sidewalk ramp, as specified above.
- C. The length of curb and gutter removal shall be determined by the Engineer in the field but shall be at least as wide as the proposed sidewalk ramp plus 1 foot on each side.

- D. The removed curb and gutter section shall be replaced with material, equal to what was removed and the joint sealed with hot poured rubber asphalt.
- E. Contractor shall install 5/8 inch diameter self-tapping hook bolts, in the existing concrete pavement as indicated on the Plans prior to placing concrete for the removed curb and gutter section.
- F. Curbs may be cut or ground down with an approved concrete grinder when the final results will leave the cut or ground down curb in a smooth, clean condition acceptable to the Engineer. Any curbs that are cut or ground down that are not acceptable to the Engineer, shall be removed and replaced as specified above at no additional cost.

3.06 PLACEMENT OF FORMS

- A. Wood forms, straight and free from warp, of nominal depth may be used for sidewalk sections less than 25 feet in length.
- B. Forms shall be staked to line and grade in a manner that will prevent deflection and settlement.
- C. When unit slab areas are to be poured, slab division forms shall be so placed that the slab division joints will be straight and continuous.
- D. Forms shall be set for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. The grade shall be uniform, except as may be necessary to eliminate short grade changes.
- E. Forms shall be oiled before placing concrete. Forms shall remain in place at least 12 hours after the concrete is placed. There shall be sufficient forms placed ahead of the pouring operations to maintain uninterrupted placement of concrete.
- F. The use of slip form pavers can be allowed when approved by the Engineer in lieu of the construction system described above.

3.07 JOINTS

- A. Transverse and longitudinal expansion and plane-of-weakness joints shall be constructed at the locations specified herein, as indicated on the Plans, or as approved by the Engineer.
- B. The transverse expansion joints shall be placed for the full width and depth of the new Work. The transverse expansion joints placed against any existing pavement shall be a minimum of 6 inches deep but no less than the thickness of the concrete being placed.
- C. Longitudinal expansion joints shall conform to the same requirements as transverse expansion joints.
- D. Joints shall be constructed true to line with their faces perpendicular to the surface of the sidewalk. The top shall be slightly below the finished surface of the sidewalk. Transverse joints shall be constructed at right angles to the centerline of the sidewalk and longitudinal joints shall be constructed parallel to the centerline or as determined by the Engineer.
- E. Unless otherwise specified on the Plans or unless otherwise determined by the Engineer, when the sidewalk is constructed in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with like joints in the adjacent slab. Also, in the case of widening existing sidewalks, transverse joints shall be placed in line with like joint in the existing sidewalk.
- F. Transverse expansion joints, 1/2 inch thick, shall be placed through the sidewalk at uniform intervals of not more than 50 feet and elsewhere as shown on the Plans, or as determined by the Engineer.
- G. Expansion joints, 1/2 inch thick, shall also be placed between the sidewalk and back of abutting parallel curbs, buildings or other rigid structures; concrete driveways and driveway approaches. The expansion joint between sidewalks and buildings shall be placed 1 foot from the property line and parallel to it.

- H. Expansion joints, 1 inch thick, shall be placed between sidewalk ramps or driveway approaches and the back of curbs.
- I. Plane-of-weakness joints shall be formed every 5 feet and shall be produced by use of slab divisions forms extending to the full depth of the concrete or by cutting joints in the concrete, after floating, to a depth equal to 1/4 the thickness of the sidewalk. The cut joints shall not be less than 1/8 inch nor more than 1/4 inch in width and shall be finished smooth and shall be at right angles to the centerline of the sidewalk.

3.08 PLACING AND FINISHING CONCRETE

- A. Concrete shall be placed on a prepared unfrozen, smooth, leveled, rolled and properly compacted base as indicated on the Plans. The surface of the subbase shall be moist with no visible water present prior to placement of the concrete.
- B. The concrete shall be deposited, in a single layer, to the depth specified in the Plans or in the Proposal. The concrete shall be thoroughly spaded or vibrated and compacted to fill in all the voids along the forms and joints. The concrete shall be struck off with a strike board until all voids are removed and the surface has the required grade and cross section as indicated on the Plans.
- C. The surface of the concrete shall be floated just enough to produce a smooth surface free from irregularities. All edges and joints shall be rounded with an edger having a 1/4 inch radius. The surface of sidewalks, driveways and approaches shall be broomed to slightly roughen the surface.
- D. The surface of sidewalk ramps shall be textured with a coarse broom transversely to the ramp slope. The texture on sidewalk ramps shall be coarser than the remainder of the sidewalk.

3.09 CURING

- A. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the concrete (and sides if slip-forming is used) shall be completely coated and sealed with a uniform layer of white membrane curing compound. The curing compound shall not be thinned. The curing compound shall be applied at the rate of 1 gallon per 200 sft of surface.

3.10 BARRICADES

- A. Suitable barricades and lights shall be placed around all newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter section in order to protect the new Work from damage from pedestrians, vehicles and others until the concrete has hardened.
- B. Barricades shall be left in place for a minimum of two (2) days, except for driveway approaches and curb and gutter section. Barricades shall remain in place for a minimum of three (3) days.
- C. Any concrete that suffers surface or structural damage shall be removed and replaced by the Contractor at Contractor's expense.

3.11 PROTECTION

- A. Contractor shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened. For this Work the Contractor shall have available on the job site at all times enough burlap or 6 mil polyethylene film to cover and protect one (1) day's work.
 - 1. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.
 - 2. Curing compound shall be applied to any areas where the compound has been disturbed or washed away.

- B. If concrete is placed between October 15 and May 15, the Contractor shall have available on the site sufficient amount of clean, dry straw or hay to cover one day's production.
 - 1. If the temperature reaches 40 degrees F and is falling, the hay or straw shall be placed 12 inches thick, immediately after the curing compound is applied.
 - 2. If the temperature is 30 degrees F and falling the curing shall be by 6 mil polyurethane film placed on the concrete as soon as the surface moisture has disappeared, and then covered with 12 inches of straw or hay.
 - 3. Also, whenever the temperature in the shade falls below 50 degrees F, the water, sand and coarse aggregate shall be heated in that order sufficiently to maintain a uniform temperature of the concrete at between 70 to 80 degrees F.
- C. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F.

3.12 CLEANUP

- A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- B. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 92 19

3.13 TESTING

- A. Engineer may require that a minimum of two cores be drilled from the sidewalk for each 500 linear foot (or fraction thereof) section placed. At least one (1) core out of two (2) required will be taken from the sidewalk at the driveway.
- B. One (1) core may be required for every 20 driveway approaches or sidewalk ramps installed.
- C. The cores shall be checked for depth and compressive strength.
 - 1. The core drilling and tests shall be done by a testing laboratory designated by the Owner and at the expense of the Owner.
 - 2. The testing laboratory shall furnish the Engineer with two (2) certified copies of the test results.
- D. In the event the test results on a core indicates a deficiency in either thickness or compressive strength the following adjustments in the unit price for concrete shall be made:
 - 1. Thickness

Under Required Thickness	Percent of Reduction in Unit Price
0 to 1/4 inch	None
more than 1/4 but not exceeding 1/2 inch	20
more than 1/2 but not exceeding 1 inch	50
more than 1 inch	Remove & Replace

- 2. Compressive Strength

Under Required Compressive Strength	Percent of Reduction in Unit Price
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0 to 150 psi	None
more than 150 but not exceeding 300 psi	20
more than 300 but not exceeding 500 psi	50
more than 500 psi	Remove & Replace

- E. The area of the deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it when possible.
1. The extra core drilling and testing shall be at the expense of the Contractor.
 2. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch and under strength by 200 psi, the total reduction is 20% plus 20% or 40% reduction.

END OF SECTION 32 13 15

SECTION 32 17 23 PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes pavement markings complete with materials, layout of markings and preparation of pavement surfaces.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM D4505: Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life
 - 2. ASTM D4592: Standard Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life
 - 3. AASHTO M 247: Standard Specification for Glass Beads Used in Pavement Markings
 - 4. AASHTO M 249: Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form)
 - 5. AASHTO MP 24: Standard Specification for Waterborne White and Yellow Traffic Paints
 - 6. FS TT-P-1952: Paint, Traffic And Airfield Marking, Waterborne
 - 7. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. Where applicable pavement markings shall conform to the current requirements of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD) issued under provisions of the Michigan Vehicle Code, Act 300, PA 1949, as amended.

1.05 SUBMITTAL OF MANUFACTURER'S LITERATURE

- A. Submit manufacturer's literature of all paints to be used in the Work. Manufacturer's literature shall show paint: type, texture, color, temperature limitations, recommended use, spreading rate, drying time, and cleanup.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to the Project site in original, unopened waterproof containers. Packaging containers shall bear manufacturing labels intact and legible.
- B. The label shall contain the following information: name and address of manufacturer, shipping point, trade mark or trade name, kind of paint, formula, amount in U.S. gallons, date of manufacture and lot number, type of paint and AASHTO Specification Number.
- C. Store all materials in waterproof containers, under protective covering, off the ground and away from extreme heat or cold until ready for use.
- D. Handling of materials shall be in accordance with the manufacturer's recommendations.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Contractor shall comply with the appropriate environmental limitations (air temperature, pavement temperature, and relative humidity) as outlined in MDOT Section 811.03.D.

PART 2 PRODUCTS**2.01 REGULAR DRY TRAFFIC MARKING PAINT**

- A. Regular drying pavement marking paint in white and yellow colors shall comply with MDOT Section 920.
 - 1. Regular Dry traffic paint shall be selected from MDOT's Qualified Products List.

2.02 WATERBORNE PAVEMENT MARKING PAINT

- A. Waterborne pavement marking material in white and yellow colors shall comply with FS TT-P-1952 (Type I, II, or III), AASHTO MP 24 and MDOT Section 920.
 - 1. Waterborne pavement marking paint shall be selected from MDOT's Qualified Products List.

2.03 THERMOPLASTIC PAVEMENT MARKINGS

- A. Hot applied thermoplastic pavement markings in white and yellow colors shall conform to AASHTO M 249, white and yellow thermoplastic striping materials (solid form), and MDOT Section 920.
 - 1. Hot applied thermoplastic paving marking and shall be selected from MDOT's Qualified Products List.

2.04 COLD PLASTIC PAVEMENT MARKINGS

- A. Preformed cold plastic pavement markings in white and yellow colors shall comply with ASTM D4505 and conform to MDOT Section 920.
 - 1. Cold applied plastic pavement markings and shall be selected from MDOT's Qualified Products List.

2.05 POLYUREA PAVEMENT MARKINGS

- A. Two-component, polyurea pavement marking material in white and yellow colors shall conform to MDOT Section 920.
 - 1. Polyurea pavement marking material shall be selected from MDOT's Qualified Products List.

2.06 TEMPORARY PAVEMENT MARKING TAPE

- A. Temporary Pavement Markings shall comply with ASTM D4592, Type R and Type NR and shall conform to MDOT Section 922.06.A.
 - 1. Temporary Pavement Markings shall be selected from MDOT's Qualified Products List.

2.07 GLASS BEADS

- A. Glass beads for reflectorizing white and yellow paint markings of pavement by the drop-in method on fresh paint stripes shall comply with AASHTO M 247 and conform to MDOT Section 920.02.
 - 1. Glass beads for use in pavement markings for the type of paint specified shall be selected from MDOT's Qualified Products List.

PART 3 EXECUTION

3.01 VERIFICATION OF EXISTING CONDITIONS

- A. Prior to the placing of any pavement markings, examine the limits of the new Work and ascertain that the existing surfaces are adequate to receive the material to be installed.

3.02 PREPARATION OF SURFACE

- A. Surfaces to be painted must be thoroughly dry and free from dirt, loose paint, oil, grease, wax and other contaminants.
- B. Costs incurred for removing and disposing of unsuitable materials in preparation of the surfaces to receive the new Work, shall be incidental to the price paid for the pavement markings.

3.03 PERFORMANCE - GENERAL

- A. Pavement marking operation shall be limited to the type of Work and the limits as specified on the Plans. If additional area is required by Contractor for storage of equipment or supplies, Contractor shall furnish Engineer with written permission obtained from the property owner of the storage area, permitting the storage.
- B. Unless otherwise specified on the Plans or approved by Engineer, Contractor shall conduct his operations and use of his equipment in such a manner that traffic will be maintained throughout the Project.
- C. For Work within public rights-of-way and other areas as determined by Engineer, the provisions for maintaining traffic shall be as specified in the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). Costs incurred in maintaining traffic shall be at Contractor's expense.
- D. Contractor's equipment shall have sufficient paint capacity to enable sustained pavement marking operations and shall be equipped so as to assure uniform application of the paint and thermoplastic pavement markings.
 - 1. Equipment shall have mechanical bead dispensers or pressurized bead dispensers. In general, the equipment shall be that necessary to accomplish the marking operations in a safe, efficient, and workmanlike manner.
 - 2. For parking lots and other small areas, approved portable equipment and use of hand methods will be allowed.
- E. The color of the paint, and the width or type of markings shall be as specified on the Plans or as directed by Engineer.
- F. Markings shall be applied so that they adhere adequately to the surface.
- G. Markings shall be applied in accordance with the applicable requirements of MDOT Section 811 for permanent pavement markings or MDOT Section 812.03 for temporary pavement markings.
 - 1. Unless otherwise specified, removal of temporary pavement markings shall be incidental to the Project.

3.04 LAYOUT FOR MARKINGS

- A. Layout work necessary for the location and placing of markings, as specified on the Plans or as determined by Engineer, shall be the responsibility of Contractor and shall be at his expense.

3.05 APPLICATION OF WATERBORNE MARKINGS

- A. Waterborne paint shall be applied when the air temperature is 50 degrees F or higher and the pavement is dry.
- B. Contractor shall be responsible for making the decision to apply waterborne paint on any specific day when there is a high probability of rain in the forecast.

1. If applied lines are washed away because of rain, Contractor shall be responsible for re-applying the lines at no additional expense to Owner.
- C. Waterborne pavement marking materials may be placed immediately on new bituminous pavement.
 1. Waterborne pavement marking material shall not be placed before May 1, or after October 1.
- D. Waterborne paint shall be applied with an application thickness of 15-mil and 8-mil dry thickness. Glass beads shall be added at the rate of 32 lbs per mile per 4 inch line, during the application process.

3.06 APPLICATION OF PRE-FORMED HOT-APPLIED THERMOPLASTIC MARKINGS

- A. Since subsurface moisture can be present in amounts sufficient to affect proper bonding of the hot-applied thermoplastic material, Contractor shall be responsible for insuring that the pavement is free of excess moisture that may effect proper bonding prior to beginning work.
- B. Testing for moisture shall be documented and provided to Engineer.
- C. Minimum ambient air temperature shall be 48 degrees F and rising at the start of marking operations. If work is started and the air temperature falls below 45 degrees F, and continual cooling is indicated, all work shall be stopped. The minimum pavement temperature is 50 degrees F.
- D. Thermoplastic material shall be heated and applied within the temperature range recommended by the manufacturer.
 1. Thermoplastic material shall not be placed before May 14, or after October 1.

3.07 APPLICATION OF POLYUREA PAVEMENT MARKINGS

- A. Polyurea pavement markings shall not be applied over existing non-polyurea pavement markings.
- B. Existing non-polyurea pavement marking shall be completely removed before applying polyurea pavement markings.
- C. Remove curing compounds from concrete pavement.
- D. Apply at 15 to 25-mil thickness. Pavement shall be clean and dry. Pavement temperature shall be 40 degrees F higher unless otherwise approved by Engineer.

3.08 TOLERANCES

- A. New markings and/or retraced markings shall be placed, with reasonable tolerance, in their proper locations.
- B. Incorrect or misplaced markings shall be obliterated and remarked in accordance with Engineer's instructions.
- C. Costs incurred to obliterate and remark incorrect or misplaced markings will be at Contractor's expense.

3.09 PROTECTION OF MARKINGS

- A. Protection of the wet paint and thermoplastic pavement markings shall be the responsibility of Contractor, and all costs incurred to provide the protection will be at his expense.

3.10 WEATHER AND TIME LIMITATIONS

- A. Markings shall not be placed when rain is threatening or when the surface to be painted is wet.
- B. Pavement marking shall be performed during the period May 1 to November 1, unless otherwise approved in writing by Engineer.

- C. No markings shall be applied when the air temperature is less than 50 degrees F, as determined by Engineer.

END OF SECTION 32 17 23

SECTION 32 31 00 FENCES AND GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes the types of fencing work indicated on the Plans complete with layout of the Work, excavation and backfill, concrete foundation, fence framing and fabric, pickets and privacy slats, gates and hardware, and hardware adjustment and lubrication.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 89 00 - Site Construction Performance Requirements

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standards:
 - 1. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM A116: Standard Specification for Metallic-Coated, Steel-Woven Wire Fence Fabric
 - 3. ASTM A121: Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
 - 4. ASTM A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 5. ASTM A153/A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 6. ASTM A392: Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
 - 7. ASTM A491: Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
 - 8. ASTM A499: Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
 - 9. ASTM A641/A641M: Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 10. ASTM A780/A780M: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 11. ASTM A817: Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
 - 12. ASTM A853: Standard Specification for Steel Wire, Carbon, For General Use
 - 13. ASTM C1107/C1107M: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - 14. ASTM F537: Standard Specification for Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials
 - 15. ASTM F567: Standard Practice for Installation of Chain-Link Fence
 - 16. ASTM F668: Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain Link Fence Fabric
 - 17. ASTM F900: Standard Specification for Industrial and Commercial Swing Gates

18. ASTM F934: Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
19. ASTM F1043: Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
20. ASTM F1083: Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
21. ASTM F1184: Standard Specification for Industrial and Commercial Horizontal Slide Gates
22. ASTM F1910: Standard Specification for Long Barbed Tape Obstacles
23. AWWA M4: Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products
24. AWWA U1: Use Category System: User Specification for Treated Wood
25. CLFMI-PM 2445: Chain Link Fence Manufacturers Institute, Product Manual (latest edition)
26. FS - Federal Specifications
27. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
28. NOMMA: National Ornamental & Miscellaneous Metals Association
29. PS 20: American Softwood Lumber Standard
30. SSPC-PA 1: Paint Application Specification No. 1: Shop, Field, And Maintenance Painting of Steel
31. U.S. Code Title 42, Section 300i-1: Tampering with Public Water Systems

1.04 SUBMITTALS

A. General:

1. Submit manufacturer's literature showing standard details of fence and gate materials.
2. Submit Shop Drawings showing details of fence and gate fabrication and installation. Include plans, elevations, sections, details, and attachments to other work.

B. Product Test Reports:

1. Chain Link Fence: Framework strength according to ASTM F1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
2. Ornamental Fence: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard only if requested.

1.05 QUALITY ASSURANCE

- ##### A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.06 WARRANTY

A. General Warranty:

1. The Special Warranty specified in this Article shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under the Contract Documents. The obligations of the Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special Warranty.

B. Special Warranty:

1. Provide manufacturer's written warranty, running to the benefit of the Owner, agreeing to correct, or at option of the Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of five (5) years after the date of Substantial Completion.
 - a. Installer agrees to repair or replace components of fences and gates that fail in materials or workmanship within specified warranty period.
 - b. Failures include, but are not limited to, the following:
 - 1) Failure to comply with performance requirements.
 - 2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 PRODUCTS

2.01 GENERAL

- A. Framing members for fence and gate framing shall be fabricated of the types and sizes of steel framing indicated on the Plans and as specified in this Section. As a minimum, framing members shall conform to the requirements in Part 2 of this Section.
- B. Framing members, posts, rails, and accessories shall be PVC coated when the fence fabric is PVC coated.
- C. Tubular sections shall be hot-dipped galvanized steel tubular materials conforming to ASTM A53/A53M or weight and coating. Steel tubular framing may be welded or seamless steel pipe reasonably straight and free from injurious defect. Burrs at ends of pipe shall be removed. The average weight of the finished steel pipe shall not be less than 95% of the weight specified, which shall include the weight of galvanizing.
- D. Structural and roll-formed steel shapes conforming to ASTM A499, hot-dipped galvanized in accordance with ASTM A123/A123M. Framing members of structural and roll-formed shapes shall be fabricated of new rail steel billets, of the weights specified and galvanized. The weight of the zinc coating of actual surface shall average not less than 2.0 oz per sft and no individual specimen shall show less than 1.8 oz per sft. All weight specified for structural and roll-formed shapes shall include the zinc coating, except that any weight of zinc galvanizing over 4.0 oz. per sft of surface shall be deducted from the weight.

2.02 POSTS AND RAILS

- A. Posts shall be round pipe or square rolled formed sections conforming to the dimensions and weights specified herein.
- B. Round posts shall be hot dipped galvanized with a minimum average zinc coating of 1.8 oz per sft meeting ASTM F1083 for standard weight (Schedule 40) galvanized pipe.
- C. Rolled form sections shall be produced from steel having minimum yield strength of 45,000 PSI and meet the strength and protective coating requirements of ASTM F1043.
- D. Intermediate Posts
 1. Intermediate posts shall be round or square conforming to the following weights and dimensions (O.D.):
 - a. For fabric 6.0 feet or less: 1.9 inch diameter round weighing 2.72 lbs per ft
 - b. For fabric 7 - 10 feet: 2.375 inch diameter round, weighing 3.65 lbs per ft; or 2 inch square weighing 2.60 lbs per ft.
 - c. For fabric over 10 feet: 2.875 inch diameter round weighing 5.79 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.
- E. Terminal Posts, Angle Posts, Pull Posts and Brace Posts

1. Round or square conforming to the following weights and dimensions (O.D.):
 - a. For fabric 6.0 feet or less: 2.375 inch diameter round, weighing 3.65 lbs per ft; or 2 inch square weighing 2.60 lbs per ft.
 - b. For fabric 7 - 10 feet: 2.875 inch diameter round weighing 5.79 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.
 - c. For fabric over : 2.375 inch diameter round weighing 8.65 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.

F. Gate Posts

1. Gate posts shall be round or square conforming to the weights and dimensions (O.D.) in Table A.

G. Top Rail, Bottom Rail, and Middle Rail

1. Round pipe: 1.66 inch diameter weighing 2.27 lbs per ft.
2. Top rail lengths shall be not less than 18 feet and fitted with couplings or swedged for connecting the lengths into a continuous run. Couplings shall be not less than 6 inches, with 0.07 inch minimum wall thickness and shall allow for expansion and contraction of the rail.

2.03 BRACING TRUSS

- A. Diagonal truss: 3/8 inch nominal diameter rod with adjustable take-up.

2.04 ACCESSORIES

- A. Post tops, extension arms, stretcher bars, rail ends and appurtenances shall be malleable iron or heavy pressed steel and galvanized in accordance with ASTM A153/A153M.
- B. Post tops on fences with a top rail shall be provided with a hole suitable for passing the top rail through the post top and shall fit over the outside of the post with a weathertight closure.
- C. Extension arms for supporting barbed wire shall be a single or "V" type as shown on the Plans, and extend from the top of the post at an angle of approximately 45 degrees. Arms shall be integral with post tops. Extension arms shall carry three (3) barbed wires equally spaced with the topmost wire approximately 12 inches above the fence fabric.
- D. Stretcher bars shall be one piece lengths equal to the full height of the fence fabric. Bands shall be approximately 1 inch wide with beveled edges to secure stretcher bars to end, corner, pull and gate posts.

2.05 WOVEN WIRE FABRIC

- A. Woven wire fabric shall be fabricated in accordance with the best commercial practices. The overall width of the fabric shall be not less than 46-1/2 inches. Fabric stays shall be uniformly spaced on 6-1/4 inch centers maximum.
- B. Galvanized steel woven wire fabric shall conform to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Grade 60, Class I, Zinc Coating.
- C. Aluminum-coated steel woven wire fencing shall conform to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Class I, Aluminum Coating.

2.06 CHAIN LINK FABRIC

- A. Fabric shall be zinc (galvanized) coated, vinyl coated or aluminum coated. Zinc coated fabric shall be galvanized after weaving.
- B. Unless otherwise indicated on the Plans or directed by the Engineer, chain link fabric regardless of type, shall be 11 gauge, zinc coated steel. Mesh shall be two 2 inch. Fabric 72 inches in height and over shall have both selvages knuckled. Fabric less than 72 inches in height shall have the top selvaige knuckled.

- C. Zinc-Coated Steel Chain-Link Fence Fabric shall conform to ASTM A392, Class 2 Coating.
- D. Aluminum-Coated Steel Chain-Link Fence Fabric shall conform to ASTM A491, and ASTM A817.
- E. Vinyl-Coated Steel (Extruded Vinyl over Galvanized Steel Wire) Chain-Link Fence Fabric shall conform to ASTM F668, Class 2a.
- F. Fused Vinyl-Coated Steel (Thermally Fused Vinyl Coating over Galvanized Steel Wire) Chain-Link Fence Fabric shall conform to ASTM F668, Class 2b.

2.07 OUTRIGGERS AND BARBED WIRE

- A. Chain link fence posts shall extend on the gate at SCS-2 and SCS-3 locations if existing gate is removed, so that three (3) strands of barbed wire can be installed as previously provided on existing gate.
- B. Chain link fence barbed wire shall conform to ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, or equivalent.
- C. Barbed wire shall be fabricated of 2-strand, 12-1/2 gage zinc-coated steel wire (Type Z, Class 3) with 4-point, 14-gage round barbs spaced on 5 inch centers conforming to Design Number 12-4-5-14R of ASTM A121. Wire shall be galvanized after fabrication.

2.08 TENSION WIRE

- A. Tension wire shall be No. 7 gage ASTM A824 with a Type I aluminum coating, a Type II, Class 2 zinc coating, or shall be hot dipped with a Type II, Class 1 galvanized coating followed by a thermally fused vinyl coating. Tension wire shall have a minimum breaking strength of 1950 pound-force.

2.09 FABRIC FASTENERS

- A. Fasteners for securing fabric to framing members shall be No. 12 gage minimum, galvanized, aluminum coated or vinyl coated as compatible with fabric.
- B. Hog rings shall be 11-gage minimum galvanized, aluminum or vinyl coated as compatible with fabric.
- C. Coatings for fasteners shall conform to the requirements of ASTM A641/A641M, Class III.

2.10 WOOD POSTS

- A. Wood posts will only be acceptable when woven wire fencing is specified on the plans or in the Proposal. Wood posts shall be Cedar, Red Oak, White Oak, Beech, Hard Maple, White Ash, Yellow Birch, Norway Pine, Northern White Pine or other species acceptable to the Engineer.
- B. Posts shall have been cut from timber seasoned by stacking in a manner acceptable by the Engineer. Timber as a minimum shall be equal to No. 3 Grade Southern Pine.

2.11 WOOD FRAMING, PICKETS, AND GATES

- A. Framing pickets and gates used in woven wire fencing shall conform to the requirements of PS 20 or the specific application as described in ASTM F537. Wood bracing shall be either Cedar Oak or other approved wood poles not less than 4-1/2 inches in diameter.

2.12 WOOD PRESERVATIVES

- A. The applicable requirements of AWPA U1, Section 6, Commodity Specification A, Use Category 4B shall apply for all preservative pressure treated wood fencing materials.
- B. Brush coated treatment of wood fencing materials shall conform to the applicable portions of AWPA M4.

- C. Oil-born treatment of wood fencing materials is not acceptable.

2.13 METAL FASTENERS FOR WOVEN WIRE FENCING

- A. All metal fasteners used in the construction and installation of woven wire fencing shall be corrosive-resistant type conforming to ASTM F537 unless otherwise indicated on the Plans. Staples shall be No. 9 gage steel wire, 1-1/2 inches minimum for softwood and 1 inch minimum for hardwood.

2.14 PRIVACY SLATS

- A. Privacy slats where shown shall be of type and sizes indicated on the Plans.
- B. Wood for privacy slats shall be graded and finished as recommended by the California Redwood Association for landscaping wood.

2.15 GATES

- A. Frames for gates shall be fabricated of Zinc-coated steel frames in accordance with ASTM F1043. Welded joints shall be coated in accordance with Practice ASTM A780/A780M, employing zinc rich primer. Gates shall be provided with intermediate braces and truss rods of sufficient strength to form a rigid frame without twist or sag. Members shall not sag in excess of the lesser of 1% of the gate leaf width or 2 inches.
- B. Gate frame members shall be in accordance with Table B, minimum.
- C. Fabric used for gates shall be the same as that used for fencing unless otherwise indicated on the Plans. Install fabric with stretcher bars at vertical edges, and tie wires at top and bottom edges.
- D. Install stretcher bars to gate frame at not more than 15 inch centers. Attach hardware with approved fasteners that will provide security against removal or breakage.
- E. Hinges shall be non-lift-off type, offset to permit 180-degree gate opening. Hinges shall be structurally capable of supporting the gate leaf and allow the gate to open and close without binding. The hinges shall be so designed to permit the gate to swing a full 180 degrees.
- F. Latch shall be forked or plunger bar type with integral padlock eye and shall be operable from either side of gate.
- G. Keeper, where required, shall automatically engage the gate leaf and hold it in the open position until manually released. Keepers shall be provided on each gate leaf over 5 feet.
- H. Double gates shall be provided with mushroom type or flat plate gate stops and anchors. Stops shall be designed to engage the center drop rod or plunger bar of both leaves.
- I. Sliding gates shall comply with ASTM F1184. Slide gates shall be horizontal slide gates supported only from above or cantilever slide gates spanning an opening without a top or bottom support as indicated on the plans. Cantilever slide gates shall be supplied with zinc coated steel frames using external or internal rollers per ASTM F1184.

2.16 CONCRETE

- A. Concrete shall conform to MDOT Section 1004; use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

PART 3 EXECUTION

3.01 FINAL GRADING

- A. Verify that final grading in the area to receive fencing has been completed. Grades shall be without irregularities that would interfere with the fence installation. Report all discrepancies in final grades that would interfere with the new Work to the Engineer. Do not commence Work until all unsatisfactory conditions have been corrected.

3.02 MEASUREMENT AND LAYOUT

- A. Measure and layout the complete fence line as indicated on the Plans. All measurements for installation of fence work shall be measured parallel to the surface of the ground.
- B. Do all locating and marking of fencing post positions. Locate line posts at equal spacings, center to center, as indicated on the Plans and specified in this Section. Locate and mark corner post positions at changes in fencing runs exceeding 30 degrees.

3.03 INSTALLATION - GENERAL

- A. Installation of fencing and gates shall meet the requirements of ASTM F567 and CLFMI CLF 2445. All work shall be installed in accordance with the best trade practices, to the best workmanship and in a manner acceptable to the Engineer. The finished fence shall be plumb, taut, true to line and ground contour and rigidly secured in position.

3.04 INSTALLATION OF WOVEN WIRE FENCE

- A. Line posts shall be spaced not more than 16.5 feet center to center. Line posts adjacent to any end, corner, gate or intermediate braced post shall be spaced not more than 10 feet, center-to-center.
- B. Posts shall be set in holes dug minimum depth of 4.5 feet except that a tolerance of ± 3 inches is permitted provided the exposed portion of the post will not be less than 4.3 feet. Posts shall be set with large end down, plumb on side to receive fabric.
- C. Angle posts shall be installed where a deflection in fence alignment exceeds 30 degrees. Install intersection posts in line of intersecting fencing runs. Intersecting runs of fence shall be connected to a common post.
- D. Metal posts shall be driven with a suitable driver acceptable to the Engineer. Metal posts shall be driven to the proper depth, plumb and in conformity with fence lines indicated on the Plans. Metal posts which are bent or otherwise damaged during driving shall be removed and replaced.
- E. End, corner, gate, angle, intersection and intermediate braced posts shall be set in concrete at least 18 inches in diameter and deep.
 - 1. Braces shall be set in concrete at least 18 inches in diameter and 18 inches deep.
 - 2. Corner, angle and intermediate braced posts shall be braced in both directions. Intersection posts shall be braced in three (3) directions.
 - 3. Braces shall be securely fastened to the post near the top.
 - 4. At all grade depressions and alignment angles, line posts shall be set in concrete at least 18 inches in diameter and 4.5 feet deep.
- F. Woven wire fabric shall be installed to the lines and levels indicated on the Plans. Fabric shall be stretched taut and securely fastened to each post with the bottom of the fabric approximately 2 inches above the ground. Each horizontal strand of wire shall be wrapped completely around the end, corner, gate, intermediate braced or angle post and securely fastened by winding the end about the wire where it leads up to the post. Line posts shall not be used as a stretching anchorage.
- G. Splicing of wire in woven wire fabric and barbed wire shall be accomplished in a manner which will develop the full strength of the wire. The distance between the vertical stays adjacent to the splice shall be the same as for the unspliced sections of the fabric. One (1) approved splice may be placed at the end of the roll of fence without regard to the distance from a post.
- H. Fabric shall be securely fastened to each metal post with at least six (6) wire clamps.
- I. Fabric shall be attached to each wood post by at least one (1) fastener for each horizontal stand and as many other fasteners as required to secure wire firmly to post.

- J. Fabric shall be topped with barbed wire as indicated on the Plans. Barbed wire shall be securely fastened to each post.
- K. Gates shall be erected using methods acceptable to the Engineer in the locations shown on the Plans.

3.05 INSTALLATION OF CHAIN LINK FENCE

- A. Posts for chain link fence shall be set and braced as indicated on the Plans, as specified herein, or if not indicated, installation shall meet the requirements of ASTM F567 and CLFMI CLF 2445.
- B. Line posts shall be spaced not more than ten 10 feet center-to-center. Angle posts shall be installed where a deflection of ten (10) degrees or more occurs in fence alignment.
- C. Intermediate, braced posts shall be spaced at 660 foot intervals or midway between end posts, angle posts or corner posts when this distance is less than 1,320 feet but more than 660 foot.
- D. Intersection (corner) posts shall be set in line with intersecting fences. Both intersecting fences shall be connected to the common post.
- E. Posts shall be set in concrete. The depth of concrete footings for line posts shall be not less than 3.5 feet.
 - 1. Footing diameters shall be 9 inches minimum for line posts.
 - 2. Footing diameters for end, corner, angle, intersection, gate and intermediate braced posts shall be 18 inches.
 - 3. Holes for post foundations shall be completely filled with concrete around post.
- F. All fences shall have at least a top rail and a bottom tension wire.
 - 1. Fences 10 feet or more in height, and where otherwise indicated on the plans, shall have center and bottom rails. Bottom and center rails shall be securely connected to posts by means of connections approved by the Engineer.
- G. The top rail shall pass through the line post tops to form a continuous brace from end to end of each stretch of fence fabric. Splice joints shall be provided as indicated on the Plan. Suitable ties or clips shall be provided for attaching the fabric securely to the top rail at intervals not exceeding 24 inches.
- H. The top, center and bottom rail shall be secured to gate, corner, pull, end and line posts as indicated on the Plans.
- I. Horizontal braces of fencing 6 feet high and over shall be securely fastened to all end, corner, angle, intersection, gate, and intermediate braced posts by means of suitable metal connections. Braces shall be positioned midway between top rail and ground and shall extend to the first line posts. Braces shall be trussed as indicated on the Plans.
- J. Posts shall be fitted with post tops.
- K. Install chain link fabric of height indicated on plans. Fabric shall be pulled taut and tied to posts, rails and tension wires. Fabric shall be secured to framing by means of suitable metal bands, hogs or clips. Fasteners shall be spaced not more than 12 inches apart on posts and not more than 15 inches apart on top rail.
 - 1. Hogs rings for connecting fabric to tension wire shall be spaced on not more than 24 inches centers.
- L. Install extension arms as indicated on the Plans. Intermediate extension arms shall have hole for passage of top rail. Extension arm shall carry three (3) barbed wires equally spaced with the top most barbed wire approximately 12 inches in or out from the fence line.
- M. Provide one (1) stretcher bar for each gate and end post; provide two (2) stretcher bars for each center and pull post. Thread bars through fabric and secure to post with metal bands on 15

inches centers maximum.

- N. Fasten tie wires where shown and as required. Use U-shaped clips of wire securely fastened around pipe for clasping pipe and fabric. Bend ends of tie wire to minimize hazard to personnel and clothing.
- O. Gates
1. Install gates of types and sizes and in locations indicated on the Plans.
 2. Install ground-set items in concrete for anchorage as recommended by the manufacturer of the chain link fence.
 3. Lower hinge of gate shall be placed on top of concrete footing in which gate post is set. The footing concrete shall extend up to the bottom of the lower hinge.
 4. Cone bolt sockets for double swing gates shall be set in concrete so that plunger pin fits in socket when gate is in closed position.
 5. Gates shall be erected to swing in direction indicated. Install gate stops to limit swing as shown on Plans.
 6. Gates shall be hung plumb, level and secure for full opening without interference.
- P. Privacy slats, where used, shall be of types and sizes indicated on the Plans. Slats shall be secured to fabric using suitable clinch-lock type fasteners acceptable to the Engineer. Slats shall be secured to fabric by suitable metal fasteners on 6 inch vertical centers.

3.06 ADJUSTMENT

- A. After erection of fences, adjust all gate hardware for smooth and positive operation.

3.07 POST LEVELING

- A. After erection of fences, the tops of wood posts shall be cut off to proper elevation.

3.08 LUBRICATION

- A. After completion of fence erection, lubricate moving parts of gate hardware to ensure smooth operation without binding.

3.09 TABLES

- A. Table A - Dimensions and Weight of Gate Posts:

Gate Leaf Width	Outside Dimension	Minimum Weight
For Fabric Height 6 foot or less		
4 feet or less - round	2.375 inch	3.65 lbs per ft
4 feet or less - square	2 inch	2.6 lbs per ft
4 - 10 feet - round	2.875 inch	5.79 lbs per ft
4 - 10 feet - square	2.50 inch	5.10 lbs per ft
10 - 18 feet - round	4.0 inch	8.65 lbs per ft
10 - 18 feet - square	2.50 inch	5.10 lbs per ft
For Fabric Heights over 6 foot		
6 feet or less - round	2.875 inch	5.79 lbs per ft
6 feet or less - square	2.50 inch	5.10 lbs per ft
6 - 12 feet - round	4.0 inch	8.65 lbs per ft
6 - 12 feet - square	2.50 inch	5.10 lbs per ft
12 - 18 feet - round	6.625 inch	18.02 lbs per ft
Over 18 feet - round	8.625 inch	27.12 lbs per ft

B. Table B - Gate Frame Members, Dimensions and Weights:

Gate Frame Material	Outside Dimension	Minimum Weight
For Fabric Heights 6 foot or less		
Round Tubular Steel	1.66 inch	1.83 lbs per ft
Rectangular Tubular Steel	1.5 inch	1.84 lbs per ft
For Fabric Heights over 6 foot		
Round Tubular Steel	1.9 inch	2.28 lbs per ft
Rectangular Tubular Steel	2.0 inch	2.52 lbs per ft
Interior Bracing		
Round Tubular Steel	1.66 inch	1.83 lbs per ft
Rectangular Tubular Steel	1.5 inch	1.84 lbs per ft

END OF SECTION 32 31 00

SECTION 32 32 23
CONCRETE SEGMENTAL RETAINING WALL SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

1.02 WORK CONSISTS OF FURNISHING AND CONSTRUCTION OF AN ANCHOR DIAMOND PRO RETAINING WALL SYSTEM IN ACCORDANCE WITH THESE SPECIFICATIONS AND IN GENERAL CONFORMITY WITH THE LINES, GRADES, DESIGN, AND DIMENSIONS SHOWN ON THE PLANS.

A. Earthwork includes:

1. Preparing Foundation Soil and Retained Soil to the lines and grades shown on the construction drawings;
2. Furnishing and installing Leveling Pad, Reinforced Fill (where required) and Low Permeability Soil (where required) to the lines and grades shown on the construction drawings; and,
3. Installation work includes:
 - a. Furnishing and installing Diamond Pro Concrete Facing Units and Unit Fill to achieve the lines and grades shown on the construction drawings.
 - b. Furnishing and installing Geosynthetic Reinforcement and Separation Geotextile of the type, size, location and lengths designated on the construction drawings (if required).
 - c. Furnishing and installing Subsurface Drainage System, including necessary fittings, of the type, size, and location designated on the construction drawings.

1.03 RELATED SECTIONS

- A. Section 31 2200: Grading
- B. Section 31 2313: Subgrade Preparation
- C. Section 31 2319: Structural Excavation and Backfill

1.04 REFERENCES

- A. American Association of State Highway Transportation Officials (AASHTO)
 1. AASHTO Standard Specifications for Highway Bridges
 2. AASHTO M 288 Geotextile Specifications for Highway Applications
 3. AASHTO M 252 Corrugated Polyethylene Drainage Pipe
 4. AASHTO National Transportation Product Evaluation Program (NTPEP)
- B. American Society for Testing and Materials (ASTM)
 1. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 2. ASTM C1262 Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units
 3. ASTM C1372 Standard Specification for Segmental Retaining Wall Units
 4. ASTM D448 Standard Classification for Sizes of Aggregate for Road and Bridge Construction
 5. ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/f³)(600 kN-m/m³)

6. ASTM D1556 Standard Test Method for Density and Unit Weight of Soil In Place by the Sand Cone Method
 7. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³)(2700 kN-m/m³)
 8. ASTM D2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 9. ASTM D2922 Standard Test Methods for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
 10. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer pipe and Fittings
 11. ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 12. ASTM D4491 Standard Test Method for Water Permeability of Geotextiles by the Permittivity Method
 13. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
 14. ASTM D4873 Standard Guide for Identification, Storage and Handling of Geosynthetics
 15. ASTM D5084 Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
 16. ASTM D5262 Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics
 17. ASTM D5321 Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
 18. ASTM D5818 Standard Practice for Obtaining Samples of Geosynthetics from a Test Section for Assessment of Installation Damage
 19. ASTM D6637 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
 20. ASTM D6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units
 21. ASTM D6916 Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units
 22. ASTM D6706 Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
 23. ASTM F405 Standard Specification for Corrugated Polyethylene (PE) Tubings and Fittings
 24. ASTM G51 Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing
- C. Federal Highway Administration
- D. Samtani, Naresh C., Christopher, B., and Berg, R., "Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Soil Slopes", Volumes 1 and 2, Federal Highway Administration Report Nos. FHWA-NHI-10-024 and FHWA-NHI-10-025, November 2009.
1. Elias, V., Fishman, K., Christopher, B., and Berg, R., "Corrosion/Degradation of Soil Reinforcements for Mechanically Stabilized Earth Walls and Reinforced Soil Slopes", Federal Highway Administration Report No. FHWA-NHI-09-087, November 2009.
- E. National Concrete Masonry Association (NCMA)
1. NCMA Design Manual for Segmental Retaining Walls, Third Edition, 2010

1.05 DEFINITIONS

- A. Segmental Retaining Wall (SRW) Units: Dry-stacked concrete masonry units used as the retaining wall fascia.
- B. Reinforced Fill: Soil which is used as fill behind the SRW unit and within the reinforced soil mass (if applicable).
- C. Unit Fill and Drainage Aggregate: Material used (if applicable) within, between, and directly behind the concrete retaining wall units.
- D. Geotextile Separation Fabric: Material used for separation and filtration of dissimilar soil types.
- E. Foundation Soil: Soil mass supporting the leveling pad and reinforced soil zone of the retaining wall system.
- F. Retained Soil: The soil mass located behind the reinforced soil zone, either undisturbed native soils or compacted fill.
- G. Leveling Pad: A level surface consisting of crushed stone, sand and gravel or unreinforced concrete placed to provide a working surface for placement of the SRW unit.
- H. Geosynthetic Reinforcement: Polymeric material designed specifically to reinforce the soil mass.
- I. Pre-fabricated Drainage Composite: three-dimensional geosynthetic drainage medium encapsulated in a geotextile filter, used to transport water.
- J. Subsurface Drainage System: horizontal pipe encapsulated within drainage aggregate at or near the base of the reinforced soil to facilitate removal of water from the wall system.
- K. Low Permeability Soil: Clay soil or low permeability geosynthetic used to prevent water percolation into the drainage zone and reinforced backfill behind the wall.
- L. Global Stability: The general mass movement of a soil reinforced segmental retaining wall structure and adjacent soil mass.

1.06 SUBMITTALS / CERTIFICATION

- A. Product Data
 - 1. Product Data: Material description and installation instructions for each manufactured product specified
 - 2. Name and address of the production facility where the proposed facing units will be manufactured. All units shall be manufactured at the same facility.
 - 3. Notarized letter from the facing unit manufacturer stating that the units supplied for this project are manufactured in complete compliance with this specification. The letter shall state that the units shown in the attached test reports are representative samples of the plants normal mix design and regular production runs.
 - 4. Notarized letter from the reinforcement manufacturer stating that the geosynthetic reinforcement has been manufactured in complete compliance with the reinforcement manufacturer's current NTPEP report.
- B. Samples:
 - 1. CONTRACTOR shall submit to the OWNER for approval, and retain for the balance of the project, a minimum of one SRW unit that represents the range of texture and color permitted.
- C. Test Reports:
 - 1. Independent Laboratory reports indicating compressive strength, moisture absorption and freeze-thaw durability of the concrete retaining wall units from the proposed production

facility.

2. Independent test reports verifying the long-term design strength properties (creep, installation damage, and durability) and soil interaction properties of the geosynthetic reinforcement.
3. Independent test reports verifying the connection capacity between the geosynthetic reinforcement and the concrete retaining wall units.

D. Retaining Wall Contractor Qualifications:

E. Notarized statement showing that the retaining wall Contractor has installed a minimum of 100,000 sq feet of segmental retaining walls.

1. The Retaining Wall Installer shall furnish five (5) project references of similar size and scope to this project including the wall(s) height and square footage. References shall include the contact information of Owner or General Contractor.

1.07 DELIVERY, STORAGE AND HANDLING

- A. SRW Units and Accessories: Deliver, store, and handle materials in accordance with manufacturer's recommendations, in such a manner as to prevent damage. Check the materials upon delivery to assure that proper material has been received. Store SRW units above ground on wood pallets or blocking. Remove damaged or otherwise unsuitable material, when so determined, from the site.
- B. Exposed faces of SRW units shall be relatively free of chips, cracks, stains, and other imperfections detracting from their appearance, when viewed from a distance of 20 feet under diffused lighting.
- C. Prevent mud, wet cement, adhesives and similar materials that may harm appearance of SRW units, from coming in contact with system components.
- D. Geosynthetics (including geosynthetic reinforcement, geotextile filter, pre-fabricated drainage composite) shall be delivered, stored, and handled in accordance with ASTM D4873.

1.08 EXTRA MATERIALS

- A. Furnish OWNER with 3 replacement SRW units identical to those installed on the Project.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. SRW Units: Diamond Pro Stone Cut Retaining Wall Units as manufactured under license from Anchor Wall Systems.
 1. Physical Requirements
 - a. Meet requirements of ASTM C1372, except the unit height dimensions shall not vary more than plus or minus 1/16 inch from that specified in the ASTM reference, not including textured face.
 - b. Unit Face Area: Not less than 1.0 sq foot.
 - c. Color: Selected by the OWNER from manufacturer's full range of standard colors.
 - d. Face Pattern Geometry: Stone Cut®
 - e. Texture: Split Rock Face.
 - f. Batter: Include an integral concrete shear connection flange/locator to provide a 1 inch setback for each wall course.
- B. Geosynthetic Reinforcement: Polyester fiber geogrid or geotextile, or polypropylene woven geotextile, as shown on the Drawings.

C. Leveling Pad

1. Aggregate Base: MDOT 21AA Crushed limestone
 - a. Base Thickness: 6 inches.

D. Anchorplex Unit Fill and Drainage Aggregate: Mixture of Portland Cement, Aggregate and Water for structural support of wall.

1. Clean crushed stone meeting the following gradation as determined in accordance with ASTM D448: (2,525 lbs / cyd)

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75 to 100
No. 4	0 to 60
No. 40	0 to 50
No. 200	0 to 5

2. Fly Ash: ASTM C618 (210 lbs / cyd)
3. Cement: ASTM C150, Type I (210 lbs / cyd)
4. Water Reducer: ASTM C494 (0.5 lbs / cyd)
5. Water: Potable (166 lbs. / cyd)
6. Unit Weight: 115 lbs / cft
7. Water Cement Ratio: 0.4
8. Percent Air Voids: 24%

E. Reinforced Fill: Soil free of organics and debris and consisting of either GP, GW, SP, SW, or SM type, classified in accordance with ASTM D2487 and the USCS classification system and meeting the following gradation as determined in accordance with ASTM D448:

Sieve Size	Percent Passing
1 inch	100
No. 4	20 to 100
No. 40	0 to 60
No. 200	0 to 35

1. Plasticity Index (PI) < 6 per ASTM D4318.
2. Maximum particle size for backfill is 1 inch unless field tests have been performed to evaluate potential strength reduction to the geosynthetic reinforcement due to damage during construction per ASTM D5818.
3. Unsuitable soils are organic soils and those soils classified as SC, CL, ML, CH, OH, MH, OL, or PT.

F. Low Permeability Soil: Clayey soil or other similar material which will prevent percolation into the drainage zone behind the wall.

G. Drainage Pipe: Perforated or slotted PVC or corrugated HDPE pipe manufactured in accordance with D3034 and/or ASTM F405. All connectors and fittings shall match the piping material.

H. Geotextile Separation Fabric: Geotextile Separation fabric shall be minimum 4.0 oz/sy, polypropylene, needle-punched nonwoven fabric.

I. Construction Adhesive: Exterior grade adhesive as recommended by the retaining wall unit manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Prior to commencing work, the retaining wall CONTRACTOR shall examine the areas and conditions under which the retaining wall system is to be erected 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.
- B. Promptly notify the ENGINEER of site conditions which may affect wall performance, soil conditions observed other than those assumed, or other conditions that may require a reevaluation of the wall design.

3.02 VERIFY THE LOCATION OF EXISTING STRUCTURES AND UTILITIES PRIOR TO EXCAVATION.

3.03 PREPARATION

- A. Ensure surrounding structures are protected from the effects of wall excavation.
- B. Excavation support, if required, is the responsibility of the CONTRACTOR, including the stability of the excavation and its influence on adjacent properties and structures.

3.04 EXCAVATION

- A. Excavate to the lines and grades shown on the Drawings. Over-excavation not approved by the ENGINEER will not be paid for by the Owner. Replacement of these soils with compacted fill and/or wall system components will be required at the CONTRACTOR 's expense. Use care in excavating to prevent disturbance of the base beyond the lines shown.

3.05 FOUNDATION PREPARATION

- A. Excavate foundation soil as required for footing or base dimension shown on the Drawings, or as directed by the ENGINEER.
- B. The ENGINEER will examine foundation soil to ensure that the actual foundation soil strength meets or exceeds that indicated on the Drawings. At the direction of the ENGINEER, remove soil not meeting the required strength. Oversize resulting excavation sufficiently from the front of the block to the back of the reinforcement, and backfill with suitable compacted backfill soils.
- C. The ENGINEER will determine if the foundation soils will require special treatment or correction to control total and differential settlement.
- D. Fill over-excavated areas with suitable compacted backfill, as recommended by the ENGINEER.

3.06 LEVELING PAD PREPARATION

- A. Place base materials to the depths and widths shown on the Drawings, upon undisturbed soils, or foundation soils prepared in accordance with this section.
 - 1. Extend the leveling pad laterally at least 6 inches in front and behind the lowermost SRW unit.
 - 2. Provide aggregate base compacted to 6 inches thick (minimum) or as shown on the drawings.
 - 3. Where a reinforced footing is required by local code official, place footing below frost depth.
- B. Compact aggregate base material to provide a level, hard surface on which to place the first course of SRW units.
- C. Prepare base materials to ensure complete contact with SRW units. Gaps are not allowed.

3.07 ERECTION

- A. General: Erect SRW units in accordance with manufacturer's instructions and recommendations, and as specified herein.
- B. Place first course of concrete wall units on the prepared base material. Check units for level and alignment. Maintain the same elevation at the top of each unit within each section of the base course.
- C. Ensure that foundation units are in full contact with the leveling pad.
- D. Place concrete wall units side-by-side for full length of wall alignment. Alignment may be done by using a string line measured from the back of the block. Gaps are not allowed between the foundation concrete wall units.
- E. Place drainage aggregate between and directly behind the SRW. Fill any voids in SRW units with drainage aggregate. Provide a drainage zone behind the SRW units a minimum of 12 inches wide to within 8 inches of the final grade. Cap the backfill and drainage aggregate zone with separation fabric and then 8 inches of low permeability soil.
- F. Install drainage pipe at the lowest elevation possible to maintain gravity flow of water to outside of the reinforced zone. Slope the main collection drainage pipe 2 percent (minimum) to provide gravity flow to the daylighted areas. Daylight the main collection drainage pipe through the face of the wall, and/or to an appropriate location away from the wall system at each low point or at 50 foot intervals along the wall. Alternately, the drainage pipe can be connected to a storm sewer system at 50 foot intervals.
- G. Remove excess fill from top of SRW units and install next course. Ensure drainage aggregate and backfill are compacted before installation of next course.
- H. Check each course for level and alignment. Adjust SRW units as necessary to maintain level and alignment prior to proceeding with each additional course.
- I. Install each succeeding course. Backfill as each course is completed. Pull the SRW units forward until the locating surface of the SRW unit contacts the locating surface of the SRW units in the preceding course. Interlock wall segments that meet at corners by overlapping successive courses. Attach SRW units at exterior corners with adhesive specified.
- J. Install geosynthetic reinforcement in accordance with geosynthetic manufacturer's recommendations and the shop drawings.
 - 1. Orient geosynthetic reinforcement with the highest strength axis perpendicular to the wall face.
 - 2. Prior to geosynthetic reinforcement placement, place the backfill and compact to the elevation of the top of the wall units at the elevation of the geosynthetic reinforcement.
 - 3. Place geosynthetic reinforcement at the elevations and to the lengths shown on the Drawings.
 - 4. Lay geosynthetic reinforcement horizontally on top of the SRW units and the compacted backfill soils. Place the geosynthetic reinforcement within one inch of the face of the SRW units. Place the next course of SRW units on top of the geosynthetic reinforcement.
 - 5. The geosynthetic reinforcement shall be in tension and free from wrinkles prior to placement of the backfill soils. Pull geosynthetic reinforcement hand-taut and secure in place with staples, stakes, or by hand-tensioning until the geosynthetic reinforcement is covered by 6 inches of loose fill.
 - 6. The geosynthetic reinforcements shall be continuous throughout their embedment lengths. Splices in the geosynthetic reinforcement strength direction are not allowed.
 - 7. Do not operate tracked construction equipment directly on the geosynthetic reinforcement. At least 6 inches of compacted backfill soil is required prior to operation of tracked vehicles

over the geosynthetic reinforcement. Keep turning of tracked construction equipment to a minimum.

8. Rubber-tired equipment may pass over the geosynthetic reinforcement at speeds of less than 10 miles per hour. Turning of rubber-tired equipment is not allowed on the geosynthetic reinforcement.

3.08 BACKFILL PLACEMENT

- A. Place reinforced fill, spread and compact in a manner that will minimize slack in the reinforcement.
- B. Place fill within the reinforced zone and compact in lifts not exceeding 6 inches where hand-operated compaction equipment is used, and not exceeding 12 inches where heavy, self-propelled compaction equipment is used.
 1. Only lightweight hand-operated compaction equipment is allowed within 3 feet of the back of the retaining wall units. If the specified compaction cannot be achieved within 3 feet of the back of the retaining wall units, replace the reinforced soil in this zone with drainage aggregate material.
- C. Compaction testing shall be done in accordance with ASTM D1556 or ASTM D2922.
- D. Minimum Compaction Requirements for Fill Placed in the Reinforced and Retained Zone.
 1. The minimum compaction requirement shall be determined by ENGINEER testing the compaction. At no time shall the soil compaction requirements be less than 95 percent of the soil's standard Proctor maximum dry density ((ASTM D698)) for the entire wall height.
- E. Utility Trench Backfill: Compact utility trench backfill in or below the reinforced soil zone to 98 percent of the soil's standard Proctor maximum dry density ((ASTM D698)), or as recommended by the ENGINEER. If the height from the utility to finish grade is higher than 30 feet, increase compaction to 100 percent of the standard Proctor density modified Proctor density.
 1. Moisture Content: Within 2 percentage points of the optimum moisture content for all wall heights.
 2. These specifications may be changed based on recommendations by the ENGINEER.
- F. At the end of each day's operation, slope the last level of compacted backfill away from the interior (concealed) face of the wall to direct surface water runoff away from the wall face.
 1. The CONTRACTOR is responsible for ensuring that the finished site drainage is directed away from the retaining wall system.
 2. In addition, the CONTRACTOR is responsible for ensuring that surface water runoff from adjacent construction areas is not allowed to enter the retaining wall area of the construction site.

3.09 CAP UNIT INSTALLATION

- A. Apply adhesive to the top surface of the SRW unit below and place the cap unit into desired position.
- B. Cut cap SRW units as necessary to obtain the proper fit.
- C. Backfill and compact to top of SRW unit.

3.10 SITE CONSTRUCTION TOLERANCES

- A. Site Construction Tolerances
 1. Vertical Alignment: Plus or minus 1-1/2 inches over any 10-foot distance, with a maximum differential of 3 inches over the length of the wall.

2. Horizontal Location Control from Grading Plan
 - a. Straight Lines: Plus or minus 1-1/2 inches over any 10-foot distance.
 - b. Corner and Radius Locations: Plus or minus 12 inches.
 - c. Curves and Serpentine Radii: Plus or minus 2 feet.
3. Immediate Post Construction Wall Batter: Within 2 degrees of the design batter of the concrete retaining wall units.
4. Bulging: Plus or minus 1-1/4 inches over any 10-foot distance.

3.11 FIELD QUALITY CONTROL

- A. CONTRACTOR is responsible for quality control of installation of system components.
- B. The OWNER will retain a qualified professional to perform quality assurance checks of the CONTRACTOR 's work.
- C. Correct work which does not meet these specifications, or the requirements shown on the Drawings at the CONTRACTOR's expense.

3.12 ADJUSTING AND CLEANING

- A. Replace damaged SRW units with new units as the work progresses.
- B. Remove debris caused by wall construction and leave adjacent paved areas broom clean.

3.13 MEASUREMENT AND PAYMENT

- A. Measurement of segmental retaining wall shall be on an installed square foot basis computed on the total face area of wall installed. Wall face area includes the bottom of the base course to the top of the wall, and the entire length of the wall.
- B. Payment for the wall will be made on a square foot basis at the agreed upon Contract Unit Price.
 1. Payment should be considered full compensation for labor, materials, equipment and testing required to install the wall in accordance with these specifications and the Drawings.
 2. Quantities may vary from that shown on the Drawings depending on existing topography. Change to the total quantity of wall face area will be paid or withheld at the agreed upon Contract Unit Price.

END OF SECTION 32 32 23

SECTION 32 90 00 PLANTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes furnishing trees, shrubs and ground cover as shown on the Plans, complete with the digging and preparation of holes, furnishing and placing of topsoil, planting, pruning, watering, fertilizing and cultivating; weed control fabric, and such other materials necessary to complete the Work and insure proper and hardy growth.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements

1.03 SOURCE QUALITY CONTROL

- A. Trees, shrubs and ground cover shall comply with state and federal laws with respect to inspection for plant diseases and insect infestation.

1.04 REFERENCE STANDARDS

- A. AAN - American Association of Nurserymen
- B. AANLS - American Association of Nurserymen Landscape Standards
- C. ANSI - American National Standards Institute
- D. ASTM C33/C33M: Standard Specification for Concrete Aggregates
- E. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity
- F. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles
- G. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- H. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile
- I. ASTM D4833/D4833M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
- J. ASTM D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles
- K. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition

1.05 SUBMITTALS

- A. Contractor shall submit to the Engineer certificates of inspection for plant diseases and insect infestation.
- B. Submit a certified analysis of imported topsoil from each off-site source prior to delivery. Deficiencies shall be corrected at Contractor's expense.
- C. Submit sample of mulch and planting mixture prior to delivery to site.
- D. Submit product data for anti-desiccants, tree wound dressing and herbicides prior to use.

1.06 PLANT SELECTION AND INSPECTION

- A. All trees shall be inspected and accepted prior to planting. Contractor may elect either of the following options as applicable:

- B. For sources within 120 miles of the site, the Engineer will tag the trees at the source. Contractor shall request, in writing, at least two (2) weeks prior to any desired inspection date, inspection and approval of the trees at the source. Approved trees will be tagged by the Engineer and the tag shall remain on the tree until planting and final inspection. Contractor shall accompany the Engineer on the inspection.
 - 1. Otherwise, the trees will be delivered to the site. Trees approved for use will be tagged by the Engineer and the tag shall remain on the tree until planting and final inspection. Rejected trees will not be tagged and shall be immediately removed from the site, and new trees shall be brought in for inspection and approval.
- C. Plant material shall be subject to approval by the Engineer at the site prior to planting.

1.07 PREPARATION OF SHIPMENTS

- A. Plant material shall be clearly labeled as to species and variety. The label or tag shall be securely attached to each plant and shall show the scientific name of the plant. Unless otherwise shown on the Plans, all plants shall be balled and burlapped or container grown.
- B. In preparation for spring planting, all balling operations for balled and burlapped stock shall be completed prior to "bud break." In preparation for fall planting of deciduous plants, balling operations shall not commence until after the plants have begun to "harden off."
- C. Stock shall be dug and packed with care immediately prior to shipment. Plants shall be dug and transported so as to provide and retain a firm ball of earth.
- D. The roots shall be carefully protected with wet straw, moss or other material. The root balls shall be adequately protected from rain or sudden changes in the weather. Balled and burlapped plants will not be accepted if the balls of earth are loosened or broken, or wrapped with material made from synthetics or plastic.
- E. Plants furnished in containers shall have their roots well established in the soil mass and shall have grown in the container for at least one (1) growing season. Containers shall be of a size large enough to provide an earth-root mass of adequate diameter and depth for the stem diameter and plant height or spread, as established by accepted nursery practice. No container grown stock will be accepted if it is root bound.
- F. The transporting of all nursery stock shall be in an enclosed or covered vehicle. Deliver plant material immediately prior to planting. Keep plant material moist.
- G. Plants will be rejected when the ball of earth surrounding the roots has been cracked or broken prior to or during the planting.
- H. Plants shall be rejected when the burlap, stakes, or ropes required in connection with transplanting have been displaced prior to final acceptance.

1.08 STORAGE AND HANDLING

- A. Roots of plants shall be kept moist and adequately protected by topsoil or other approved covering until planted.
- B. Trunks and branches of trees shall be carefully protected from injury of any kind during operations of digging, loading, transporting and planting. Trees that are injured may be rejected.

1.09 PLANTING SEASON

- A. The planting seasons for deciduous plants shall be between March 1 and June 1 and from October 1 until the ground becomes frozen, except that, when unusual planting conditions exist or when container-grown material is used, these planting seasons may be altered.
 - 1. When approved by the Engineer, plants, having a ball of earth attached, may be planted during the summer months, provided adequate moisture will and can be applied to the plants.

- B. The planting season for evergreen plants shall be between March 1 and June 1.

1.10 GUARANTEE AND ACCEPTANCE

- A. Contractor shall warrant that all trees have been grown, transported, handled and planted properly so as to be in a vigorous growing condition at the start of the establishment period.
- B. Trees, shrubs and ground cover shall be guaranteed for the establishment period(s). Contractor shall replace all trees, shrubs and ground cover showing defective growth, more than 20% dieback, disease, insect infestation or other impairing defects during the Establishment Period with sound, healthy, vigorous growing trees, shrubs and ground cover at no additional expense to the Owner and in accordance with the plans and specifications.
- C. At the end of the Establishment Period, the Contractor shall request final acceptance. Final acceptance will be made by the Engineer and Owner provided the trees are healthy and all requirements of the Project have been fulfilled.

1.11 EXPERIENCE AND QUALIFICATIONS

- A. Concrete shall conform to MDOT Section 1004, use 3500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.
- B. Contractor or Subcontractor must be experienced and capable of completing the Work so that the plant materials are in a healthy, vigorous growing condition at the end of the Project. In order to show that the Contractor or Subcontractor is capable of completing the Work successfully, when requested by the Engineer, the Contractor shall submit references from the last five (5) projects of a similar nature. Failure to show successful completion of the last five projects of a similar nature may result in the Contractor or Subcontractor being deemed unacceptable for this Work on this Project.

PART 2 PRODUCTS

2.01 TREES AND SHRUBS

- A. All trees and shrubs shall conform to the requirements of AANLS and as specified herein.
- B. Plant material shall conform to the sizes given in the plant list or Proposal. All measurements such as spread, ball size, number of canes, quality designations, etc. shall be in accordance with AAN "American Standard for Nursery Stock".
- C. Plant material shall be typical for their species or variety and shall be sound, healthy, vigorous, and free from plant diseases and insect pests or their eggs. They shall have healthy, well developed root systems.
- D. Plants designated "B&B" shall be balled and burlapped. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord. No balled and burlapped plant shall be planted if the ball is cracked or broken. No planting with rot proof burlap or ties shall be permitted. Sand balls are not acceptable.
- E. Trees shall be nursery grown stock which has been pruned to encourage single main stems, compact fibrous root systems and symmetrical branching. Trees of the same species shall be uniform in height and spread. All trees shall be free from all insects, diseases, mechanical injuries or other objectionable features. Root balls shall be of the sizes specified in AANLS for the tree root system.
- F. Container-grown stock shall have been grown in the containers for one (1) growing season minimum. Plants showing "Pot Bound" root ends will not be accepted.
- G. Trees caliper for trees less than 4 inch caliper shall be determined at a point 6 inch above ground when installed. Trees above 4 inch caliper shall be measured at a point 12 inch above the ground.

- H. Ornamental trees and shrubs shall be well formed and shall have a crown typical of the species or variety. Low-branched crown types shall be furnished unless the Plans or Proposal specifies a tree form or bush form. Material shall be balled and burlapped, unless otherwise indicated.
- I. Plant stock shall have grown to the required size in a normal progressive manner. Heading-back plants to meet sizes called for on the Plans will not be permitted.
- J. Evergreen trees will require ball and burlap or other adequate root protection. Tops shall be of a form typical to the species and not unnaturally sheared or color treated. Anti-desiccant protection may be required for evergreen trees.
- K. Plant material shall be nursery grown at sources in the same or higher hardiness zone as determined by the latest edition of the Plant Hardiness Zone Map, Agricultural Research Service, U.S. Department of Agriculture.
- L. Substitutions will be permitted only upon submission of proof that specified plants are not obtainable and with the authorization of the Engineer. Requests for substitutions and price adjustments due to substitutions must be submitted in accordance with the General Conditions.

2.02 MULCHING

- A. Mulching material shall be one of the following as specified on the plans.

- 1. Compost:

- a. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in MCLA PA 641 as amended and shall be in compliance with all federal and state laws.
- b. Compost shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- c. The manufacturer of the compost shall provide test data and a statement to show that the following criteria are being met by the compost provided for the project. The composition of the compost shall be within the following range of values:

Quality Parameter	Range of Value
Soil pH	6 to 7.5
Soluble Salts	2 to 5 mmho/cm
Carbon/Nitrogen Ratio	13 to 20 parts C to 1 part N
Inerts	< 1%
Organic matter	35 to 55 %
Nitrogen	1 to 2 %
Phosphorus	0.2 to 0.8 %
Potassium	0.5 to 1.5 %
Unit Weight	535 to 775 kg per cubic meter
Moisture Content	40 to 50 %
Particle Size	< 20 mm maximum
Water Holding Capacity	> 100%
Heavy Metals	None

- d. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

- 6. Deleterious Mat'l* 5% max *rock, gravel, stone, sticks, roots, sod, etc.
- B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8 inch maximum mesh screen prior to delivery to the Project site.
 - 1. Engineer shall review source and final screen results prior to release of topsoil. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer.
 - 2. Topsoil shall be placed in 4 inch (100 mm) minimum thickness throughout, or as specified in the plans or Specifications.
- C. Contractor shall obtain his own topsoil borrow pit source and shall obtain necessary permits and agreements for the use of such borrow pits at his own expense.

2.04 SAND

- A. Sand for planting mixture shall be clean, course, ungraded sand conforming to ASTM C33/C33M for fine aggregates.

2.05 FERTILIZER

- A. Fertilizer shall be Agriform 21-Gram Planting Tablets Plus Minors or Engineer approved equal. Planting Tablets shall be tightly compressed, long-lasting and slow-release with an N-P-K analysis of 20-10-5. Apply at manufacturer's recommendations and soil analysis.

2.06 PEAT

- A. Granulated raw Canadian peat or baled Canadian peat, containing not more than 9% mineral on a dry basis. For ericaceous plants, baled peat with a pH of 4.0 shall be used.

2.07 LANDSCAPE WEED CONTROL FABRIC

- A. Weed barrier fabric shall consist of a geotextile fabric, spun-bonded polypropylene, non-woven fabric and a UV stabilizer.
- B. Fabric shall have the following Minimum Average Roll Values:

Fabric Properties	Minimum Values	Test Method
Unit Weight	3.0 oz/yd ²	ASTM D5261
Grab Tensile Strength	135 lbs.	ASTM D4632/D4632M
Elongation at Break	70%	ASTM D4632/D4632M
Puncture Strength	35 lbs.	ASTM D4833/D4833M
Trapezoidal Tear	50 lbs.	ASTM D4533/D4533M
Permittivity	1.2 sec. ⁻¹	ASTM D4491/D4491M
Apparent Opening Size (equivalent Sieve)	60/70	ASTM D4751
Ultraviolet Stability	70% @ 500 hrs.	ASTM D4355/D4355M

2.08 STEEL LANDSCAPE EDGING

- A. Comply with ASTM A36/A36M or ASTM A283/A283M, hot-rolled, standard flexible carbon steel landscape edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately 30 inches apart to receive stakes. Steel landscape edging shall be double staked at overlap joints, and designed to receive tapered steel stakes.
- B. Steel Edge shall be 12ga steel, 4 inches wide, by 10 foot length, with 4 stakes. Painted finish shall be Sherwin Williams H68GT85 powder coat paint electrostatically applied and oven baked. Minimum thickness to be 1.5 mils. Color shall be green, brown, or black as determined by the Owner.
- C. Steel stakes shall be Steel, tapered, 14 inch length and finished to match specified steel landscape edging. Stakes shall be designed specifically to anchor steel landscape edging in

place, and made by the manufacturer of the steel landscape edging for which they will be used.

- D. Furnish and install manufacturer's standard start/end sections, 90 degree corners, and splicers as required.

2.09 STAKES FOR GUYING AND BRACING

- A. Stakes used for bracing or guying plants shall be sound wood of nominal 2 x 2 inch stock and shall be approximately 30 inches in length for guying or of the required length for bracing. The stakes shall be pointed on one end by beveling on two (2) sides.
- B. Metal stakes for bracing trees shall be green metal T-section posts with no anchor plates. Posts shall be at least 8 foot long. Posts shall only be used where specified on the plans.

2.10 WIRE FOR GUYING AND BRACING

- A. Wire shall be new and free from bends or kinks.
- B. Wire used for guying trees 4 inches or less in diameter shall be No. 11 steel wire.
- C. Wire used for guying trees over 4 inches in diameter shall be No. 9 galvanized steel wire.

2.11 HOSE

- A. Hose used with wire for guying trees shall be new 1/2 inch reinforced rubber garden hose or steam hose.

2.12 PLASTIC GUYING AND BRACING MATERIAL

- A. High density polyethylene, chain-lock type material, 1 inch wide with a breaking strength of 100 lbs minimum.
- B. Flat, woven, webbing type 3/4 inch wide tape constructed of polypropylene with a breaking strength of 900 lbs in either white or olive green.

2.13 TREE BALLING BURLAP

- A. Balling material shall be untreated burlap or other material which will readily decompose. Synthetic materials such as nylon or plastic will not be permitted.

2.14 PLANTING MIXTURE

- A. Planting mixture shall be a mixture of 1/3 topsoil, 1/3 sand, and 1/3 peat. Add fertilizer at the quantity as recommended by the manufacturer. Planting mixture shall be free from stick, stones, sod, clods or other material which might leave pockets around the roots.

2.15 BIORETENTION PLANTING MIXTURE

- A. Bioretention planting mixture shall have a sandy loam, loamy sand, or loam texture per USDA textural triangle. Maximum clay content shall be 5%.
- B. The soil mixture shall have a pH between 5.5 and 6.5 and an organic content of 1.5 – 3.0%.
- C. The soil mixture shall have an infiltration rate greater than 0.5 inches/hr.
- D. The soil shall be a uniform mix, free of stones, glass, trumps, roots, or other similar objects larger than 1 inch.
- E. No other material or substances shall be mixed or dumped with the bioretention mix that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.
- F. The planting mixture shall be free of Bermuda Grass, Quack grass, Johnson Grass, Mugwort, Nutsedge, Poison Ivy, Canadian Thistle, Tearhub, or other noxious weeds.

2.16 ACCEPTABLE MANUFACTURERS

- A. Plastic guying and bracing material shall be Adj-A-Tye heavy duty poly chain lock by A. M. Leonard Inc., ArborTape by Neptco Inc. or Engineer approved equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Contractor shall stake all plant locations and confirm the locations and type of plants to be placed with the Engineer. Inspect trees, shrubs and ground cover for injury, insect infestation and improper pruning. Verify that all trees, shrubs, and ground cover are in healthy growing condition.

3.02 PREPARATION

- A. Contractor shall not begin excavation until stake out of tree and/or shrub locations are acceptable to the Engineer.
- B. Contractor shall stake enough planting locations for two weeks work. Contractor shall arrange periodic site meetings with the Engineer for the purpose of reviewing the work that has taken place in the prior two weeks and the staking for the next two weeks. Contractor shall notify the Engineer at least three (3) working days prior to the desired date for inspection of staking.
- C. Contractor shall accurately stake plant material location according to the plans. Stakes for trees shall be 36" high above finished grade and painted a bright color to be clearly visible for inspection. Distinguish by color between types of material, i.e., evergreen trees, canopy trees, flowering trees. Staking for shrubs, perennials, and ground covers shall be staked 18 inches high above finished grade and painted white. Stakes shall be placed at the perimeter and at the bed line 30 feet on center. Engineer shall review the locations and make changes in locations as necessary.

3.03 PLANTING

- A. Balled and burlapped plants shall be set plumb. Tree pits shall be excavated as shown on the plans. Contractor shall dispose of subsoil dug from pits, trenches and beds.
- B. Contractor is responsible for planting to correct grades and alignment and all plants shall be set so that, when settled, they will bear the same relation to finish grade as they did before being transplanted. No filling will be permitted around trunks or stems.
- C. At the start of the Work tree pits and beds are to be excavated and the Contractor shall request inspection and approval by Engineer. Approval must be received before backfilling occurs.
- D. The root ball shall be set on a compacted base as detailed. Burlap shall be cut away from top 1/3 of the root ball and all ropes, wires, etc. securing the ball shall be removed.
- E. Plastic tape and/or plastic fabric shall be completely removed from the root ball during the planting operation. "Rot proof" or treated burlap shall also be totally removed.
- F. Container-grown plants shall be planted as specified for balled and burlapped stock, except that when plants are furnished in non-plantable containers, the container shall be removed only at the time of planting. Plants furnished in plantable type containers shall have container sides severed in multiple places and the upper half of the container removed during the planting operation. Care shall be taken to protect tree roots during severing and removal operation.
- G. When the plant has been properly set, the pit shall be backfilled with planting mixture, gradually filling, tamping and settling with water. No soil in a frozen or muddy condition shall be used for backfilling. The backfill shall be placed to an elevation flush with the ground elevation and the rootball, except that a saucer shall be created near the edge of the hole to capture water.
- H. During fall planting, an Engineer approved superphosphate fertilizer shall be applied over the planting mixture at a rate per the manufacturer's instructions.
- I. All evergreen plant material shall be sprayed with an Engineer approved anti-desiccant according to manufacturer's instructions and limitations immediately following planting and during final seasonal watering.

3.04 MULCHING

- A. After backfilling is completed, mulching material shall be placed over the plant hole area to a depth of 5 - 6 inches or as specified on the plans. Thoroughly soak all mulched areas. After watering, all mulched areas shall be raked and left in a complete and finished manner.
- B. Perennial areas shall have 3 inches of mulch or as specified on the plans. Mulch these areas first and then plant ground cover through the mulch.
- C. Planting beds shall be mulched with a 4 inches cover of mulch as shown on the drawings and details, unless otherwise indicated on the drawings. Mulch depths shall be 4 inches at time of inspection.
- D. For plants located on slopes, an earth saucer or berm shall be constructed halfway around each plant on the down slope side. The saucer or berm shall have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. A trench shall be dug on the down slope side and filled with planting mixture to allow for drainage.

3.05 BRACING AND GUYING

- A. Only evergreen trees equal to or larger than 5 feet high and deciduous trees with a caliper equal to or larger than 2 inches need to be staked or guyed unless clay soil conditions exist, a tree is planted on a steep slope, or otherwise becomes apparent that a tree needs to be braced or guyed.
 - 1. Trees required to be braced, shall be braced or guyed immediately after planting.
 - 2. All plants required to be braced shall be braced with a minimum of two (2) stakes. Stakes shall be driven to avoid ball and shall be no closer than 1 foot -foot (300 mm) from the trunk.
 - 3. Stakes shall be driven to a depth which will firmly anchor the plant, but in no case less than 1 foot below the bottom of the planting hole. The wide side of the stake shall face the trunk of the plant.
 - 4. Stakes shall extend to within 4 inches of the lowest plant's main branches. Top of stake shall be firmly attached to the trunk with steel wire or plastic guying and bracing material.
 - 5. When using steel wire, place wire so it forms a figure eight (8) around the stake and trunk. Portions of wire around trunk shall be encased in water hose of sufficient length to contain the wire loop around the trunk. Enclosed trunk loops shall not restrict normal trunk growth.
 - 6. Stakes shall be positioned on opposite sides of trunks and secured to the trunk at approximately 2/3 the height of plant. Warning tape or ribbon shall be tied to the wiring between the tree and the stake.

3.06 PRUNING

- A. Where determined by the Engineer, pruning will be required. All pruning of the new plants shall be done by workmen experienced in this type of Work. Pruning shall be completed prior to planting. Hedge shears shall not be permitted for pruning. Pruning shall be done in accordance with the best standard practices.
- B. Deciduous trees shall have branches pruned to balance the loss of roots in such a manner as to retain the natural form of the tree type.
- C. Evergreen trees shall be pruned only to the extent of removing broken or damaged branches.
- D. Cuts shall be made flush, leaving no stubs. Paint all cuts over 3/4 inch in diameter with tree paint.
- E. Notify the Engineer at least one (1) week prior to pruning operations.

3.07 WATERING, FERTILIZING AND CULTIVATING

- A. All plants shall be thoroughly soaked after planting. After all watering, all beds shall be raked and left in a complete and finished manner.
- B. Watering, Fertilizing and Cultivating is required during the Establishment Period. Watering, Fertilizing and Cultivating shall include all measures necessary to establish and maintain plants in a vigorous and healthy growing condition for the entire Establishment Period.
- C. Contractor shall manually water the plants a minimum of once a week or as necessary to keep the plant in a thriving condition from May 15 until October 15 or for the duration of the Establishment Period.
- D. If the planted areas have an automatic irrigation system that the Contractor is relying upon, it is the responsibility of the Contractor to ensure that the irrigation system is functioning properly.
 - 1. If the Contractor concludes that at any time the irrigation system is not working properly, then they shall notify the Engineer or the Owner so that it may be fixed in a timely manner.
 - 2. However, the Contractor will have to manually water the plants as necessary to keep them in a thriving condition at all times that the irrigation system is not working properly.
- E. Keep planting beds and tree saucers free from weeds to the satisfaction of the Owner. Treat mulch with pre-emergent weed killer.
- F. Keep trees erect. Raise trees that settle below grade to the established elevation. Keep tree wrap and wire in neat condition. Prune dead or broken branches from all trees and shrubs. Fill to the original grade level areas that have settled around trees and shrubs.
- G. Winter protection shall include late fall spraying of all evergreen trees and evergreen shrubs with anti-desiccant, emulsion type agent, at the manufacturer's recommended rate to prevent winter desiccation and late fall watering if required by a dry season.
- H. At the seasons first watering, an Engineer approved organic timed release, balanced fertilizer shall be applied to the ground around the tree at the rate instructed by the manufacturer. In lieu of organic fertilizer, pre-packaged, controlled release fertilizer packets may be used. Use one (1) 2 oz packet of fertilizer per every 1 inch caliper of tree, or one (1) 2 oz packet for every shrub.
- I. During the first and second watering of the growing seasons, the water used for each plant shall be a nitrogen-enriched solution containing available nitrogen at the rate of 8.5 lbs/1000 gallons of water (42 pounds of 20-0-0, or 18 pounds of 45-0-0, fertilizer per 1,000 gallons of water). No fertilizer shall be applied after July 7.
- J. During the establishment period(s) as called for in the Contract Documents, the Contractor shall do all required watering, cultivating, pruning, fertilizing, weeding, and all other work necessary to keep the planted material vigorously growing sound and healthy. Contractor shall repair or replace any guying or bracing which is damaged, destroyed, or broken. Contractor shall spray any plant material which becomes diseased or infested with insects.
- K. Contractor shall repair or replace any trees which are blown over, knocked down, uprooted or otherwise become impaired or defective.
- L. Contractor shall replace any plant material which is not in good physical condition, has more than 20% die back, shows defective growth, disease, signs of insect infestation, or any other signs of impairing defects during the Establishment Periods.
- M. Contractor shall repair or replace any plant material damaged or impaired by wind, rain, snow, ice, sleet, sun, heat, drought, or any other weather related occurrences.
- N. The costs for all labor, material, and equipment necessary to carry out the provisions of this Article shall be included in the Contractor's bid price for the planting of trees unless otherwise indicated in the Proposal. Contractor shall notify the Engineer prior to beginning any work called for under this Article.

- O. At the end of the Establishment Period, unless otherwise determined by the Engineer, the guying material, wrapping material, identification tags, and inspection tags shall be removed and disposed of off the project and the mulch around all the plants shall be replenished to the required depth of 5 - 6 inches.

3.08 ESTABLISHMENT PERIOD

- A. The Establishment Period shall begin on the day of written acceptance of the installation of the trees, shrubs, bulbs, ground cover or other plant material. Each subsequent establishment period shall begin on the same day of the succeeding year(s). The Establishment Period shall be a minimum of one year unless otherwise indicated in the Contract Documents.

3.09 SCHEDULES

- A. The general planting location, type and size of tree or shrub shall be as indicated on the Plans. Any substitutions of plant material or alteration in plant sizes or specifications shall be approved by the Engineer prior to ordering.

3.10 STEEL LANDSCAPE EDGING

- A. Install steel landscape edging where indicated on Drawings, according to manufacturer's recommendations. Anchor with steel stakes spaced approximately 30 inches on-center, driven below top elevation of edging, or at every stake pocket location in landscape edging sections designed and manufactured to receive stakes. Stakes shall be located in solid undisturbed soil, or in soil compacted to 85% of its maximum density.
- B. Install straight sections true to the alignments as indicated, free of waves or bends, using strings as guides. Install curved sections true to the alignments as indicated, free of waves or bends, following marked alignments approved in the field by the Engineer. Engineer shall be given the opportunity to review the layouts.
- C. Set top of edging flush with finish grade. Set top of stake 1/2 inch below top of edging.
- D. Replace edging sections damaged by construction operations.

END OF SECTION 32 90 00

SECTION 32 92 19 SEEDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes seeding complete with earth bed preparation, providing and placing topsoil, preparation and fertilizing topsoil, sowing of seed for lawns and other ground cover, protection of seeded areas, watering of seeded areas, mowing of seeded areas, protection and cleanup.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 89 00 - Site Construction Performance Requirements
- D. Section 31 22 00 - Grading
- E. Section 32 92 23 - Sodding

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with the applicable requirements of the Michigan Seed Law, Act 329, PA of 1965, as amended.
- B. Comply with the applicable requirements of the AOSA Rules for Testing Seeds.
- C. Chemical fertilizer shall be supplied in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Bulk shipments shall be accompanied by an analysis and net weight certification of the shipment.
 - 1. Custom mixed fertilizers shall be accompanied by a certification of the weight of each commercial fertilizer used in the mixture and a guaranteed analysis of each shipment expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P2O5) and total available Potash (K2O) included.

1.04 SOURCE QUALITY CONTROL

- A. A seed mixture proposed for use in the Work shall have been tested for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 REFERENCE STANDARDS

- 1. AOSA RULES - Association of Official Seed Analysts
- 2. ASTM C602: Standard Specification for Agricultural Liming Materials
- 3. ASTM D977: Standard Specification for Emulsified Asphalt
- 4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.06 SUBMITTALS

- A. Submit Seed Producers Certification that seed meets the requirements of these Specifications and conform to the State of Michigan Seed Act referenced above.
- B. Where required, submit test reports for all seed proposed for use in the Work to the Engineer, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.
- C. Contractor shall perform soil tests -1 per designated area - to confirm the fertilizer and lime necessary for the site. Contractor to limit the amount of fertilizer and lime to what is absolutely

necessary to ensure optimal growth.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the Project site in their original, unopened containers. Containers shall be clearly marked showing, name of manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents and date of packaging, where applicable.
- B. Seed shall be delivered to the site in durable bags, tagged or labeled to show date of tests, warranty of purity and germination analysis, name, lot number and net weight of contents.
- C. Commercial fertilizers shall be delivered to the site of the Work in the original unopened bags. Bags shall not exceed 100 lbs net weight each and shall be clearly marked with guaranteed analysis in a conspicuous location on each bag.
- D. Material shall be stored at the Project site, under shelter, off the ground and shall be protected from damage by moisture, temperature, exposure to elements, vandalism or other action which might otherwise impair their use.
- E. Materials proposed for use in the Work shall be handled in a manner that will protect the material and the personnel involved in the Work. Handle seed in a manner which will protect the mixture from contamination or deterioration.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Seeding is limited to the periods between April 20 and June 1, and August 10 to October 10 and after for as long as weather permits preparation of the seed bed without irrigation and the ground is not frozen. With the use of irrigation and/or mulch, seeding can be done from April 20 thru October 1 inclusively.
- B. Comply with the limitations placed on the use of certain soil protection materials because of prevailing temperatures as described in this Section.
- C. Comply with the limitation placed on seeding applications because of wind velocity as described in this Section.

1.09 PROTECTION

- A. Provide suitably approved warning signs and barricades for protection of seeded areas from pedestrian or vehicular traffic. Protect newly seeded areas during the progress of the Work and until completion of the turf establishment period.
- B. Protect adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.10 FINAL ACCEPTANCE

- A. Contractor shall establish a dense cover of seeded grass on all disturbed areas. These areas shall be maintained until final acceptance of the Work by the Engineer. Engineer will inspect the turf to insure that the grass seed is well established, weed free, in a growing and vigorous condition. Areas that do not meet the approval of the Engineer shall be re-seeded at the Contractor's expense.

PART 2 PRODUCTS

2.01 SEED

- A. Seed and seeding mixtures shall be certified, mature, clean, dry, new crop seed products suitable for the specified applications and having the percentages of purity, germination and proportions, by weight, indicated in Table 1.

Table 1 - Seeding Mixtures		
Kind		

	Seeds		Mixture Proportions (%)			
	Purity	Germination	TDS	TUF	TGM	THM
	Kentucky Blue Grass	98%	80%	5	10	10
Perennial Rye Grass	96%	85%	25	20	20	20
Hard Fescue	97%	85%	25	20	30	
Creeping Red Fescue	97%	85%	45	40	40	50
Fults Salt Grass	98%	85%*		10		

- B. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding per Table 2, unless otherwise indicated on the Plans or as designated by the Engineer.

Symbol for Turf Seed Mixture	Soil Type	General Location	Rate of Seeding lbs/ac (kg/ha)
TDS	Dry Sandy to Sand Loam	Rural or Urban	250 lbs/acre
TUF	All Types	Urban Freeway, Blvds, City Streets	250 lbs/acre
TGM	Medium to Heavy	All	250 lbs/acre
THM	Loamy to Heavy	Home and Business Turf	250 lbs/acre

- C. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 MULCHING MATERIAL

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to the Engineer.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to the Engineer.
2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.
3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2 x 3 inch and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber.
4. Blankets shall be produced in the form of a tightly compressed roll 36 ±1 inch wide and approximately 120 feet long. Blanket shall have a fiber net on the outside of the fiber mat.
5. Blanket roll weight, when manufactured, shall average 85 lbs ± 10%.
6. Each roll shall have separator sheets of 40 pound Kraft paper placed at the beginning and at the end of each roll to facilitate unrolling and handling at the job site. The Kraft paper sheet at the end of each roll shall also form a wrapper for the roll.

- C. Netting:
 - 1. Twisted Kraft paper or synthetic fiber, biodegradable woven mesh net material suitable for the application and acceptable to the Engineer.
 - 2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2 x 3 inch.
 - 3. The net shall be furnished in widths of not less than 35 inches.
- D. Proprietary Mulch Material:
 - 1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to the Engineer.

2.03 MULCH ANCHORING MATERIAL

- A. Emulsified Asphalt:
 - 1. ASTM D977, Rapid Setting (R.S. 1 or 2), Medium Setting (M.S. 2 or 2h) or Slow Setting (S.S. 1).
- B. Mulch Anchoring Tool:
 - 1. Suitable unit having a series of flat, notched discs for punching and anchoring mulch in soil, or a regular farm disc weighted and set nearly straight as a substitute.
- C. Latex Base Adhesive:
 - 1. Latex base adhesive mixed with water at a 25 to 1 ratio of water to adhesive with 25 lbs of recycled newsprint as a tracer.
- D. Recycled Newsprint:
 - 1. Mix 7 lbs of newsprint with 7 gallons of water.
- E. Guar Gum:
 - 1. Mix 1 lb of dry adhesive with 26.5 gallons of water with 5 lbs of recycled newsprint as a tracer.

2.04 FERTILIZER

- A. Fertilizer shall be a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. The fertilizer shall contain slow release nitrogen amounting to 75% of the nitrogen available.
- B. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected.
- C. Fertilizer for hydraulic seeding shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the slurry.

2.05 AGRICULTURAL LIMING MATERIALS

- A. Burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells and by-products shall conform to the requirements of ASTM C602.

2.06 WATER

- A. Free of matter harmful to plant growth.

2.07 STAPLES

- A. Wire staples for holding mulching materials in place shall be not less than 6 inches long No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 TOPSOIL

- A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than 1 inch in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

Quality Parameter	Range of Value
Soil pH	5.0 to 7.5
Soluble Salts	500 ppm max
organic content	5 to 30 %
silt content	35% to 50%
clay content	5% to 10%
USDA Soil Classification	Loam or Sandy Loam
deleterious mat'l*	5% max
*rocks, gravel, stones, sticks, roots, sod, etc	

- B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8 inch maximum mesh screen prior to delivery to the Project site.
- C. Engineer shall review source and final screen results prior to release of topsoil.
- D. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer.
- E. Topsoil shall be placed in 3 inch minimum thickness throughout, or as specified in the Plans or Specifications.
- F. Contractor shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at Contractor's expense.

2.09 IMPROVED TOPSOIL

- A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor.

2.10 COMPOST

- A. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable and shall be in compliance with all federal and state laws. The mixture shall be free of objectionable odors, glass, plastic, metal, and other contaminants; as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- B. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.
- C. The composition of the compost shall be within the following range of values:

Quality Parameter	Range of Value
Soil pH	6 to 7.5
Soluble Salts	2 to 5 mmho/cm
Carbon/Nitrogen Ratio	13 to 20 parts Carbon to 1 part Nitrogen
Inerts	< 1%
Organic matter	35 to 55 %
Nitrogen	1 to 2 %

Phosphorus	0.2 to 0.8 %
Potassium	0.5 to 1.5 %
Unit Weight	535 to 775 Kg/m ³
Moisture Content	40 to 50 %
Particle Size	< 20 mm maximum
Water Holding Capacity	> 100%
Heavy Metals	None

1. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.
2. Temperature: The compost material must have undergone the procedure to significantly reduce the pathogen level as referenced in EPA 40 CFR, Part 257 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations. The temperature must be maintained at 40° C for 5 days with a temperature exceeding 55°C for at least 4 hours.
3. Pathogens and Trace Elements: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.
4. To comply with the annual filing requirements, the supplier of the compost shall certify that the compost meets EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.
5. A data sheet shall accompany the certification.
 - a. The data sheet shall show the following:
 - b. Standard compost total nutrient test results, including N, P, K, Ca, Mg, Mn, Cu, Fe total carbon, pH, as provided by an acceptable testing laboratory
 - c. Organic content
6. Inert contamination
 - a. Soluble salts
 - b. Carbon/Nitrogen ratio
 - c. Proof of maturity/stability acceptable to the Michigan Department of Agriculture

PART 3 EXECUTION

2.01 PREPARATION OF SUBGRADE

- A. Complete all fine grading within the areas to be covered with topsoil necessary to bring the surface of the proposed subgrade to the elevations indicated on the Plans and parallel to the proposed finished grade.
- B. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of 2 inch to facilitate making a bond between the subsoil and the topsoil.

2.02 PREPARATION OF SOIL

- A. After the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up, the existing soil shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least 4 inches.
- B. Lumps and clods shall be thoroughly broken. When the area to be seeded has been prepared and covered with a layer of topsoil as specified under Part 3 of this Section, this operation will not be required.

2.03 PREPARATION OF MULCH MATERIAL

- A. When seed is to be sown through mulch which has been in place for a period of more than two (2) weeks or which is being held in place by a surface-applied coating of asphalt emulsion or other adhesive, the mulched area shall be prepared for seeding by discing, a spike-toothed harrow, or by other means acceptable to the Engineer.

2.04 PLACING AND SPREADING TOPSOIL

- A. Topsoil shall be placed and spread over the area designated on the Plans, or as determined by the Engineer, to a depth of 4 inches or to such depth as specified on the plans.
- B. Topsoil shall be placed to a depth sufficiently greater than that shown on the Plans or specified so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations shown on the Plans.
- C. Spreading of topsoil shall be completed in such a manner that seeding as specified can proceed without additional moving of topsoil. Topsoil furnished and placed shall be considered incidental to seeding unless otherwise specified in the Proposal.
- D. After topsoil is spread, large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by the Contractor.

2.05 FERTILIZING

- A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 660 lbs per acre of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs per acre of chemical nutrient.
- B. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1 inch.
- C. Where hydraulic seeders are used for sowing seed, one half the recommended rate of fertilizer may be spread in combination with such sowing with the balance incorporated into the soil prior to seeding. In all other cases, fertilizer shall be incorporated into the soil before any seeding is started.

2.06 SEEDING

- A. Seed of the kind required shall be sown at the rate as specified in Table 2. Seed shall be sown in the presence of an inspector by mechanical spreader, hydraulic seeder or broadcasting. The broadcasting method shall be used for sowing seed only in areas inaccessible to mechanical spreading equipment. Seeding during winds above 15 mph shall not be permitted.
- B. Prior to placing seed materials, water topsoil to a depth of 4 inches at least 48 hours prior to seeding operations to obtain a loose friable seed bed. Time and depth of watering operations shall be varied at the direction of the Engineer for varying conditions at the site of the Work.
- C. Broadcasting methods for sowing seed materials shall be accomplished by spreading one-half of the specified amount of seed in one direction and then broadcasting the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method.
- D. Rate of broadcast shall be as specified herein or per the written recommendations of the Producer of the seed material used.
- E. Roll seeded area with roller weighing a maximum of 150 lbs per foot of width.
- F. Hydroseeding shall be performed using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer and suitable mulch material as approved by the Engineer. Seed slurry mixture shall be distributed uniformly at a rate approved by the Engineer for the seeding materials and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs per acre.

2.07 MULCHING

- A. Mulching shall consist of placing a mulch material on areas that have been or are to be seeded. Mulch shall be placed in a loose enough condition so as to allow penetration of sunlight and circulation of air, but thick enough to shade the ground, reduce the rate of water evaporation and prevent erosion by wind or water. Mulch shall be secured with suitably acceptable anchoring material.
- B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:
 - 1. Small grain wheat straw or grass hay applied at 1-1/2 to 2 tons per acre with disc packer, asphalt or netting tie-down.
 - 2. Wood chips applied at 6 to 9 tons per acre.
 - 3. Asphalt emulsion alone at 600 to 1200 gallons per acre. (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)
- C. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:
 - 1. Straw or grass hay applied at 1-1/2 to 2 tons per acre, anchored with asphalt or netting tie-down.
 - 2. Asphalt emulsion alone at 600 to 1200 gallons per acre. (Limited to areas where tracking is not a problem.)
- D. Anchor straw or hay mulch by the methods as specified herein.
- E. Wood chips will not need anchoring when used on workable slopes.
- F. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with the manufacturer's printed instructions for the material used.
- G. Punch and anchor mulch material into soil using mulch anchoring tool. Soil must be moist, free of stones and loose enough to permit disc penetration to a depth of 3 inches.
- H. Blow on liquid or emulsified asphalt materials with the straw or hay mulch or spray or sprinkle asphalt tie-down materials immediately after mulch is spread.
 - 1. Apply emulsified asphalt at 200 gal per acre.
 - 2. Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water.
 - 3. Apply liquid (cut back) asphalt at approximately 485 gal per acre.

2.08 CONVERSION FROM SOIL PROTECTION TO PERMANENT VEGETATION

- A. Following straw or hay mulching, grass seeding can be made in early spring by broadcasting seed directly into the mulch. Fertilizer or lime, where needed, should be incorporated into the soil before mulching.
- B. Asphalt emulsion alone can be readily incorporated into the soil by ordinary tillage before seeding.
- C. Wood chip mulch may be removed before seeding or incorporated deeply into the soil. If wood chips are incorporated into the soil, the addition of extra nitrogen fertilizer to the soil will be required to provide nitrogen in the new seeding.
- D. Fiberglass mulch shall be removed before seeding because of its permanence. Care shall be taken to prevent fiberglass filaments left in place from becoming entwined or wound around shafts of power mowers or other power equipment.

- E. Acceptable proprietary netting and erosion control materials shall be disposed of in accordance with the manufacturer's printed instructions for the material used prior to any seeding operations.

2.09 TURF ESTABLISHMENT

- A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces.
- B. Contractor shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.
- C. The seeded areas shall be mowed with mowing equipment acceptable to the Engineer to a height of 2 inches whenever the average height of grass establishment reaches four 4 inches. When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass.
- D. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed, or in the case of rank growths, shall be uprooted, raked and legally disposed of from the area.
- E. Reseed and mulch areas larger than 4 sq inches not having a dense, uniform, vigorous stand of grass acceptable to the Engineer.
- F. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to the Engineer. The minimum period shall be 30 days.
- G. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by the Contractor, the Owner may reseed the defective areas and all costs will be deducted from the Contractor's payments.

END OF SECTION 32 92 19

SECTION 33 05 13 MANHOLES AND STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes Monolithic concrete manholes with lid frame, covers, anchorage and accessories, as well as modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 04 05 11 - Mortaring and Grouting
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 31 23 16 - Structural Excavation and Backfill
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 33 - Trenching and Backfilling
- G. Section 31 70 00 - Tunneling and Mining

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ACI - American Concrete Institute
 - 2. ASTM ASTM International

1.05 SUBMITTALS

- A. Shop Drawings: Indicate manhole and vault locations, elevations, piping, conduit, and sizes and elevations of penetrations.
- B. Product Data: Provide manufacturer's data and installation instructions for precast manhole and vault sections, joint connections, water stops, gaskets, corrosion protection system, flexible pipe joints, chimney seals, manhole and vault castings, and other pertinent information for precast and cast-in-place manholes and vaults.
- C. Manufacturers Certification: Certify that all products furnished meet or exceed the specified requirements, including worst case depth loadings for this project.
- D. Calculations: Submit calculations for review sealed and signed by a registered Professional Structural Engineer in the State of Michigan. Include structural, depth of bury, buoyancy, and all other information necessary to determine adequacy of the item.
- E. Results of manhole and vault leakage and vacuum tests.

1.06 CLOSEOUT SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 77 00 - Closeout Procedures:
 - 1. Manufacturer's field reports.
- B. Project record documents:
 - a. Accurately record actual locations of manholes, connections, and invert elevations.

- b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 DESIGN REQUIREMENTS

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C890 "Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures." Provide lifting inserts designed for four times the anticipated lifting load. Grout inserts in place when complete.
- C. Design of Joints for Precast Structures: Gaskets in accordance with ASTM C923/C923M "Standard Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals" with maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.
- D. Use precast concrete manholes or vaults designed by the precast manufacturer's registered Professional Structural Engineer, licensed in the State of Michigan in accordance with the Contract Documents. Furnish precast concrete manholes, however, conforming to the following minimum design requirements in addition to the ASTM standards referenced in this Section:
- E. The top slab of all manholes or vaults shall be designed for an H-20 truck loading.
- F. Minimum manhole or vault base slab thickness shall be eight (8) inches up to twenty five (25) feet depth and twelve (12) inches over twenty five (25) feet depth.
- G. Manholes and vaults shall resist buoyancy due to flooding with a high ground water table elevation at the top of the precast concrete structure. The factor of safety against buoyancy shall be 1.20. Buoyancy calculations shall be provided with the submittal.
- H. Walls backfilled with cohesive soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height for walls below the ground water table.
- I. Walls backfilled with granular soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height for walls below the ground water table.
- J. Design walls for surcharge load from adjacent structures or minimum 300 psf surcharge, whichever is greater.
- K. Loads associated with testing manholes and vaults for water-tightness by vacuum testing in accordance with this Section.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes, vaults and drainage structures.
- B. Store precast concrete manholes, vaults and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

1.09 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.01 VALVE VAULTS, MANHOLES, FRAMES, AND COVERS

- A. Valve Vaults and Manhole Manufacturers:

1. Northern Concrete Pipe, Inc.
 2. Mack Industries
 3. Engineer-approved equal
- B. Manhole and Vault Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- C. Benching:
1. Provide full height and poured-in-place benching.
 2. Use non-shrink grout as specified in Section 04 0511.
 3. Appropriate granular filler may be used, subject to the approval of Engineer.
- D. Watertight Cover and Frame Manufacturers:
1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
 2. Neenah Foundry Co. - Model R-1916-F.
 3. Engineer approved equal
- E. Cover and Frame Product Description:
1. ASTM A48/A48M, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.02 STORM SEWER MANHOLES, FRAMES, AND COVERS

- A. Storm Sewer Manhole Manufacturers:
1. Northern Concrete Pipe, Inc.
 2. Mack Industries
 3. Engineer approved equal
- B. Cover and Frame Manufacturers:
1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
 2. Neenah Foundry Co. - Model R-1916-F.
 3. Engineer approved equal.
- C. Cover and Frame Product Description:
1. ASTM A48/A48M, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.03 OTHER MANHOLE AND VAULT COMPONENTS

- A. Steps: Per Contract Drawings.
- B. Base Slab:
1. Per Contract Drawings, cast-in-place concrete of type specified in Section 03 30 00 - Cast-in-Place Concrete or integral, monolithically cast precast concrete or standard tee pipe base sections.
- C. Pipe to Manhole/vault Connection:

1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM C923/C923M , to connect pipes to the manhole. Use an A-Lock press wedge, Kor-n-Seal, or Res-Seal connector. No substitutions will be allowed. Non-shrink grout may only be used per the Contract Drawings or with written permission of Engineer.

D. Manhole and Vault Chimney Seals:

1. As shown on the Contract Drawings, seal the outside of the manhole or vault cone or riser section to the grade rings and manhole and vault frame with a heat shrinkable wrap or a compressible rubber seal with 304 stainless steel compression bands.

E. Manufacturers:

1. Canusa - WrapidSeal Manhole Encapsulation System
2. Cretex Specialty Products - External Manhole Seal
3. Engineer approved equal

2.04 CONFIGURATION

- A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female gasketed joints; flexible rubber joint to receive pipe.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated on Contract Drawings and as required for construction.
- D. Design Depth: As indicated on Contract Drawings and as required for construction.
- E. Clear Lid Opening: As indicated on Contract Drawings and as required for construction.
- F. Pipe Entry: Provide openings as indicated on Contract Drawings and as required for construction.
- G. Steps: As indicated on Contract Drawings and required by applicable safety code.

2.05 BEDDING AND COVER MATERIALS

- A. Structure and Pipe Bedding: Fill Type A1, A2 or A5 as specified in Section 31 23 33 - Trenching and Backfilling and on the Contract Drawings.
- B. Topsoil Fill Type: S3 or S4 as specified in Section 31 23 33 and on the Contract Drawings.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1 or S2, as specified in Section 31 23 33 and on the Contract Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes or vault is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.
- D. Prepare manhole or vault for installation of chimney seals per manufacturer's instructions.

3.03 INSTALLATION

A. Excavation and Backfill:

1. Excavate for manholes, vaults and drainage structures in accordance with Section 31 23 16 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes, vaults or drainage structures in dry trench.
3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.
4. Placement and compaction of surrounding backfill material shall be accomplished to provide sufficient and equal side pressure on the manhole or vault.
5. Backfill excavations for manholes, vaults and drainage structures in accordance with Section 31 23 16.
6. Form and place manhole cylinder or vault wall plumb and level, to correct dimensions and elevations.
7. Connect pipe with flexible rubber joints as shown on the Contract Drawings.
8. Set cover frames and covers level without tipping, to correct elevations.
9. Install chimney seals per manufacturer's instructions and Contract Drawings.
10. Coordinate with other sections of Work to provide correct size, shape, elevation, and location.
11. Use manufacturer's recommended method, procedure and equipment for handling, installing, and connecting the manholes or vaults.

3.04 STANDARD PRECAST STRUCTURE INSTALLATION

- A. Prepare granular bedding as shown on Drawings, to receive integral, monolithically cast base slab as specified.
- B. Lift precast structures at lifting points designated by manufacturer. Grout all lifting holes when structure is in place.
- C. When lowering manholes, vaults and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- D. Set precast structures bearing firmly and fully on granular bedding, compacted in accordance with provisions of Section 31 23 16 or on other support system shown on Contract Drawings.
- E. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- F. Remove foreign materials from joint surfaces and verify gaskets are installed properly.
- G. Maintain alignment between sections by using guide devices affixed to lower section.
- H. Verify manholes, vaults and drainage structures installed satisfy required alignment and grade.
- I. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Connect pipe to manhole or vault with a flexible rubber joint as specified. Fill annular space with mortar.
- J. Cut pipe to finish flush with interior of structure.
- K. Shape inverts through manhole or vault as shown on Contract Drawings. Provide cast-in-place full height benching. Trowel smooth and slope to drain per Contract Drawings.

3.05 CASTINGS INSTALLATION

- A. Set frames using a precast concrete grade ring with butyl rope to seal joint. Use grade ring sizes per Contract Drawings
- B. Unless Contract Drawings indicate otherwise, set frame and cover 6 inch above finished grade for manholes, vaults and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
- C. Set frame and cover flush with ground surface for manholes, vaults and other structures located within paved areas.

3.06 LEAKAGE TESTING FOR MANHOLES AND VAULTS

- A. After completion of manhole or vault construction, inspect all manholes for leakage and repair all visible leaks.
- B. After repairing all leaks, test manholes and vaults for water-tightness using vacuum testing procedure as follows:
- C. Temporarily plug the influent and effluent lines with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for the pressure required for the test. Place plugs a minimum of 6 inches outside the manhole or vault walls. Brace inverts to prevent lines from being dislodged.
- D. Install vacuum tester head assembly at the top access point of the manhole or vault and adjust for a proper seal. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure. Do not over-inflate.
- E. Evacuate manhole or vault with vacuum pump to 10-inches of mercury (Hg). Disconnect the pump and monitor vacuum for the time period specified in the following table (Use equivalent volume for testing vaults):

Depth (feet)	48" Dia. MH	60" Dia. MH	72" Dia. MH	96" Dia. MH
4	30	30	30	30
8	30	30	32	38
12	30	39	48	57
16	40	52	64	76
20	50	65	80	95
24	60	78	96	114
+2	+5	+6.5	+8	+9.5

- F. If the drop in vacuum exceeds 1-inch of mercury (Hg) over the specified time period, locate the leaks and complete repairs necessary to seal the manhole or vault. Repeat the test until acceptable results are obtained.

3.07 FIELD QUALITY CONTROL

- A. Test concrete in accordance with Section 03 30 00.
- B. Vertical Adjustment of Existing Manhole and Drainage Structures:
 1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.
 2. Reset existing frames, grates, and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
 3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated in the Contract Drawings.

4. Clean and apply sand-cement-bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 30 00.

END OF SECTION 33 05 13

SECTION 33 05 23.13
UTILITY HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1 GENERAL**1.01 SCOPE OF WORK**

- A. The work specified in this section consists of furnishing and installing underground utilities using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring. This work will include services, equipment, materials, and labor for the complete and proper installation; testing; restoration of underground utilities; environmental protection; and restoration.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 23 16 - Structural Excavation and Backfill
- D. Section 31 23 19 - Dewatering
- E. Section 31 23 33 - Trenching and Backfilling
- F. Section 33 14 00 - Water Utility Distribution Piping
- G. Section 33 30 00 - Sanitary Utility Sewerage Piping
- H. Section 33 34 00 - Sanitary Utility Force Mains

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- B. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- C. ASTM C139 - Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
- D. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- E. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
- F. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
- G. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- H. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- I. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
- J. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
- K. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- L. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- M. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

- N. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
- O. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)
- P. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
- Q. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- R. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
- S. AWWA C153/A21.53 - Ductile-Iron Compact Fittings
- T. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
- U. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- V. AWWA C651 - Disinfecting Water Mains
- W. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
- X. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in. (350 mm through 1,200 mm), for Water Transmission and Distribution
- Y. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
- Z. NSF 14 - Plastics Piping System Components and Related Materials
- AA. Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 SUBMITTALS

- A. Prior to beginning Work, Contractor will prepare and submit to the Engineer for review, copies of a report of schedules, calculations, procedures and any supplemental subsurface soil condition investigations performed along the path of the proposed crossing. Number of copies of the report shall be as specified in Section. The report will summarize the subsurface conditions that are known to the Contractor and that Contractor's proposed crossing procedure is based upon factual, best available information. If the subsurface conditions are known to the Contractor by previous work or geotechnical studies done in the immediate area, the information shall be recorded in the report along with any additional geotechnical studies performed by the Contractor. The report shall include the following:
 - 1. Subsurface Information:
 - a. Record in the report subsurface conditions known to the Contractor by previous work or prior geotechnical studies performed in the immediate project area.
 - b. Boring information obtained by Owner, if any, is listed in the Supplementary Conditions section of these Specifications.
 - c. Additional borings performed by the Contractor and analysis of soils along the path of the proposed crossing. Contractor will be responsible for obtaining and including in the bid price the cost of any additional borings along the pipe alignment which may be necessary to design the proposed directionally drilled crossing.
 - d. At a minimum any supplemental borings performed by the Contractor will include standard classification of soils, standard penetration tests, split spoon sampling and sieve analysis. Test borings will be performed to a minimum depth of ten (10) feet below the proposed pipe invert unless rock is encountered in which case test borings shall penetrate at least two feet into the rock.

2. Drilling Equipment and Methods:
 - a. Submit information on equipment and written procedure with working drawings describing in detail the proposed boring method and the entire operation to be used. This shall include, but not be limited to, entry and exit pits; settlement pit; size, capacity and arrangement of drilling and pulling equipment; layout of carrier pipe; details and spacing of pipe rollers; type of current head; method of monitoring and controlling line and grade; method of detection of surface movement; and layout of any proposed construction staging areas.
 - b. In addition, submit for approval nameplate data for the drilling equipment, mobile spoils removal unit, and Material Safety Data Sheets (MSDS) information for the drilling slurry compounds. This must be submitted and reviewed by Engineer before work can proceed.
3. Piping:
 - a. Submit shop drawings showing the pipe lengths, design details, joint details, etc. for Engineer's review. Submittals shall include, but are not limited to, the following:
 - 1) Welding or fusion procedures to be used in fabrication of the different pipe materials and installation methods.
 - 2) Certified records for hydrostatic testing of all pipe materials to be used.
 - 3) An affidavit stating that all pipe materials furnished under this section have been manufactured in the United States and comply with applicable provisions of referenced AWWA standards.
4. Proposed Alignment:
 - a. Submit a graph in plan and profile plotting the pilot drilling hole alignment to Engineer for review, including entry/exit angles and radius of curvature. After completion of the crossing, submit a final pipe alignment.
5. Schedule:
 - a. Time schedule for completing the directional drilling, including any delays due to anticipated soil conditions.
6. Calculations:
 - a. Submit detailed design calculations for several representative loading conditions for the proposed crossing. If requested by Engineer, submit calculations to support the design of any particular location of pipe anywhere along the length of the crossing at no additional cost to Owner.
 - b. Design calculations shall be presented in a neat, readable format, with all figures, values and units included to facilitate ease of verification.
 - c. Calculations shall be submitted to demonstrate that the pipe thickness design is sufficient to meet design criteria specified.
 - d. Calculations shall address the following loading conditions:
 - 1) Pre-installation: Hoop and longitudinal stress during hydrostatic test; spanning stress with pipe full of water and supported on installation rollers, and maximum roller/support spacing.
 - 2) Installation/Post-Installation: Longitudinal stress from pulling force; longitudinal curvature stress at point of entry and in final position; external pressure from drilling fluid, overburden, and loads from the obstacle being crossed.
 - 3) Post-Installation/In-Service: Hoop and longitudinal stress during hydrostatic test; internal working and surge pressure; buckling with internal vacuum.

- e. Perform and submit to Engineer fluids pressure versus overburden strength calculations. These calculations will be performed to determine minimum acceptable cover requirements and prevent drilling fluids from breakout to the ground surface.
- f. Calculations shall bear the seal of a Registered Professional Engineer. Licensure in the State in which the work is being performed is required.

B. Approval:

- 1. Prior to beginning directional drilling operations, submit copies of permits and inspection records obtained from state and local authorities having jurisdiction as described under Part 1 of this Section.
- 2. Details and design calculations shall be submitted and approved well in advance of the drilling operation to prevent delays in work. Final layout work, including grades, shall be the Contractor's responsibility.

1.05 QUALITY ASSURANCE

- A. Contractor will be responsible for the complete design of all methods used for directional boring including the implementation of materials, tools, labor, and equipment proposed for use in the Work. Requirements set forth in this document specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this specification, will in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.
- B. Pipe and appurtenances of similar type and material shall be furnished by a single manufacturer.
- C. HDD operations will be carried out under the constant direction of a drilling supervisor who will remain on site and be in responsible charge throughout the drilling operation.
- D. Requirements of Regulatory Agencies:
 - 1. Federal, State, and Local Regulations:
 - a. Conform to the requirements of all federal, state, and local regulatory agencies having jurisdiction.
 - 2. Permits and Inspections:
 - a. Where applicable, obtain and pay for permits and inspections for pipe directional boring operations as required by PA 451, State of Michigan, 1994, and government and private agencies having jurisdiction. No additional compensation will be allowed because of the Contractor's failure to obtain and pay for such permits and inspections. Be aware of and conform with Owner-obtained permits.
 - 3. Occupation Health and Safety Requirements:
 - a. Conform to the requirements of:
 - 1) Michigan State Department of Labor, Construction Safety Standards Commission Construction Standard, Part 14; and
 - 2) Tunnels, Shafts, Caissons and Cofferdams, and the Michigan State Department of Public Health, Occupational Health Standards Commission, Occupational Health Standards, Part 2.

1.06 QUALIFICATIONS

- A. Contractor will have actively engaged in the installation of pipe using directional drilling for a minimum of 7 years' and have installed a minimum of 35,000 feet.

- B. Field supervisory personnel employed by the Contractor will have at least 7 years' experience in the performance of the work and tasks as stated in the Contract Documents.
- C. Equipment operators shall be trained to operate the specific HDD equipment for this project and will have at least 3 years' experience in directional drilling obtained within the last 5 years.

1.07 JOB CONDITIONS

- A. Contours, topography and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct but are not guaranteed to be absolutely so and are presented only as an approximation. It is the Contractor's responsibility to verify all elevations required to successfully complete the crossing.
- B. Where soil conditions or obstructions are encountered that prevent the completion of pipe directional boring Work started or in progress, develop and submit to the Engineer for review alternate methods of performing the Work as described under Part 1 of this Section. Perform no additional Work until completion of review by the Engineer of the alternate method proposed.
- C. Protection:
 - 1. Provide structures, safety equipment and professional services required to provide for the health and safety of the public and of personnel involved in pipe directional boring Work in accordance with the requirements of the regulatory agencies having jurisdiction.
 - 2. Take measures necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, drains, sewers, utilities, structures, and appurtenances from damage due to pipe directional boring Work. Responsibility and payment for correction of such damage will be the sole responsibility of Contractor.
 - 3. Pothole existing underground utilities including sanitary sewers, sanitary leads, storm sewers, water mains, water services, gas mains, gas services, telephone lines, cable television lines, oil lines, etc. to ascertain the clearance between the existing utilities and the pipe to be bored and to ensure the pipe boring will not adversely affect the existing utilities. Potholing is required and will not be paid for separately unless otherwise specified in the Proposal.

1.08 COORDINATION OF WORK

- A. Coordinate connections to existing pipelines that require shutdown of existing facilities. Method of connection and designated times are to cause the least amount of disruption to customers. The cost for connections is to be included in the Contract Price. No contract price adjustment will be allowed for overtime, premium time, or other related costs.

PART 2 PRODUCTS

2.01 GENERAL

- A. Directional drilling equipment will consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. Equipment will be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.02 DRILLING RIG

- A. Directional drilling machine will consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine will be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system will be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system will be free of leaks. Rig will have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig will be grounded during

drilling and pull-back operations.

2.03 DRILLING SYSTEM

- A. The drill head will be steerable by changing its rotation and will provide the necessary cutting surfaces and drilling fluid jets.
- B. Mud motors will be of adequate power to turn the required drilling tools.
- C. Drilling system will be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.04 GUIDANCE SYSTEM

- A. Magnetic Guidance System (MGS) or proven gyroscopic system will be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance will be capable of tracking at depths up to one hundred feet and in any soil condition, including hard rock.
- B. The MGS will enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system will be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 18-inches horizontally.
- C. The MGS will be of a proven type and will be operated by personnel trained and experienced with this system. MGS operator will be aware of magnetic anomalies on the surface of the drill path and will consider such influences in the operation of the guidance system if using a magnetic system.

2.05 DRILLING FLUID (MUD) SYSTEM

- A. A self-contained, closed, drilling fluid mixing system will be of sufficient size to mix and deliver drilling fluid. Mixing system will continually agitate the drilling fluid during drilling operations.
- B. Drilling Fluids:
 - 1. Drilling fluid will be composed of clean water and appropriate additives including bentonite clay. Water will be from an authorized source with a pH of 8.5 to 10. Water of a lower pH or with excessive calcium will be treated with the appropriate amount of sodium carbonate or equal. The water and additives will be mixed thoroughly and be absent of clumps or clods. No potentially hazardous material may be used in drilling fluid.
 - 2. The mud pumping system will be of an adequate capacity for delivering the drilling fluid at a constant pressure suitable for the Work. The delivery system will have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe will be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations will be contained and conveyed to the drilling fluid recycling system. A berm, a minimum of 12-inches high, will be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills. Pumps and or vacuum truck(s) of sufficient size will be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.
 - 3. The drilling fluid recycling system will separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

2.06 OTHER EQUIPMENT

- A. Pipe rollers will be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers will be used to prevent excess sagging of pipe.

2.07 PRESSURE PIPE AND FITTINGS FOR HORIZONTAL DIRECTIONAL DRILLING

A. Ductile Iron Pipe (DIP):

1. Ductile Iron Pipe for horizontal directional drilling will be restrained and boltless flexible joint pipe that conforms to AWWA C111/A21.11 and AWWA C151/A21.51. Gaskets will be fluoroelastomer that are highly resistant to hydrocarbon, chemical, fuel as well as oil deterioration, by Viton or approved equal.
 - a. Gripping, push-on joint gaskets that utilize stainless-steel teeth locking segments are not acceptable.
2. Ductile iron cement lined pipe will meet the requirements of Pressure Class 350 pipe for sizes 12-inch and smaller, and pressure Class 250 for all pipe 16-inch and larger, unless otherwise indicated on the Drawings.
3. The exterior of the pipe will be coated with a bituminous coating of coal-tar or asphalt base at least one mil thick. Pipe shall have a cement lined interior in accordance with AWWA C104/A21.4.
4. Ductile iron pipe will have a minimum bursting tensile strength of 21,000 psi modulus of rupture. Thickness design is based on Laying Condition "A" or "Type I," unless otherwise noted. The pipe thickness classification shall be Class 50.
5. The manufacturer must furnish in writing that the pipe specified is suitable for directional drilling applications.
6. Approved manufacturers include:
 - a. American Cast Iron Pipe Company
 - b. US Pipe & Foundry Company
 - c. Engineer approved equal.

B. Polyvinyl Chloride (PVC) Pipe:

1. Pipe and couplings will conform to AWWA C900 or AWWA C905, as appropriate for the size of the watermain indicated on the plans. Pipe materials and joints will be rated for 200 psi or greater.
2. Pipe and couplings will be made from unplasticized PVC compounds having a minimum cell classification of 12454-B, as defined in ASTM D1784. Pipe, couplings, and locking splines will be completely non-metallic. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4 degrees Fahrenheit, in accordance with the requirements of ASTM D2837.
3. Pipe will be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360 degrees restraint with evenly distributed loading.
4. Couplings will be designed for use at or above the rated pressures of the pipe with which they are utilized and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.
5. Approved manufacturer includes PVC restrained-joint pipe from CertainTeed Corporation and any other manufacturer approved by the Engineer.

C. High-density polyethylene (HDPE):

1. HDPE pipe will meet the requirements for Type III, Grade P345 Polyethylene Material as defined in ASTM D1248 (PE 3408). The minimum pressure class/SDR rating acceptable will be Class 200/SDR 11. The pipe shall be DIPS and shall have an interior diameter no

less than the piping that it is connected to.

2. Joints will be of a heat fusion joining system. Pipe and fittings will be thermal butt fusion, saddle fusion, or socket fusion in accordance with manufacturer recommended procedures and ASTM D2161. At the point of fusion, the outside diameter and minimum wall thickness of the fitting will match the outside diameter and minimum wall thickness specifications of ASTM D1248 for the same size pipe.
3. Joining of the pipes and fittings will be performed in accordance with ASTM D2774. Depending upon the installation requirements and site location, joining will be performed within or outside the excavation. Joints of the pipe sections will be smooth on the inside and internal projection beads will not be greater than 3/16 inch.
 - a. The tensile strength at yield of the butt-fusion joints will not be less than the pipe. A specimen of the pipe cut across the butt-fusion joints will be tested in accordance with ASTM D638.
4. Fittings:
 - a. Fitting will be provided as indicated on the plans. HDPE fittings will be of the same material and class as the pipe and will be manufactured by the manufacturer of the pipe. HDPE elbows, tees, and wyes will be manufactured by mitered fabrication. The manufacturer will have a written specification for standard mitered fittings, which establishes Quality Control criteria and tolerances. The manufacturer may be required to demonstrate its ability to produce product required by this specification.
 - b. Mechanical joint (MJ) anchor fittings (Adapter) will be used to transition from ductile iron to HDPE and from HDPE to PVC. The fitting will be stronger than the pipe in that when it is subjected to tensile stress the pipe will pull apart before the fitting will pull out and the pipe will blow before the fitting will rupture under pressure.
 - 1) The MJ Adapter will have a pre-installed stainless steel stiffener, in accordance with Plastic Pipe Institute (PPI) recommendations, to neutralize point-loading, ACQ, creep and loss of gasket seal due to diameter contraction. The stiffener will be engineered sufficiently thick to avoid radial buckling due to gasket pressure.
 - 2) The MJ Adapter requires longer bolts and will be sold with the modified longer bolt kit to avoid construction crew delays or improper installation with too short bolts.
 - c. Fittings will be rated according to the manufacturer's written specifications, and clearly labeled on the fittings as such.
 - d. Installation will conform to the requirements of the manufacturer, the AWWA Standard, and as indicated on the plans and specified herein.
5. Marking and Certification:
 - a. Each length of HDPE sanitary sewer will be clearly marked with the Manufacturer's Name, Tradename or Trademark, Nominal pipe size, Pipe Stiffness, Production Code/Extrusion Code, Material Cell Class Designation and ASTM number.
 - b. The pipe manufacturer will provide certification that the stress regression testing has been performed on the specific product. The said certification will include a stress live curve per ASTM D2837.
 - c. The stress regression testing will have been performed in accordance with ASTM D2837, and the manufacturer will provide a product supplying a minimum Hydrostatic Design Basis of 1,600 psi as determined by ASTM D2837. This certification will also state that the pipe was manufactured from one specific resin in compliance with these specifications. The certificate will state the specific resin used and its source.

2.08 THICKNESS DESIGN

- A. The following design criteria shall be used in calculating pipe thickness for HDPE, steel or ductile iron pipe:
1. Working Pressure: _____ psi
 2. Test Pressure: _____ psi
 3. Surge Pressure: Working pressure + 100 psi
 4. Dead Load: Earth cover as shown on Drawings, but not less than 15 feet.
 5. Buckling Design: Considering dead load, internal vacuum, H2O Wheel Loading and a hydrostatic load over top of pipe to grade.
 6. Maximum Allowable: 3%
 7. Horizontal Deflection Radius of Curvature: 90% of Actual Design Radius
 8. Downhole Friction Factor: 1.0
 9. Factor of Safety for Drilling Fluid Density: 1.5
- B. The stresses in the pipe will be calculated for the pre-installation, installation, and post installation loading conditions as specified in Part 1 of this Section. Thickness will be selected so that stresses do not exceed the following under any of the loading conditions.
1. Conditions except internal surge pressure: 50% of minimum yield point
 2. Internal surge pressure condition: 75% of minimum yield point
- C. Contractor will increase the minimum "in-service" thickness as necessary to support the expected stresses and loadings which are expected to be encountered during the installation of the HDD pipeline. The final selected thickness shall be supported by calculations as required herein. No additional cost shall be considered by Engineer for pipe thickness greater than the specified minimum "in-service" thickness.

2.09 DEVIATIONS

- A. Should the Contractor choose to submit a bid using material that does not meet all the requirements of these specifications, include a description of the deviation with data showing the magnitude of the deviation. Acceptance of such deviations to these specifications shall be subject to the review and approval of the Owner before a contract can be awarded.

2.10 OTHER MATERIALS

- A. Concrete:
1. Concrete will conform to MDOT Section 1004, use Grade 3000 concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.
- B. Concrete Reinforcement:
1. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.
- C. Concrete Block:
1. Block cast from Portland cement sand, gravel or crushed stone, of uniform and compact texture, free from cracks or warpage and with square corners conforming to ASTM C139.

PART 3 EXECUTION

3.01 VERIFICATION

- A. Prior to performing directional boring operations, verify grades, lines and levels to which the new Work is to be installed. Directional boring Work that requires adjustment of grades, lines and levels after Work has started will be at the expense of the Contractor performing the Work.
- B. Prior to beginning directional boring Work, contact the local one call system for locating buried utilities (811). Also contact the local municipalities who may not be part of the one call system, to mark their buried facilities. Excavate or pothole to verify in the field the location and elevation of existing active utilities and structures scheduled to remain and requiring protection from damage because of the Work. Existing utilities will include gas mains and services, water mains and services, sanitary sewers and house leads, oil lines, telephone lines and services, cable television lines and services, electric lines and services, and any other similar buried utilities.
- C. Plan and plot a bore path and submit bore path to Engineer in accordance with Part 1 of this Section. Notify the Engineer where existing utilities directly affect the progress or performance of the Work. Contractor is responsible for excavation or potholing necessary to determine the elevation of existing utilities that cross the proposed water main at no additional cost to the Project unless otherwise indicated in the Proposal.

3.02 PREPARATION

- A. Layout of the Work:
 - 1. Stake, mark, and layout the Work using suitable stakes and markers to facilitate verification of grades, lines, levels, and locations of the Work to be performed in a manner acceptable to the Engineer.
 - 2. From reference points established by the Engineer on the surface of the ground, carry line and grade down to the bottom of any shafts or boring pits. Perform the Work to the line and grades established using methods acceptable to the Engineer. Protect such reference points throughout the progress of the Work.
 - 3. If utilities of unknown depth or other obstructions require grade or alignment deviations from the Drawings, the grade and/or alignment may be adjusted with Engineer's approval. Adjustments will permit gradual bends of the pipe to the original alignment beyond the directional bore section. At unusual site conditions, the Contractor may request a review of site conditions by the Engineer for additional adjustment, and such determination will be final. An adjustment in alignment, position, or elevation approved by the Engineer will not be cause for an adjustment of costs.
 - 4. Pipe entry and exit points are to be allowed no more than five (5) feet of deviation from the staked centerline. The entry point may be moved up to 25-feet further from the original entry point only with the Engineer's prior written approval. Exit point lengths greater than 25-feet from the original point require the Engineer's written approval. Entry and exit points normally will not be allowed closer to the banks of a waterway being crossed. Installation that deviates from the plan may be rejected and any rejected installation shall be reconstructed at the Contractor's expense.
 - 5. The vertical profile as shown on the Drawings is the minimum depth to which the pipeline shall be installed. Contractor may, at Contractor's option and with the permission of Owner, elect to install the pipe at a greater depth than shown on the Drawings, at no additional cost to Owner.
- B. Examination of Materials:
 - 1. Prior to performing directional boring Work, examine new pipe for damage due to fabrication, shipment, or handling. Inspect pipe for cracks, breaks, bends, dents, broken ends, or other damage which might affect the structural integrity, performance requirements, or jointing as shown on the Plans, specified herein or as directed by the

Engineer. Defective pipe will be rejected by the Engineer and will be removed from the Work and replaced with acceptable pipe at the expense of the Contractor.

C. Site Disturbance and Soil Erosion:

1. Sediment barriers will be constructed as shown on the Drawings or where directed by Engineer. Soil erosion and sediment control work will be done in accordance with the standards for soil erosion and sediment control for the location where the Work is performed. Contractor will maintain sediment barriers until the project is deemed complete.
2. Contractor will be responsible for the preservation of existing trees, plants, and other vegetation that are to remain within or adjacent to the construction site and will also be responsible for protecting existing concrete curb, fence, utilities, and other structures that are located within or adjacent to the construction site.
3. Contractor assumes liability for environmental damage and cleanup due to inadvertent discharges of slurry or other causes related to Contractor's construction activities. Slurry materials will be selected based on the soil conditions encountered to minimize the risk of mud returns.

D. Notifications:

1. Prior to performing directional boring Work, Contractor will notify applicable inspecting agencies under Part 1 of this Section, of Work Schedule with a minimum of two (2) working days' notice.

3.03 INSTALLATION

A. General:

1. Except for the method of installation (directional boring versus open cut), the pipe will be installed per requirements of Section 33 11 00 Water Utility Distribution Piping and Section 33 34 00 Sanitary Utility Force Mains.
2. Contractor will be responsible for providing a Maintenance of Traffic Plan to the agency having jurisdiction for review and approval. The Maintenance of Traffic (MOT) Plan will show the location of all barricades, signs, devices and alternate routes for local traffic and pedestrian safety. Erection of the appropriate safety and warning devices in accordance with the USDOT "Manual of Uniform Traffic Control Devices" (MUTCD) will be completed prior to beginning work and maintained until construction is completed and the site restored.
3. Specifically note in the MOT Plan street intersections that are to remain open as required during the pipe pull-back operation, or traffic detours implemented. Install a temporary sleeve across the street intersections through which the pipe can be pulled or to construct a temporary bridge for the pipe over the intersections as required. No additional payment will be made for temporary structures required in order to permit access through street intersections or the implementation of traffic detours.
4. The cost of restoring pavement, curb, sidewalk, driveways, lawns, storm drains, etc., and other landscaped facilities shall be borne by the Contractor unless otherwise noted.

B. Sheeting, Shoring, and Bracing:

1. Furnish, install and maintaining throughout the progress of the Work, such sheeting, shoring, and bracing in tunnels, shafts, pits and trenches as may be required for safety of workmen, for protection of the Work and adjacent structures, and for issuance of applicable agency permits. Sheeting, shoring, and bracing will be removed after completion of the Work unless otherwise indicated on the Plans or directed by the Engineer.
2. Design of earth supports will be the responsibility of the Contractor and will be as required by the nature of the soils encountered. Supports will be dimensioned and spaced as to prevent caving, loss of earth or squeezing within the neat lines of the excavation. Supports will effectively restrain movement of the adjacent soil.

3. The sheeting of pits along roads will be required if the leading edge of the pits falls within the one-on-one zone of influence from the shoulder point or curb and gutter edge.

C. Excavation:

1. Excavate as required to perform directional boring Work to the grades, lines and levels indicated on the Plans and as specified herein.
2. Construct approach trenches, pits and shafts of sufficient length and width to accommodate the equipment being used, the pipe units to be placed and the manpower working. Provide guide timbers or rails in the bottom of the trenches, pits and shafts for keeping the Work on line and grade.

D. Pipe:

1. Construction:
 - a. Use the types and sizes shown on the Plans. Contractor will construct the pipe on the surface in the area indicated on the Plans. Use care to not damage pipe, joints or joint material. Coiled HDPE pipe will be re-rounded before using.
2. Connection to Structures and Existing Water Mains:
 - a. Connecting HDPE pipe to manholes will be accomplished by butt fusion welding a flange adapter to the end of the pipe and fully embedding the flange adapter to the inside manhole wall.
 - b. Final connections of HDPE pipe to existing water mains will be made after the new HDPE pipe has been allowed to relax for a minimum of 24 hours. Connections of HDPE pipe to existing water mains will consist of a full-circle Flex Restraint Collar fused to the HDPE pipe embedded in a 30" x 30" concrete thrust block poured to undisturbed earth placed a maximum of 5-feet from the connection point.
3. Hydrostatic Testing:
 - a. The pipe will be hydrostatically tested twice for leakage, including a preliminary test after the pipe has been constructed on the surface, and an acceptance test after the pipe has been installed in the drilled hole. Contractor will furnish the pump, pipe connection, valves and other necessary apparatus including gauges, meters, and personnel necessary for conducting the test.
 - 1) Hydrostatic testing will be in accordance with: Hydrostatic testing for HDPE pipe will be in accordance with ASTM F2164.
 - (a) Ductile Iron Pipe: AWWA C600
 - (b) HDPE Pipe: ASTM F2164.
 - (c) PVC Pipe: AWWA C605.
 - 2) Before applying the test pressure, air will be expelled from the pipe. If necessary to accomplish this, taps will be made at points of higher elevation and afterwards plugged.
 - 3) Allow the test section to equalize to a common temperature and pressure. Gradually increase pressure to required test pressure.
 - 4) HDPE pipe will be held at the test pressure for 4 hours prior to beginning the test to allow for stabilization of expansion of the pipe under test pressure.
 - 5) Full pressure will be held for the length of time as specified in Part 2 of this Section.
 - 6) Faulty pipe fitting, valves or other accessories which permit leaks during testing will be replaced by the Contractor with sound material and the test will be repeated until specified requirements are met.

- 7) If no visual leakage is observed, and pressure during the test phase remains steady (within 5% of the test phase pressure) for the entire test period, a passing test is indicated.
- 8) The maximum permissible leakage measured by water meter from the section of main tested under pressure, will not exceed the rate as specified in Part 2 of this Section.
- 9) If retesting is necessary, depressurize the test section and correct faults or leaks in the test section.
- 10) Test sections will not exceed 2,000 feet. In the event more than 2,000 feet of water main is tested, the permissible leakage will remain at the amount determined for 2,000 feet of pipe.
- 11) Allowable Leakage:
 - (a) Leakage allowance for fused HDPE and PVC pipe joints is zero.
 - (b) The leakage allowance per joint for gasketed fittings (based upon 150 psi test pressure) is as follows:

Size	6"	8"	10"	12"	14"
Gal / Hour	0.010	0.013	0.017	0.020	0.023

- 4. Water for Testing:
 - a. Water for testing will be obtained from a potable water supply. Contractor will provide water required at Contractor's own expense and Contractor will make the necessary arrangements with the authority which controls the source of water system for water. Contractor will be governed in using the water by the rules and regulations imposed thereon by said authority.
 - b. Contractor will provide and remove temporary connections between the source water system and the mains constructed under this Contract. Temporary connections will meet the approval of the Engineer, the authority controlling the source water system, and public health authorities having jurisdiction.
- 5. Installation:
 - a. After satisfactory hydrostatic testing, the Contractor will install pipe with continuous pullback until the pipe is in place as indicated on the plans. No connections to the pipe will be made for a period of 24 hours after the continuous pullback has been completed.
- 6. Installing Fittings (fire hydrants, gate valves, tees, crosses, etc.):
 - a. Where required, fittings will be cut into the new pipe after it is bored and allowed to relax sufficiently. The new pipe will be excavated and precision cut.
 - b. Prior to cutting fusible PVC the pipe, the pipe will be scored around the full circumference of the pipe as recommended by the manufacturer to prevent the pipe from splitting.
 - c. Fittings will be installed on the new pipe with cutting in sleeves. Mechanical joints will be the restrained type suitable for PVC C900 pipe.
 - d. Connections of HDPE pipe to mechanical joint fittings will use mechanical joint adapters with ductile iron backup rings fusion welded to each end of the pipe.
- 7. Disinfection:
 - a. Water main will be disinfected per AWWA C651. Bacteriological analysis and sampling will be in accordance with AWWA C651 and Section 33 14 00 - Water Utility Distribution

Piping.

- b. For HDPE pipe, disinfection with solutions containing chlorine will not contain more than 12.5% active chlorine.
8. Water Services Connections:
- a. Water services connections greater than 1 inch installed on directional bored fusible PVC pipe will be:
 - 1) a tee cut into the pipe as noted above, or,
 - 2) a service saddle inside of a restraining harness to relieve the axial stress and keep the pipe from splitting when tapped. Contractor will verify dimensions of service saddle and restraining harness prior to construction.
 - b. Water services connections will be:
 - 1) For HDPE pipes, electrofusion corporation saddle with 1-inch brass outlet threads and brass corporation stops as noted above.
 - 2) For HDPE pipe, stainless steel, full circle, double bolt service saddle with spring washers and 1-inch brass outlet threads and brass corporation stop. Saddle will be designated by the manufacturer in writing as specifically approved for use on HDPE pipe.

3.04 DRILL PATH SURVEY

- A. Entire drill path will be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on Drawings. If Contractor is using a magnetic guidance system, drill path will be surveyed for surface geo-magnetic variations or anomalies. Submit completed bore path complete with line and grade references and pulling loads imposed to Engineer at completion of directional boring Work.

3.05 DRILLING PROCEDURE

- A. Pilot hole will 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 bore path more than 5% 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.
- B. In the event that a drilling fluid fracture ("frac out"), inadvertent drilling fluid returns, or drilling fluid loss occurring during pilot hole drilling operations, Contractor will 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 then wait another 30 minutes. If mud fracture or returns loss continues, Contractor will cease operations and notify Engineer. Engineer and Contractor will discuss additional options and work will then proceed accordingly.
- C. Upon successful completion of pilot hole, Contractor will ream bore hole to the minimum amount necessary to accommodate outside diameter of pipe. Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
- D. After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole using a swivel in front of the pipe. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations Contractor will not apply more than the maximum safe pipe pull pressure at any time.
- E. In the event that pipe becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, Contractor will notify Engineer. Engineer and Contractor will discuss options and then work will proceed accordingly.

3.06 PULLING LOADS

A. The maximum allowable tensile load imposed on the pipeline pull section will not exceed the following amounts:

1. Allowable Tensile Load:

Nominal Size (inches)	Ductile Iron (lbs)	HDPE (lbs)	PVC (lbs)
4	10,000	6,879	10,600
6	20,000	14,215	21,900
8	30,000	24,455	37,800
10	45,000	36,788	56,500
12	60,000	52,025	80,800
14	75,000	69,895	108,000
16	95,000	90,399	139,000
18	120,000	113,536	175,000
20	150,000	139,306	210,000
24	210,000	198,748	300,000
30	220,000	305,748	

B. The amount of pull applied to the pipe will be controlled and limited by devices such as hydraulic pressure regulator or a load sensor between the pulling equipment and the pipe.

3.07 PIPE TESTING

A. Following successful pull-back of pipe, Contractor will hydrostatically test the pipe per the requirements of this Section. After successful completion of hydrostatic test, pipe will pigged dry.

B. After completion of hydrostatic test and before connection to the water supply, the pipe will be chlorinated and tested per the requirements of AWWA C651 and Section 33 14 00 - Water Utility Distribution Piping.

3.08 BACKFILLING

A. After the pipe has been installed and approved by the Engineer, the Contractor will backfill the entrance/exit pits, approach trenches or shafts. The entrance/exit pits, approach trenches or shafts and other excavations, will be considered as open cut trench and will be backfilled as specified in Section 31 23 33 - Trenching and Backfilling. Special backfill will apply where they exceed the maximum allowable trench width.

3.09 ACCEPTANCE AND INSPECTION

A. Contractor will maintain line and grade and will provide the Engineer with as-built location at five-foot intervals. If unable to maintain line and grade or to maintain directional boring operations, Contractor will propose alternate methods of construction as specified under Part 1 of this Section to complete the Work.

B. Water main will be inspected and accepted under Section 33 14 00 - Water Utility Distribution Piping.

C. If excavation or installation Work done by the Contractor is to be abandoned or not completed, the Contractor will fill voids and spaces caused by the abandoned Work, as directed by the Engineer.

3.10 RECORD KEEPING, AS-BUILTS

- A. Contractor will maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer at completion of project. As-built drawings will be certified as to accuracy by Contractor.

END OF SECTION 33 05 23.13

SECTION 33 41 00 STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes storm sewer Work indicated on the Plans complete with pipes, joints, structures, pipe bedding, final inspection and appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 03 60 00 - Grouting
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 16 - Structural Excavation and Backfill
- G. Section 31 23 33 - Trenching and Backfilling

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO M 36: Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
 - 2. AASHTO M 167M/M 167: Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
 - 3. AASHTO M 196: Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
 - 4. AASHTO M 245: Standard Specification for Corrugated Steel Pipe, Polymer- Precoated, for Sewers and Drains
 - 5. AASHTO M 252: Standard Specification for Corrugated Polyethylene Drainage Pipe
 - 6. AASHTO M 274: Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
 - 7. AASHTO M 278: Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
 - 8. AASHTO M 330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
 - 9. ASTM A48/A48M: Standard Specification for Gray Iron Castings
 - 10. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 11. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 12. ASTM C12: Standard Practice for Installing Vitrified Clay Pipe Lines
 - 13. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
 - 14. ASTM C55: Standard Specification for Concrete Building Brick

15. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
16. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
17. ASTM C150/C150M: Standard Specification for Portland Cement
18. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
19. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
20. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
21. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
22. ASTM C507: Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
23. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
24. ASTM C877: Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
25. ASTM C990: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
26. ASTM C1433: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
27. ASTM C1577: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
28. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
29. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
30. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
31. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
32. ASTM F2881/F2881M: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
33. American Concrete Pipe Association (ACPA)
34. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.04 SOURCE QUALITY CONTROL

- A. Laboratory test not less than one (1) percent, with a minimum of three (3) pieces each size, material and class of gravity pipe required in the Work.

1.05 SUBMITTALS

- A. Submit a complete field report of the location of all wye openings and sump pump discharge leads to the Engineer at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

- B. Submit two (2) copies of the laboratory test reports required per Part 1, Source Quality Control, of this Section to the Engineer.
- C. Complete Shop Drawings for all manhole tees shall be submitted to the Engineer.
- D. Submit shop drawings and design information for all precast concrete box sections.

1.06 STORAGE OF MATERIALS

- A. Piping material shall not be stacked higher than 4 feet or as recommended by the manufacturer, whichever is lowest. Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.
- B. Jointing and sealing materials used in the storm sewer system shall be protected from sunlight and stored in as cool and clean a place as practicable until ready for application.

1.07 HANDLING OF MATERIAL

- A. Load and unload materials using suitable approved equipment. Material shall not be dropped, bumped or allowed to impact against itself. Damaged material shall be rejected by the Engineer.
- B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of sewer pipe, joints, manholes, etc. which have been indicated throughout the Plans and Specifications. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 CLAY PIPE

- A. Clay pipe shall conform to ASTM C700, extra strength vitrified clay pipe.
- B. Premium joints shall be compression type joints conforming to ASTM C425.
- C. When not specified, joints shall be made with cold applied pipe joint sealer. See Part 2 of this Section for requirements for cold applied pipe joint sealer.

2.03 NONREINFORCED CONCRETE PIPE SYSTEMS

- A. Pipe shall conform to ASTM C14, Class III nonreinforced concrete sewer pipe.
- B. When not specified, pipe joints shall be made with cold applied pipe joint sealer. Part 2 of this Section for requirements for joints.

2.04 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall conform to ASTM C76. Pipe sizes 12 to 30 inch diameter shall be Class II thru V, Wall B or Wall C, circular reinforced. Pipe sizes 36 to 108 inch diameter shall be Class I through V, Wall B or Wall C, circular reinforced or elliptical reinforced.
- B. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used.
 - 1. A dummy lift pin form shall be set in the outer pipe wall form projecting into the pipe wall a minimum of 1-3/4 inch and a maximum of . An additional spacer chair shall be welded to the elliptical steel cage at the proper location so as to engage the dummy lift pin form during the pipe casting operation.
 - 2. It is the intent of the spacer chair and dummy lift pin arrangement to provide a means of assuring the final position of the elliptical steel cage within the barrel of the pipe and, further, for providing a means of indexing the pipe in the field to assume proper placement of the pipe.

3. Prior to shipment of the elliptically reinforced pipe, they shall be striped along the inside top with a minimum 1 inch wide indelible marker so that final inspection of the pipe orientation can be made following completion of the installation.
- C. For circular pipe 114 inch or larger in diameter, the design information in accordance with Section 6 of ASTM C76, shall be submitted to the Engineer for approval, prior to fabrication.
- D. The design of all pipes shall meet the d-load requirements for the class of pipe indicated on the Plans.
- E. When not specified, pipe joints shall be made with cold applied pipe joint sealer.

2.05 REINFORCED CONCRETE ELLIPTICAL PIPE

- A. Reinforced concrete elliptical pipe shall conform to ASTM C507.
- B. When not specified, pipe joints shall be made with cold applied pipe joint sealer.

2.06 PRECAST CONCRETE BOX SECTION

- A. Precast concrete box sections shall meet the requirements of ASTM C1433, ASTM C1577 or ACPA "Boxcar". Unless specified otherwise, CONTRACTOR shall use the same design conditions as exist at the time of construction or as planned for future development.

2.07 JOINTS FOR CONCRETE OR CLAY PIPE, BOX SECTIONS AND MANHOLES

- A. Sealed Joints (Cold Applied Pipe Joint Sealer):
 1. When not specified, pipe joints shall be made with cold applied pipe joint sealer.
 2. Cold-applied pipe joint sealer shall conform to MDOT Section 909.09. The bituminous material shall be of such consistency that it may be spread on the joints with a trowel when the temperature of the air is between 20 and 100 degrees F.
 3. The bituminous material shall adhere to the pipe so as to make a watertight seal and shall not flow, crack or become brittle when exposed to the atmosphere.
- B. Premium Joints:
 1. Premium joints for circular pipe shall conform to ASTM C443 limited as follows: Section 5.1 of ASTM C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of ASTM C361, "Rubber Gaskets." Also, Section 5 of ASTM C443 shall be limited to a modified grooved tongue to receive a rubber gasket.
 2. Premium joints for elliptical pipe shall conform to ASTM C877, external sealing bands for non-circular concrete pipe.
 - a. The width of the sealing bands shall be at least equal to twice the depth of the groove. For modified bell tongue and groove pipe, use the next larger gasket.
 - b. The length of the sealing bands shall be equal to the outside circumference of the pipe at its largest diameter plus an amount equal to the width of the gasket to be used.
 3. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirement.
- C. Preformed Flexible Joint Sealant:
 1. Butyl Rubber Sealant complying with ASTM C990.
- D. The inside annular space of all concrete pipe 36 inch diameter (or equivalent) and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for "dry packing."

2.08 CORRUGATED METAL PIPE

- A. Galvanized Corrugated Metal Pipe:
 - 1. Corrugated galvanized steel pipe with circular cross section and corrugated galvanized steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M 36, and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section of pipe.
- B. Polymeric Coated Corrugated Galvanized Steel Pipe:
 - 1. Polymeric coated corrugated galvanized steel pipe with circular cross section and polymeric coated corrugated galvanized steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M245, and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section of pipe.
- C. Aluminized Type 2 Corrugated Metal Pipe:
 - 1. Type 2 aluminized corrugated steel pipe with circular cross section and corrugated steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M 36, AASHTO M 274, Type 2 and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section.
- D. Corrugated Aluminum Alloy Pipe:
 - 1. Corrugated aluminum alloy pipe with circular cross section and corrugated aluminum alloy pipe with arch-pipe shape shall conform to the requirements of AASHTO M196 and MDOT Section 909.05.
- E. Joints for Corrugated Metal Pipe:
 - 1. The joints for corrugated metal pipe shall be made by use of coupling bands. The coupling bands shall be of the same material as specified for the pipe and shall prevent infiltration of the side fill material.
 - a. Coupling bands shall be corrugated to match the corrugations of the pipe to be jointed, and shall include two (2) "O" ring neoprene gaskets for each joint. Dimple bands shall not be used.
 - b. All joints shall be wrapped with a 3 foot wide geotextile filter fabric centered on the joint.
 - 2. When called for in the Contract Documents, joints shall have bell and spigot coupling system and rubber gasketed joint.

2.09 DUAL WALL CORRUGATED PVC PIPE – SMOOTH INTERIOR

- A. Pipe shall be a single extrusion of PVC with smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless.
- B. Pipe and fittings shall be in accordance with ASTM F949. Joints shall be bell and spigot type with a elastomeric gasket meeting the requirements of ASTM F477 and be suitable for storm sewer service.
- C. Wyes or tees shall be a molded wye or tee fitting per ASTM F949, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.
- D. Acceptable manufacturers of Dual wall corrugated pipe include Contech A2000, Uponor ETI Ultra-Corr or Engineer approved equal.

2.10 CORRUGATED POLYETHYLENE PIPE

- A. Smooth-Lined Corrugated Polyethylene Pipe:
 1. Smooth lined corrugated polyethylene pipe shall meet the requirements of MDOT section 909.06 and AASHTO M 252, Type S for sizes 4 to 10 inch diameter, and AASHTO M 294, Type S for 12 to 48 inch diameter.
 2. Fittings shall conform to the corresponding pipe specification and be constructed of the same material classification as the pipe. Fittings shall be welded on the interior and exterior at all junctions.
 3. Joints shall be bell & spigot type with rubber gaskets on both sides of the joint conforming to MDOT section 909.03 and ASTM F477. Split collar couplers are not allowed. Joints shall be watertight meeting the performance requirements of ASTM D3212.
- B. Corrugated Plastic Edge Drain / Underdrains.
 1. Corrugated plastic tubing for edge drains or underdrains shall meet the requirements of AASHTO M 252 for polyethylene tubing. Pipe shall be wrapped in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.11 SMOOTH PLASTIC PIPE

- A. Smooth plastic pipe for underdrains shall be polyvinyl chloride PVC meeting the requirements of AASHTO M 278. Pipe shall be wrapped in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.12 DUAL WALL CORRUGATE POLYPROPYLENE PIPING

- A. Dual Wall Corrugate Polypropylene Pipe shall have a smooth interior and annular exterior corrugations. Pipe 12 through 60 inch diameter shall meet the requirements of ASTM F2881/F2881M or AASHTO M 330.
- B. Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M 330, Section 6.1.
- C. Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881/F2881M or AASHTO M 330. The joint shall be watertight according to the requirements of ASTM D3212.
- D. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A manufacturer approved joint lubricant shall be used on the gasket and bell during assembly.
- E. Fittings
 1. Fittings shall conform to ASTM F2881/F2881M or AASHTO M 330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

2.13 STRUCTURAL PLATES FOR FIELD ASSEMBLY OF PIPE, PIPE-ARCHES, AND ARCHES

- A. The plates, bolts and nuts to be used in field assembled circular pipe, pipe-arches and arches shall meet all applicable requirements of AASHTO M 167M/M 167 and as specified in MDOT Section 909.

2.14 END SECTIONS

- A. The precast concrete end section shall conform to ASTM C76, Class II and as specified in MDOT Section 909.04. The joint for connection to pipe shall be by means of a standard tongue and groove with cold-applied pipe joint sealer. See Part 2 of this Section for requirements for the cold-applied pipe joint sealer.

- B. Metal end sections shall conform to MDOT 909.05. See Part 2 "Corrugated Metal Pipe" for requirement for joints for end sections.

2.15 STORM STRUCTURES

- A. Materials for storm sewer structures shall conform to the requirements indicated on the Plans and as specified below.
- B. Concrete Brick:
 - 1. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3 inch thickness.
- C. Concrete Block:
 - 1. Block shall conform to ASTM C139, manufactured of Portland cement conforming to ASTM C150/C150M, Type II. Blocks shall be solid curved blocks with the inside and outside surfaces parallel and curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends.
 - a. Blocks intended for use in the cones or tops of manholes shall have such shape as may be required to form the structure as indicated on the Plans.
- D. Precast Concrete:
 - 1. Precast concrete manhole, flat top slabs, risers, cone, bases, grade rings, transition sections and bottom sections shall conform to ASTM C478/C478M, and shall be circular with circular reinforcement.
 - a. For depths greater than 32 feet, the manhole shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
 - 2. Base slab shall be minimum 8 inches thick for depths up to 25 feet and minimum 12 inches thick for depths greater than 25 feet.
 - 3. Transition sections, reducers and flat top slabs shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
 - 4. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. Shop Drawings shall be provided for all manhole tees.
 - 5. The joints on the precast manhole tee shall be the same as the joints on the storm sewer section.
- E. Manhole Steps:
 - 1. Cast iron manhole steps shall conform to ASTM A48/A48M, Class 30, gray iron with a minimum cross section dimension of 1 inch in any direction.
 - 2. Steel reinforced plastic steps shall be of suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02 with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615/A615M, Grade 60.
 - 3. Manhole steps shall be of the type and size indicated on the Plans and shall comply with applicable occupational safety and health standards. Manhole steps shall be installed at locations indicated on the Plans.
- F. Frames and Covers:
 - 1. Frames and covers for manholes, catch basins, and inlets shall conform to ASTM A48/A48M, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, holes and other defects.
 - 2. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

2.16 CONCRETE

- A. The concrete shall conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

2.17 CONCRETE REINFORCEMENT

- A. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM ASTM A1064/A1064M for welded wire fabric.

EXECUTION**3.01 VERIFICATION OF EXCAVATION AND BEDDING**

- A. Prior to the installation of any storm sewer piping, structures, or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work.
- B. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive the storm sewer materials to be installed.
- C. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING STORM SEWERS AND DRAINS

- A. Expose the existing storm sewer and structures to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required to align the new storm sewer Work with the existing system.

3.03 PREPARATION

- A. The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.
- B. Pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.

3.04 INSTALLATION - GENERAL

- A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.
- B. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize air-borne particles, shall be employed.
 - 1. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of the pipe materials being cut and according to the best trade practices.
 - 2. When cutting pipe, care shall be taken to prevent damage to the interior and exterior surfaces. Damage to either shall be cause for rejection of a complete section of pipe.
- C. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water. A dewatering system, in accordance with Section 31 23 19 shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is backfilled.
- D. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33.

3.05 PIPE LAYING

- A. Installation of pipe shall conform to ASTM C12, and as recommended by the pipe manufacturer.

- B. The pipe shall be protected during handling against impact shocks and free fall. Hooks shall not be permitted to come in contact with premolded joint surfaces.
- C. Pipes having premolded joint rings or attached couplings shall be handled so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material.
- D. Care shall be taken to avoid dragging any pipe on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.
- E. Pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid, shall be checked by the Contractor with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the Contractor shall have an independent and alternate means of checking the line and grade.
- F. Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the bedding material.
- G. Lubricants, primers or adhesives as recommended by the pipe or joint manufacturer shall be used immediately prior to jointing.
- H. The pipe shall be centered in the bells or grooves and pushed tight together to form a smooth and continuous invert. After laying of pipe, care shall be taken so as not to disturb its line and grade. Pipe found off grade or out of line shall be re-laid properly by the Contractor.
- I. Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.
- J. Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes to the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs.
- K. Type HE elliptical pipe shall be installed with the longer axis placed horizontally within a tolerance of \pm five degrees.
- L. Type VE elliptical pipe shall be installed with the longer axis placed vertically within a tolerance of \pm five degrees.
- M. The finished work shall be straight and shall be sighted through between manholes.

3.06 PIPE BEDDING

- A. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 23 33. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations.
- B. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 23 33. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.
- C. A continuous and uniform bedding as specified in Section 31 23 33, shall be provided in the trench for all buried pipe.

3.07 UNDERDRAINS

- A. The pipe shall be laid in close conformity with the lines or grades shown on the Plans or established by the Engineer.
- B. The upgrade ends of all underdrains shall be closed with suitable plugs to prevent entry of soil or other foreign material.
- C. Perforated pipe shall be laid with the perforations down.

- D. Underdrains shall be bedded in MDOT open graded drainage course material. The bedding shall have a minimum thickness beneath the pipe of 6 inches, a minimum width of 6 inches on each side of the pipe and extend to a level not less than 12 inches above the top of the pipe.
- E. The bedding shall be placed equally on both sides of the underdrain at the same time. Staking or other methods to restrain the pipe may be necessary during the backfilling operation to maintain the line and grade of the underdrain.
- F. Rodent screens and outlet endings are required for all underdrains which terminate in a ditch or swale.

3.08 STORM STRUCTURES

- A. Construct storm sewer manholes, catch basins, inlets and other structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment bricks, etc., as shown and as required for a complete installation.
- B. Storm sewer structures shall conform to the type of material and dimensions indicated on the Plans.
- C. Cast-in-place structures shall be constructed in accordance with Section 03 30 00.
- D. Block Structures:
 1. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.
 2. Mortar joints shall be full and close in all courses. Courses shall be level throughout. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable. Joints shall be uniform in thickness throughout the structures.
 3. Strike all joints and properly point to provide true, smooth surfaces.
 4. A cement mortar plaster coat shall be applied to the exterior surfaces of the brick and block sections of all storm structures as indicated on the Plans. Plaster coat shall be 1/2 inch thick.
- E. Precast Concrete Structures:
 1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide three (3) to five (5) courses of 8 inch brick or concrete grade rings at top of structure for future adjustment of castings.
- F. Provide and install all frames and covers to the elevations indicated on the Plans. Castings shall be set in a full bed of cement mortar 1/2 inch thick, minimum. Mortar joints shall be struck smooth.
- G. Steps shall be installed at the plant by the manufacturer of precast units. Field install steps for brick, block, or cast in place structures of the types and in the locations indicated on the Plans.
- H. Pipe up to 42 inches in diameter, shall be connected to storm structures using a grouted joint, as indicated on the Plans. The pipe shall be properly supported, so that any settlement will not disturb the connection.
- I. For pipe, in diameter or larger, the pipe shall be installed as an integral part of the manhole (manhole tees) which shall be constructed of 3500 pdi concrete and reinforcing, as indicated on the Plans.
- J. Manhole tees, as indicated on the Plans, may be used for pipe 42 inches in diameter or larger. Connection to manhole tees shall be made using tees and pipe having the same type of joint. The pipe and tee shall be properly supported with concrete as indicated on the Plans.

- K. Sump shall be provided, as indicated on the Plans, in all catch basins and storm manholes having outlets of 18 inches in diameter or less.
- L. Flow channels shall be constructed in all structures not requiring a sump and shall be constructed as indicated on the Plans.

3.09 FIELD QUALITY CONTROL

- A. After all the pipe and structures have been laid, constructed and backfilled, the system shall be final inspected. The sewer system shall be ready for the final inspection within two (2) weeks after the completion of each 2,000 feet section of sewer installed.
- B. The final inspection shall consist of a visible and audible check of the sewers and structures to ascertain that the steps have been placed, all lift holes filled, the channeling of the manhole bottoms completed, all visible or audible leaks stopped, all pipe has been placed straight and true to the proper slopes and elevations, the required brick courses for adjustment have been placed, the frame and cover properly installed, the required end section installed, all trenches and structures backfilled in a workmanlike manner, and that the system has been thoroughly cleaned.
- C. The final inspection shall be considered complete when all the repairs have been made.

3.10 DEFLECTION TEST FOR PLASTIC PIPE

- A. Plastic pipe shall be tested for deflection; but no sooner than 30 days following the backfilling of the pipe.
- B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent.
- C. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.
- D. Optional devices for testing include a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. Mandrel shall have a minimum of nine (9) legs.

3.11 REMOVE STORM SEWER

- A. Excavate and remove the existing storm sewer where indicated on the plans. Bulkhead the opening in storm sewers or structures where the existing storm sewer has been removed.
- B. Where removal of existing storm sewer is occurring in essentially the same location as a new sewer or structure, the removal of the existing sewer is incidental to the project, unless otherwise indicated in the Proposal.

3.12 REMOVE CULVERTS

- A. Excavate and remove culverts where indicated on the plans. Backfill the completed work as specified under "Backfilling Trenches" in Section 31 23 33.

3.13 REMOVE STRUCTURE

- A. Excavate and remove structures where indicated on the plans. Bulkhead the ends of any sewers remaining in place. Backfill the completed work as specified under "Backfilling Trenches" in Section 31 23 33.
- B. Removal of existing storm structures is incidental to the project if a new structure or sewer is being constructed in essentially the same location; unless otherwise indicated in the Proposal.

3.14 REMOVE AND REPLACE STORM SEWER

- A. Remove and replace storm sewer shall consist of the complete removal and disposal of the existing sewer and replacement with the size and type of sewer as called for on the plans or specified.

- B. Materials and installation shall be in accordance with the requirements of this section and Section 31 23 33, as applicable.

3.15 REMOVE AND REPLACE STORM STRUCTURE

- A. Remove and replace storm structure shall consist of the complete removal and disposal of the existing structure and replacement with the size and type of structure as called for on the plans or specified.
- B. Materials and installation shall be in accordance with the requirements of this section and Section 31 23 33, as applicable.

END OF SECTION 33 41 00



GEOTECHNICAL INVESTIGATION REPORT
EUREKA ROAD CORRIDOR
DRAIN AND STREETScape IMPROVEMENTS
ALLEN ROAD TO TELEGRAPH ROAD (US-24)
TAYLOR, MICHIGAN

Owner:



City of Taylor

Prepared for:



WADETRIM

25251 Northline Road
Taylor, Michigan 48180

July 29, 2020

Somat Project Nos. 2018019A&B



Somat Engineering,
INCORPORATED



July 29, 2020
2018019A&B

Mrs. Kelly McRobb-Ackland, P.E.
Wade Trim
25251 Northline Road
Taylor, Michigan 48180

Re: Revised Geotechnical Investigation Report
Eureka Road Corridor Drain and Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan

Dear Mrs. McRobb-Ackland:

We have completed the geotechnical investigation for the proposed drain and streetscape improvements along the Eureka Road Corridor between Allen Road and Telegraph Road (US-24) in Taylor, Michigan. The initial report, submitted on September 17, 2020, presented the results of our testing and observations, geotechnical recommendations, and construction considerations based on the project information provided. This revised report includes design recommendations for drilled shafts proposed for support of the gateway signs along US-24.

It was a pleasure working with you on this project. If you have any questions regarding this report, please do not hesitate to contact us.

Sincerely,

Somat Engineering, Inc.

A handwritten signature in black ink, appearing to read 'J. Zaremski'.

Jonathan D. Zaremski, P.E.
Geotechnical Services Manager

KB/JSS/JZ/nf/aer

**GEOTECHNICAL INVESTIGATION REPORT
EUREKA ROAD CORRIDOR
DRAIN AND STREETScape IMPROVEMENTS
ALLEN ROAD TO TELEGRAPH ROAD (US-24)
TAYLOR, MICHIGAN**

REPORT SUMMARY

A general summary of the report conclusions and recommendations is provided below:

1. This project includes improvements along the Frank and Poet Drain and the installation of three new entryway signs as part of the City of Taylor's corridor improvement project along Eureka Road. The drain improvements include the replacement of the existing culvert ends (with new head walls and wing walls), drain channel widenings, a full culvert replacement at Racho Road, and a full drain enclosure east of Telegraph Road (approximately 1,200 feet in length). The new culverts will consist of 20-foot by 6-foot concrete box culvert sections.
2. The field exploration program consisted of drilling a total of twenty-six (26) soil borings. The drilling operations for the initial investigation were performed on various days between May 9 and May 23, 2018. Supplemental investigation borings were performed on August 14, 2019.
3. Based on our soil borings, the soils encountered near the invert elevations of the drain consist of medium to hard lean clay. We recommend factored bearing resistances ranging between 2,000 and 5,000 psf for the culvert and wingwall footings, depending on the structure location. We anticipate the total settlement will be 1 inch or less, with differential settlement at about half of the total.
4. We anticipate the soils encountered near the proposed sign bearing elevations at 3.5 feet below finished grade will consist of natural very stiff to medium lean clay or fill soils at the three locations. We recommend maximum allowable bearing pressures between 2,000 and 3,000 psf, depending on the structure location and recommended subgrade preparation. We anticipate the total settlement will be 1 inch or less, with differential settlement at about half of the total. For the proposed signs within the median of Telegraph Road, north and south of Eureka Road, complete removal and replacement of the fill material is recommended. Alternatively, the sign foundations may be designed as helical piles or drilled shafts. Recommendations have been provided for spread foundations, helical piers, and drilled shafts.
5. We estimate the long-term groundwater level in the area of the proposed culvert is situated at a depth of about 5 to 10 feet below existing grade, which is likely consistent with the water level in the Frank and Poet Drain. The use of sheeting will likely be required for removal of the existing culvert structures and construction of the new structures.

The summary presented above is general in nature and should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned therein. Details of our findings and recommendations are discussed in the following sections and in the appendices of this report.



**GEOTECHNICAL INVESTIGATION REPORT
EUREKA ROAD CORRIDOR
DRAIN AND STREETScape IMPROVEMENTS
ALLEN ROAD TO TELEGRAPH ROAD (US-24)
TAYLOR, MICHIGAN**

REPORT SUMMARY (continued)

REPORT PREPARED BY:

Lorenzo Martinez, E.I.T.
Senior Staff Engineer

Kevin D. Brown, P.E.
Project Manager

REPORT REVIEWED BY:

Jennifer S. Schmitzer
Quality Manager

Jonathan Zaremski, P.E.
Geotechnical Services Manager



**GEOTECHNICAL INVESTIGATION REPORT
EUREKA ROAD CORRIDOR
DRAIN AND STREETScape IMPROVEMENTS
ALLEN ROAD TO TELEGRAPH ROAD (US-24)
TAYLOR, MICHIGAN**

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**GEOTECHNICAL INVESTIGATION REPORT
EUREKA ROAD CORRIDOR
DRAIN AND STREETScape IMPROVEMENTS
ALLEN ROAD TO TELEGRAPH ROAD (US-24)
TAYLOR, MICHIGAN**

1.0 INTRODUCTION

1.1 GENERAL

Upon authorization from Wade Trim, Somat Engineering, Inc. (Somat) has performed a geotechnical investigation for the proposed drain and streetscape improvements along the Eureka Road Corridor between Allen Road and Telegraph Road (US-24) in Taylor, Michigan. This geotechnical investigation was performed in accordance with Somat Proposal No. P170020R, dated January 9, 2018. A supplementary geotechnical investigation was also performed in accordance with Somat Proposal No. P190211A-R1, dated June 20, 2019 (Revised July 9, 2019).

The following sections of this Geotechnical Investigation Report (GIR) will provide our understanding of the project, a description of our field investigation, the results of the field and laboratory tests, the logs of test borings, and our interpretation of subsoil and groundwater conditions.

1.2 PROJECT INFORMATION

Our geotechnical investigation for this project included the proposed structural improvements along the Frank and Poet Drain and the installation of new entryway signs as part of the overall Eureka Road corridor improvement project.

Frank and Poet Drain Improvements

The section of the Frank and Poet Drain within the project limits is generally located along the north side of Eureka Road from Racho Road to West Point Street (just east of Telegraph Road). Along the drain, improvements are proposed for eleven (11) existing culvert structures. The majority of these existing culverts within the project limits support driveway access from Eureka Road to local businesses, though two existing culvert structures support City of Taylor roadway crossings (Pardee Road and Syracuse Street). The improvements for the existing culvert structures generally include the replacement of the culvert ends with new headwalls and wing walls and drain channel widenings.



Along the west end of the Frank and Poet Drain, approximately 1,200 lineal feet of the drain is proposed to be enclosed from the west end of the project limits to about 1,500 feet east of Telegraph Road centerline. Four existing culvert structures will be incorporated into the overall culvert enclosure, as well as an existing 350-foot segment of enclosed drain east of Syracuse Street. The new drain enclosure sections will consist of similar 20-foot by 6-foot concrete box culvert sections.

Only one culvert structure will require full replacement: the existing culvert structure at Racho Road. The existing structure consists of a pipe arch tube supporting five lanes of traffic. A final design for the replacement culvert has not been completed at the time of this report; however, we anticipate the replacement structure will also consist of a 20-foot by 6-foot concrete box culvert section, approximately 130 feet in length.

We understand the proposed culvert improvements and the replacement at Racho Road will be constructed along the same general existing drain alignment. Further, we anticipate the proposed invert of the new culvert improvements will be situated at similar elevations as the existing conditions. The design for the replacement culverts will be performed by Wade Trim.

Eureka Road Corridor Entry Signs

As part of the corridor improvements, three entryway signs are proposed to be installed along Eureka Road and will primarily serve as decorative welcome signs. One sign is proposed at the east end of the project corridor, generally east of I-75 and west of Allen Road. The proposed location of the sign is within the median of Eureka Road, just east of the CN Railroad bridge. This sign is anticipated to be a small structure (either a concrete, masonry, or metal sign), and is planned to be supported on a shallow foundation.

At the west end of the project corridor, two identical arch-shaped signs are proposed to be located within the median of Telegraph Road at its intersection with Eureka Road; one sign is to be installed on the north side of Eureka Road, and one sign is to be installed on the south side of Eureka Road. These signs could be supported on conventional shallow, helical pile, or drilled



shaft foundations. Tieback features will also be attached to these arches for aesthetic purposes only; as such, no soils investigation or engineering analysis were performed for these tieback locations.

1.3 SITE CONDITIONS

This area of Taylor is predominantly commercial, with some residential areas north of the western segment of the project. Eureka Road is an arterial roadway oriented in the east and west direction with five to seven lanes of traffic. Eureka Road is an undivided roadway west of Racho Road. However, east of Racho Road to Allen Road, Eureka Road transitions to a divided roadway with three lanes in each direction and a grass median east of Racho Road to Allen Road.

The Frank and Poet Drain is located along the north side of Eureka Road, and extends through the project limits. Based on our visual observations, the drain is approximately 5 to 10 feet deep compared to the surrounding elevations within the site area. The existing slopes along the sides of the drain are predominately grass covered; however, portions of the drain are lined with concrete bricks near some of the culverts. The water depth in the drain fluctuates greatly with seasonal precipitation.

In general, the existing driveways connecting Eureka Road to businesses north of the Frank and Poet Drain are oriented in the north and south direction, and each support two to four lanes of traffic. The culvert crossings are generally located along these intersecting roadways and driveways in the north and south directions. The existing culverts are constructed of either a concrete pipe arch, concrete box, or corrugated metal pipe (CMP). Table 1.3 provides a summary and description of the existing culverts.



Table 1.3: Existing Culvert Summary

Crossing	Approximate Location	Existing Culvert Description
Racho Road over Frank and Poet Drain	550 feet north of Eureka Road	Pipe arch tube supporting 5 lanes of traffic; 2 lanes each direction and 1 center lane
Cross Creek Plaza entrance over Frank and Poet Drain (Southland 4)	500 feet north of Eureka Road and 375 feet west of Racho Road	Pipe arch tube supporting 2 lanes of traffic; 1 lane each direction
Southland Mall east entrance over Frank and Poet Drain (Southland 3)	250 feet north of Eureka Road and 900 feet west of Racho Road	Triple CMP supporting 4 lanes of traffic; 3 lanes southbound 1 lane northbound
Southland Mall central entrance over Frank and Poet Drain (Southland 2)	125 feet north of Eureka Road and 1,350 feet west of Racho Road	Triple CMP supporting 2 lanes of traffic; 1 lane each direction, divided with median
Southland Mall west entrance over Frank and Poet Drain (Southland 1)	125 feet north of Eureka Road and 500 feet east of Pardee Road (north)	Triple CMP supporting 2 lanes of traffic; 1 lane each direction, divided with median
Pardee Road (north) over Frank and Poet Drain	125 feet north of Eureka Road	Double CMP supporting 5 lanes of traffic; 3 lanes southbound, 2 lanes northbound
Meijer east entrance over Frank and Poet Drain (Meijer 3)	125 feet north of Eureka Road and 525 feet west of Pardee Road (north)	Box culvert supporting 3 lanes of traffic; 2 lanes southbound, 1 lane northbound
Meijer central entrance over Frank and Poet Drain (Meijer 2)	125 feet north of Eureka Road and 925 feet west of Pardee Road (north)	Box culvert supporting 3 lanes of traffic; 2 lanes southbound, 1 lane northbound
Meijer west entrance over Frank and Poet Drain (Meijer 1)	100 feet north of Eureka Road and 1,200 feet west of Pardee Road (north)	Box culvert supporting 3 lanes of traffic; 2 lanes southbound, 1 lane northbound
Syracuse Street over Frank and Poet Drain	50 feet north of Eureka Road and 1,300 to 1,650 feet west of Pardee Road (north)	Box culvert supporting 2 lanes of traffic; 1 lane each direction
Shopping Center Drive over Frank and Poet Drain	50 feet north of Eureka Road and 150 feet west of Syracuse Street	Box culvert supporting 2 lanes of traffic; 1 lane each direction
KE's Salon Drive over Frank and Poet Drain	50 feet north of Eureka Road and 450 feet west of Syracuse Street	Box culvert supporting 2 lanes of traffic; 1 lane each direction

Pardee Road, Racho Road, and Telegraph Road all travel in the north and south directions. Pardee Road and Racho Road each carry a total of five lanes of traffic. Telegraph Road is a divided roadway and maintains four to five lanes of traffic in each direction. A grass median



measuring approximately 50 feet wide divides the northbound and southbound traffic lanes of Telegraph Road.

2.0 SUBSURFACE INVESTIGATION

2.1 FIELD EXPLORATION

The field exploration program consisted of drilling a total of twenty-six (26) soil borings designated as SB-01 to SB-26. Soil borings SB-01 to SB-22 were each drilled to a depth of about 50 feet below existing grade. Soil borings SB-23 to SB-26 were each drilled to a depth of 30 feet below existing grade. Two (2) supplemental hand augers ranging from 2.5 to 8 feet below existing grade were performed at the proposed sign location at Telegraph Road, north of Eureka where soil boring SB-25 was offset more than 10 feet away from the original location.

The number of soil borings was requested by Wade Trim. For the drain improvements, the number of borings was based on performing two soil borings for each existing culvert to be improved, with one additional soil boring at the west end of the proposed enclosed drain section. The locations of these soil borings were selected by Somat with approval by Wade Trim; the soil borings were located on either end of the existing culvert. For the proposed entryway signs, the number of borings was based on performing one soil boring at each sign location. The locations of the signs were selected by Wade Trim. The locations of all the soil borings were staked in the field by Somat, with consideration to the locations of existing utilities (underground and overhead), as well as surface obstructions and drill rig accessibility.

The as-drilled locations of the soil borings were recorded by measuring and documenting offsets. Coordinates and elevations were estimated from locations documented with a hand-held global positioning system (GPS) unit with an accuracy of ± 10 feet and verified using geographic information system (GIS) software. The estimated coordinates and elevations are reported on the boring logs using horizontal datum "North American Datum of 1983" (NAD 83) (NSRS 2011) and vertical datum "North American Vertical Datum of 1988" (NAVD 88). Exact elevations and



coordinates of the soil boring locations were not available at the time of this report. Soil boring location diagrams are presented in Appendix A.

2.1.1 Drilling Operations

The drilling operations for the initial investigation were performed on various days between May 9 and May 23, 2018. Supplemental investigation borings were performed on August 14, 2019. The soil borings were drilled using either a truck mounted drill rig or an all-terrain vehicle (ATV) mounted drill rig, as required by the site condition. Where soil borings were performed through existing pavement, the pavement was cored with a portable core machine prior to drilling.

The soil borings were drilled by advancing 2¼-inch diameter hollow stem augers. For the 50-foot soil borings, the drilling was performed by advancing hollow stem augers to the appropriate depth to transition to a wash rotary process, then continuing the boring with the wash rotary technique. Upon completion, the 50-foot boreholes were backfilled with cement-bentonite grout, and patched at the surface with cuttings and topsoil. The 30-foot boreholes were backfilled with excess soil cuttings. Where soil borings were performed through existing pavement, the boreholes were backfilled with grout, the pavement core was replaced, and the surface was patched with asphalt cold patch.

Supplemental hand auger probes were performed using a 3-inch bucket auger. Upon completion of the hand auger probes, the locations were backfilled with soil cuttings. The hand augers were identified with the same number as the corresponding soil boring, with the prefix of “HA”.

2.1.2 Standard Penetration Test (SPT)

Soil samples collected during the drilling portion of the subsoil exploration were labeled with the soil boring designation and a unique sample number. Soil boring samples were obtained by Standard Penetration Tests in general accordance with ASTM D-1586 procedures, whereby a conventional 2-inch O.D. split-spoon sampler is driven into the soil with a 140-pound hammer repeatedly dropped through a free-fall distance of 30 inches. A hydraulically driven automatic



SPT hammer fixed to a drill rig was used to perform the test. The sampler is generally driven three successive 6-inch increments, with the blows for each 6-inch increment being recorded. The number of blows required to advance the sampler through 12 inches after an initial penetration of 6 inches, is termed the Standard Penetration Test resistance (N-value) and is presented graphically on the individual Logs of Test Borings. As added information, the number of blows for each 6-inch increment are also presented on the boring logs. The N-values reported on the Logs of Test Borings are the direct blow counts from the field and are uncorrected.

2.1.3 Sampling

Soil samples from the borings were recovered using SPT sampling procedures in general accordance with ASTM Standard D-1586 (“Standard Method for Penetration Tests and Split Barrel Sampling of Soils”). In general, the SPT samples were obtained at a regular interval of 2.5 feet to a depth of 15 feet below grade and at an interval of 5 feet thereafter to the exploration depth of the borings. The soil samples were sealed in glass jars in the field to protect the samples and maintain their natural moisture contents.

Hand auger samples were recovered from each apparent soil strata encountered in the hand auger probes. The samples were sealed in plastic bags in the field to protect the soil and maintain the soil’s natural moisture content.

All soil samples were transported to Somat’s laboratory for further analysis and testing. The soil samples collected for this investigation will be retained in our laboratory for 90 days from the date of this report. After this time, the soil samples will be disposed of unless otherwise directed.

2.1.4 Groundwater Level Observation Procedures

Whenever possible, groundwater level observations were made during the drilling operations and immediately after completion of drilling, and are shown on the individual Logs of Test Borings. During drilling, the depth at which free water was observed, where drill cuttings became saturated or where saturated samples were collected, was indicated as the groundwater level during drilling. In granular, pervious soils, the indicated water levels are considered relatively



reliable when solid or hollow-stem augers are used for drilling. However, in cohesive soils, groundwater observations are not necessarily indicative of the static water table due to the low permeability rates of the soils, and due to the sealing off of natural paths of groundwater flow during drilling operations.

It should be noted that seasonal variations and recent precipitation conditions may influence the level of the groundwater table significantly. Groundwater observation wells are generally used if precise groundwater table information is needed, however the installation of groundwater monitoring wells was not included in the scope of the investigation. Therefore, the discussion and recommendations provided within the report are based on our knowledge of the soil and groundwater conditions in this area, which should provide for a reasonable approximation of the groundwater level.

2.2 GEOTECHNICAL LABORATORY TESTING

All samples were classified in accordance with the Unified Soil Classification System. Representative cohesive soil samples were subjected to laboratory tests consisting of moisture content determination tests, hand penetrometer tests, and Torvane tests. Representative sediment samples were subjected to grain size and hydrometer analysis. All laboratory tests were performed in accordance with applicable ASTM procedures.

Moisture Content Determination Tests

All samples were sealed in the field to retain the natural moisture content of the soil specimen. Moisture content determination tests were performed on cohesive samples in accordance with ASTM D2216. Results of the moisture content determination tests are included in Appendix B on the respective logs of test borings.

Unconfined Compressive Strength Tests

Standard test methods for unconfined compressive strength of cohesive soil were performed in accordance with ASTM D2166 on selected cohesive samples from the soil borings. The unconfined compression test consists of axially loading a small cylindrical soil sample at a slow rate of strain,



until failure occurs. Failure is defined as the maximum stress level in the soil sample or the stress level at 15 percent strain, whichever is less. The results of these tests are shown on the respective logs of test borings in Appendix B.

Estimation of unconfined compressive strength on cohesive samples was obtained by performing either a hand penetrometer test or a Torvane test. In the hand penetrometer test, the shear strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small, calibrated spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square foot. In the Torvane test, the shear strength of a cohesive soil sample is estimated by measuring the resistance of the sample in shear when twisting a small, calibrated spring-loaded vane pressed into the sample. The results of these tests are shown on the respective logs of test borings in Appendix B.

Loss-On-Ignition Tests

The organic content of a soil sample is determined using the Loss-On-Ignition (LOI) test in accordance with ASTM D2974. Soil samples that appeared or suspected to contain excessive organic material were subjected to the LOI test. The soil sample is super-heated as a means to burn off all present organic matter and the percentage of organic matter is then calculated.

Grain Size & Hydrometer Analyses

Grain size/hydrometer analyses were performed in accordance with (withdrawn) ASTM D422 on selected sediment samples to evaluate the gradation of the soil represented by the sample. The distribution of particle sizes larger than 75 micrometers (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 micrometers is determined by a sedimentation process using a hydrometer. Graphical results of the grain size analyses are included in Appendix C.

2.3 LIMITATIONS

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water,



groundwater, or air, on, below or around this site. Any statement in this report or on the boring logs regarding odors, colors, unusual or suspicious contents or conditions are strictly for informational purposes.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL STRATIFICATION

Soil conditions encountered at the test boring locations have been evaluated and are presented in the form of Logs of Test Borings. The Logs of Test Borings presented in Appendix B include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the test borings. In addition to the observed subsoil stratigraphy, the boring logs present information relating to sample data, Standard Penetration Test results, groundwater level conditions observed in the boring, personnel involved, and other pertinent data. For information, and to aid in understanding the data as presented on the boring logs, General Notes defining nomenclature used in soil descriptions are included immediately following the logs in Appendix B. It should be noted that the Logs of Test Borings included with this report have been prepared on the basis of laboratory classifications and testing as well as field observations and logs of the soils encountered.

A generalized description of the soils encountered in soil borings and hand auger probes is provided below:

Surface Materials

Topsoil was encountered at the surface of the majority of the soil borings. The thickness of the topsoil ranged from 3 to 12 inches.

Existing pavement was encountered at the surface of soil borings SB-01, SB-02, SB-15, SB-20, and SB-22. The pavement consisted of Portland cement concrete (PCC), asphaltic cement concrete (ACC), or composite sections comprised of either ACC over PCC or PCC over ACC over PCC. The thickness of the existing pavement ranged from 5 to 15.5 inches.

Fill and Possible Fill

Fill soils and possible fill soils were encountered below the surficial layers. These soils consisted of slag aggregates, limestone aggregates, gravel, poorly graded sand, lean clay,



sandy lean clay, or a combination of these soil layers. The fill and possible fill soils extended to depths ranging from 2.5 to 10 feet below existing grades (approximate elevation 606 to 596 feet). The consistency of the clay fill soil was hard to medium. The apparent density of the granular fill soil was very loose to medium dense.

LOI tests performed on various samples obtained within the fill/possible fill strata indicated organic contents ranging between 1.8% and 6.3%. In addition, small amounts of concrete debris were encountered in borings SB-14 and SB-19 within the fill layers. Asphalt millings were encountered within the fill layers in boring SB-26 to a depth up to 10 feet below existing grade.

Clay

Soils consisting of predominantly lean clay were encountered below the fill/possible fill soils in all of the soil borings. The lean clay soils extended to the termination depth of the soil borings. In general, the consistency of the clay was hard to stiff with occasional layers of medium clay to depths ranging from 15 to 30 feet below existing grade (approximate elevations ranging from about 589 to 572 feet). Below that, the consistency of the clay was generally stiff to very soft, with occasional layers of very stiff clay.

Please refer to the boring logs for the soil conditions at the specific boring locations. It is emphasized that the stratification lines shown on the Logs of Test Borings are approximate indications of change from one soil type to another at the location of the boreholes. The actual transition from one stratum to the next may be gradual and may vary within the area represented by the test boring.

3.2 GROUNDWATER OBSERVATIONS

During the drilling process, groundwater was encountered in eleven (11) of the borings (SB-01, SB-03, SB-04, SB-05, SB-06, SB-10, SB-14, SB-16, SB-21, SB-25, and SB-26) prior to the introduction of any drilling fluids. Groundwater was not encountered during drilling in any of the remaining soil borings. Due to the use of drilling fluids in some of the boreholes, groundwater level measurements could not be obtained upon drilling completion of these boring since these readings would not be reliable. At borings SB-25 and SB-26, hollow stem augers were utilized to the termination depth of the borings, and groundwater was encountered upon completion of drilling.



A lack of groundwater in the boreholes does not necessarily indicate that there is no groundwater, due to the sealing off of natural flow paths due to the drilling process. In our experience, the depth at which clayey soils change from brown to gray in color (an indication of oxidation) is frequently indicative of the long-term groundwater level. This color change was apparent at depths ranging between about 7 and 15 feet below existing grades. As such, we anticipate the long-term ground water level is likely consistent with the water level in the Frank and Poet Drain between 5 and 10 feet below existing grades (approximate elevations of 600 to 595 feet)

It should be noted that the elevation of the perched or natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation, and percolation in the area, as well as on the water level of surface water bodies in the vicinity affecting the groundwater flow pattern. The possibility of perched water trapped in granular soils above the clay soils (above the long-term level) should also be expected.

3.3 GRAIN SIZE ANALYSIS

Grain size and hydrometer analysis were performed on two sediment samples to aid in the hydraulics analysis. These samples were obtained at the stream bed level at the general location of the influent and effluent of the proposed drain enclosure section. Based on the results of the grain size/hydrometer analyses of the sediment, the fines content ranged from 80.6% to 5.6% for the upstream and downstream samples, respectively. Relevant soil parameters for scour analysis are provided in the following table.

Sample ID	Sample Depth	Approximate Elevation	Material Classification	D50 (mm)	D84 (mm)	Percent Fines (Passing #200)
SED-1 (Upstream)	0 to 1 ft.	600 ft.	Lean clay with sand, trace gravel (CL)	0.005	0.14	80.6%
SED-2 (Downstream)	0 to 1 ft.	599 ft.	Poorly graded sand with gravel and clay (SP-SC)	0.34	5.4	5.6%



4.0 ANALYSIS AND RECOMMENDATIONS

4.1 CULVERT RECOMMENDATIONS

Culvert structure improvements along the Frank and Poet Drain include the replacement of the existing culvert ends with new headwalls and wing walls and drain channel widenings. Along the west end of the drain, the improvements consist of enclosing the drain approximately 1,200 lineal feet from the west end of the project limits to about 1,500 feet east of Telegraph Road centerline. In addition, a full replacement of the existing culvert structure at Racho Road is also proposed. We understand new culvert sections for the proposed drain enclosure, as well as the replacement culvert at Racho Road, will consist of a 20-foot by 6-foot concrete box culvert section.

We recommend the use of shallow foundations for support of the new headwall and wing wall structures. We presume the existing structures are supported on spread footings bearing on similar native clay soils as encountered in our soil borings, though no specific as-built drawings were available. The new box culvert sections will generally be supported by the base of the box.

Based on the project drawings dated March 29, 2019 provided by Wade Trim, the proposed invert elevations range from 600 feet at the west end of the site to 595 feet at the east end of the site. Table 4.1 lists a summary of the proposed improvements, the soil borings drilled at each existing culvert structure, and the soils expected at the proposed culvert invert level.

Based on our soil borings, we anticipate the soils encountered near the invert elevations of the drain should consist of the medium to hard lean clay soils indicated in the table above. There was some variability of the strength of the clay soils encountered between borings drilled for the same culvert structure. The variability of these soils will likely be observed in the field and should be expected. The design of each culvert improvement should consider the worst-case soil condition encountered within the borings at their respective invert depth.



Table 4.1: Proposed Improvements Summary

Boring Numbers	Existing Culvert Type and Size	Approximate Existing Invert Elevation	Invert Soils	Culvert crossing general location	Proposed Improvement
SB-01, SB-02	Approximately 12' x 5' Concrete pipe arch tube	595.5 feet	Stiff to very stiff clay, (CL)	Racho Road	20-foot by 6-foot box culvert replacement
SB-03, SB-04	19'-6" span x 5'-4" rise CMP multi-plate arch culvert	594.3 feet	Stiff to very stiff clay, (CL)	Cross Creek Plaza (Southland 4)	Open drain; new head walls and wing walls
SB-05, SB-06	3, 106-inch x 73-inch, CMP, multi-plate arch culvert pipes	595.4 feet	Stiff clay, (CL)	Southland Mall Drive (Southland 3)	Open drain; new head walls and wing walls
SB-07, SB-08	3, 106-inch x 73-inch, CMP, multi-plate arch culvert pipes	597.1 feet	Stiff to hard clay, (CL)	Southland Mall Drive (Southland 2)	Open drain; new head walls and wing walls
SB-09, SB-10	3, 106-inch x 73-inch, CMP, multi-plate arch culvert pipes	597.3 feet	Stiff clay, (CL)	Southland Mall Drive (Southland 1)	Open drain; new head walls and wing walls
SB-11, SB-12	2, 106-inch x 73-inch, CMP, multi-plate arch culvert pipes	598.0 feet	Stiff to medium clay, (CL)	Pardee Road	Open drain; new head walls and wing walls
SB-13, SB-14	6 ft. x 9 ft. dual cast-in-place concrete box culvert	598.1 feet	Very stiff to stiff clay, (CL)	Meijer Drive (Meijer 3)	Open drain; new head walls and wing walls
SB-15, SB-16	6 ft. x 9 ft. dual cast-in-place concrete box culvert	598.8 feet	Very stiff to stiff clay, (CL)	Meijer Drive (Meijer 2)	Open drain; new head walls and wing walls
SB-17, SB-18	6 ft. x 9 ft. dual cast-in-place concrete box culvert	598.8 feet	Very stiff to stiff clay, (CL)	Meijer Drive (Meijer 1)	20-foot by 6-foot box culvert enclosure to the west of existing
N/A	20 ft. x 6 ft. precast concrete box culvert	599.0 feet	N/A	Syracuse Street	No change
SB-19, SB-20	20 ft. x 6 ft. precast concrete box culvert	599.4 feet	Very stiff to stiff clay, (CL)	Shopping Center Drive	20-foot by 6-foot box culvert enclosure east and west of existing
SB-21, SB-22	20 ft. x 6 ft. precast concrete box culvert	599.6 feet	Stiff to very stiff clay, (CL)	KE's Salon Drive	20-foot by 6-foot box culvert enclosure east and west of existing
SB-23	No existing culvert present – open channel	600.0 feet	Stiff clay (CL)	West Point Street	20-foot by 6-foot box culvert enclosure



4.1.1 Foundation Design Recommendations

We recommend the use of shallow foundations for support of the proposed structure improvements and replacements. The existing soils (indicated in Table 4.1) are generally considered suitable for supporting the proposed culvert structures and culvert improvements, provided they are properly prepared during construction.

Proposed Concrete Box Culvert

With a box culvert structure, the base of the culvert is generally considered the foundation bearing area. We assumed the dimensions of the 20-foot by 6-foot concrete box culvert sections will be constructed in 10-foot lengths. The bearing depths are assumed to be approximately 1 foot below the proposed invert elevations (about 7 to 10 feet below existing grades), on properly prepared bedding material. We do not anticipate widening of the roadways at the culvert locations, therefore no additional loading is assumed other than the weight of the structure.

Proposed Head Walls and Wing Walls

New head walls and wing walls are proposed for seven existing culverts, as well as on each end of the proposed drain enclosure structure. For the analysis of the head walls and wing walls, the dimensions of the footings were assumed with a width of 5 feet, and anticipated lengths of about 10 feet. We have not assumed any surcharge loading behind the wing walls or any additional loading other than the weight of the structure. The wing wall foundation design at each structure should use the factored bearing resistance according to Table 4.1.1 based on the stationing of the proposed structure.

AASHTO LRFD Bridge Design Specifications were used to analyze the Strength Limit State for the proposed foundations. The factored bearing resistance at each location is provided in Table 4.1.1.



Table 4.1.1: Factored Resistance Summary					
Frank and Poet Drain – Factored Bearing Capacity					
<i>Applicable Soil Borings</i>	<i>General Culvert Locations</i>	<i>Approximate Station</i>	<i>Culvert Invert Elevation (ft)</i>	<i>(q_R) Factored Resistance</i>	<i>Bearing Stratum</i>
SB-17 to SB-23	Meijer 1, Shopping Center Drive, and West Point Street/KE's Salon Drive	6+06 to 18+04	599.6 ~ 598.8 +/-	4,000 psf	Stiff to very stiff clay
SB-13 to SB-16	Meijer 2 and Meijer 3	18+04 to 29+30	598.8 ~ 598.0 +/-	5,000 psf	Stiff to very stiff clay
SB-11 and SB-12	Pardee Road	29+30 to 30+90	598.0 +/-	2,000 psf	Stiff to medium clay
SB-03 to SB-10	Southland 1, 2, 3, and 4	30+90 to 57+60	598.0 ~ 594.3 +/-	4,000 psf	Stiff to very stiff clay
SB-01 to SB-02	Racho Road	57+60 to 58+84	595.5 +/-	3,500 psf	Stiff to very stiff clay

With variability in bearing soil strengths found along the length of the culverts, the above factored bearing resistances should be used for design. These values were calculated using the worst-case clay properties as encountered in our soil borings. These factored bearing resistance values incorporate a resistance factor of 0.5 (factor of safety of 2) based on the theoretical method in clay.

Proper bedding material should be placed below the bottom of footing. The bedding soils (or envelope backfill material) should consist of the soils specified in LRFD Section 12.4.1.3. As shown on project drawings dated March 29, 2019 provided by Wade Trim, 8 inches of 21AA aggregate bedding is proposed between the bottom of the culvert and the natural grade. A non-woven geotextile separator fabric may be required between the culvert bedding and the natural subgrade if they are not compatible in grain size, or if an open-graded bedding material is utilized. Where less dense soils are encountered, it may be necessary to place a stabilization layer below the bedding to provide a stable platform.



At (or very near) the proposed invert levels in borings SB-11 and SB-12, medium lean clay soils were encountered. Based on our analyses, a factored bearing resistance of about 2,000 psf can be achieved for the medium clay soils. Foundations for the proposed head walls and wing walls should be appropriately sized to reduce the applied pressure on these medium clay soils. If the footings cannot be sufficiently widened, some improvement of the medium clay soils should be considered. Improvement could be achieved with an undercut and replacement or a geogrid and aggregate mat system.

However, we anticipate the factored bearing resistance values shown in Table 4.1.1 is more than sufficient for support of the anticipated loading of these structures with proper bedding. Generally, the net increase in load at the bearing depth for a culvert structure is negligible, since the weight of the structure is generally considered equal to the weight of the soil removed. Therefore, we do not believe a bearing capacity failure is a concern.

Considering the anticipated light to moderate loading from the culvert structures, we anticipate the total settlement could be about 1 inch or less, with differential settlement at about one half of the total, provided it is bearing on suitable soils that are not disturbed. Similarly, for the new head wall/wing walls, we anticipate they will not have any significant loading (above what the bearing soils have previous experienced) but will act mainly as retaining walls to support the grading of the soils around the culvert structures. Theoretically, we do not anticipate any settlement occurring at the proposed culvert structures where no new loads are imposed on the bearing soils. However, once the final design is complete, the weight of the new structures should be verified they are not imposing loads greater than the existing soil and groundwater conditions. It should be noted that constructing the culvert on disturbed bearing soils could result in settlement, and care should be taken to prevent this.

The design of the structures should take into account any unbalanced hydrostatic pressures occurring when the drain is empty. In general, because these culverts are open-ended structures, groundwater should not build up to a level outside of the culvert and not within the culvert. As such, buoyancy should not be an issue.



Shallow foundations supporting the proposed structures will need to be located below the level of any predicted scour or sufficient creek bed armor will be required to prevent any scouring of the bearing soils. If a significant scour event occurs, the soils supporting the footings will be washed out, resulting in foundation failure.

4.1.2 Lateral Earth Pressures

The proposed box culvert walls and wing walls should be designed based on the recommended lateral earth pressures summarized in the following table. The required lateral movement of the top of the wall to reach the earth pressure conditions in granular soils is based on the AASHTO LRFD requirements summarized in Table C3.11.1-1 of the LRFD Manual. The lateral earth pressures provided in the following table resulting from the soft to hard clay soils are assumed to be in-situ clay soils. Compacted clay backfill soils are not typically recommended behind walls as it is difficult to properly compact and monitor the placement of the clay. Compacted clay backfill results in very high lateral earth pressures which do not dissipate over time.

4.1.2 Lateral Earth Pressures									
Recommended Lateral Earth Pressures ^(A,B,C)									
Soil		Granular ^c		Clay			Random Fill	MDOT Class II 95% ASTM 1557	MDOT 21AA 95% ASTM 1557
		Loose	Dense	Hard	Stiff	Soft			
Consistency							---		
ACTIVE	Lateral Translation to Mobilize ¹	(0.003)H	(0.001)H	(0.01)H	(0.02)H	(0.05)H	(0.02)H	(0.002)H	(0.001)H
	Active Coefficient (K_a)	0.32	0.28	0.45	0.45	0.45	0.60	0.31	0.22
	Equivalent Fluid Active Earth Pressure ²	40 psf	35 psf	65 psf	65 psf	65 psf	65 psf	40 psf	30 psf
	Lateral Surcharge (q) Effect ³	0.32*q	0.28*q	0.45*q	0.45*q	0.45*q	0.60*q	0.31*q	0.22*q
AT-REST	At-Rest Coefficient (K_o)	0.48	0.44	0.63	0.67	0.75	0.75	0.47	0.36
	Equivalent Fluid At-Rest Earth Pressure ²	60 psf	55 psf	90 psf	90 psf	95 psf	95 psf	55 psf	50 psf
	Lateral Surcharge (q) Effect ³	0.48*q	0.44*q	0.63*q	0.67*q	0.75*q	0.75*q	0.47*q	0.36*q
PASSIVE	Passive Coefficient (K_p)	3.12	3.54	2.20	2.00	1.67	1.67	3.25	4.60
	Equivalent Fluid Passive Earth Pressure ²	375 psf	440 psf	320 psf	270 psf	210 psf	220 psf	405 psf	640 psf
	Lateral Bearing Capacity for Transient Loading ⁴	---	---	6 x Clay Cohesion			---	---	---



Notes on Table 4.1.2:

- ¹ – For active earth pressures, the structure must rotate about the base, with the top of the structure laterally translating between 0.001 and 0.05 of the exposed height to fully mobilize the active earth pressures. Otherwise the structure should be considered to be in an At-Rest condition.
- ² – Equivalent Fluid Earth Pressures should be applied in a triangular distribution laterally against the structure.
- ³ – The lateral effect of a surcharge, q , on ground surface at the top of the structure should be applied uniformly against the structure.
- ⁴ – Passive pressures for long term loading conditions. For transient loads, i.e. wind or traffic loading, short term lateral loads will mobilize the cohesion in the clay soils and may be resisted by the “lateral bearing capacity” of the clay soils. However, long term or permanent lateral loads applied to the stiff to soft clays will cause the soils to creep and lose the horizontal resistance. Therefore, the lateral resistance from the clay soils for the life time of the structure will shift from the cohesive “lateral bearing capacity” to the equivalent fluid pressures as the pore water pressure dissipates.
- ^A – All earth pressures provided are for the drained condition. If drainage is not provided behind the structure or a soil stratum is situated below the long-term ground water table, then the equivalent earth pressures should be recalculated using the buoyant unit weight of the soil and include the hydrostatic pressure from the long-term groundwater table.
- ^B – No resistance factors have been applied to any of the recommended lateral earth pressures. It is anticipated that these factors will be applied in the design of the structure.
- ^C – Granular soils include silt, sand, and gravel.

The application of the earth pressures in the design of below grade structures will be influenced by the geometry of the structure, the fixity conditions imposed on the structure, the method and material used for construction and soil and groundwater conditions. Generally, the soil conditions acting on below grade structures can be assumed to be in one of the three conditions. Active earth pressure occurs when the top of the structure rotates away from the soil a sufficient amount to mobilize its shear strength (noted as the required lateral translation) so the soil mass stretches horizontally and a condition of plastic equilibrium is reached. If the structure is rigidly restrained, so that it does not rotate sufficiently to reach the active earth pressure condition, at-rest earth pressure conditions will exist. If the structure is partially restrained, the actual lateral earth pressure may be somewhere between the active and at-rest pressure conditions. The actual pressure distribution will depend on the flexibility and stiffness of the structure. Also, any additional lateral structure loads resulting from surcharge loading, such as traffic loads, should be added to the above earth pressures. Passive earth pressure occurs when the wall or foundation moves into the soil and the soil mass is compressed horizontally, mobilizing its shear strength fully.

As noted, the recommended lateral earth pressures are all unfactored and do not include hydrostatic pressures or account for the long-term groundwater level. Due to the culvert structures being open-ended, we do not anticipate that there will be any unbalanced hydrostatic



pressure on either the inside or outside of the culvert. We anticipate that the relevant load and resistance factors will be applied to these recommended pressures during the structural design.

For cast-in-place below grade structures or other below grade structures requiring backfill behind the structure, the backfill should consist of granular engineered fill consistent with MDOT Class II gradation. To accurately apply the recommended earth pressures for the MDOT Class II granular fill, the backfill must extend out from the base of the structure at an angle of at least 45 and 60 degrees from the vertical for the active and passive cases, respectively. Precautions should be considered to avoid overstressing the structure during backfilling and compaction. Temporary bracing of the walls during backfilling may be required to help avoid this problem.

4.2 CULVERT APPROACH RECOMMENDATIONS

We understand that flowable fill will be used as backfill behind the culvert walls under any pavement area. For any new or reconstructed pavement at the culvert locations, we anticipate it will be constructed at about or slightly above the existing surface grade. We assume a minimum of 12 inches of granular engineered fill will be placed below any new pavements, regardless if the subgrade consists of flowable fill or native clay material. The flowable fill material should provide more than enough capacity to support traffic loads, as long as adequate drainage is provided below the proposed pavement slab.

For slabs constructed directly on the existing soils, the following recommendations apply. Based on the soil borings, the subgrade soils behind the existing culverts consisted of materials with elevated fines content, such as *silty* sand or clay. A large percentage of fines encountered within the subgrade soils may reduce the ability of the material to effectively allow drainage below the pavement and may pose a risk to detrimental frost action. Several areas of subgrade were also found to be in a loose condition (N-values less than 10). In addition, non-engineered fill material may increase the risk of pavement cracking, faulting, or uneven settlement. All of these conditions eventually lead to detrimental pavement distress.



Typically, we do not recommend constructing new pavement on undocumented fill soils, however, at some locations, the existing fill soils do not appear to contain excessive organic material or debris. As such, these soils should be acceptable to support new pavement sections, provided they are compacted thoroughly. Locations where asphalt, concrete, and other debris materials were encountered will need to be removed prior to pavement construction. The risk of premature pavement cracking, faulting or uneven settlement should be considered when placing a pavement on a non-engineered fill material. If the risk of this type of distress is *not* tolerable, then it may be necessary to remove some or all of the existing non-engineered fill material and replace it with engineered fill. We recommend a geotechnical engineer or qualified technician confirm the suitability of the subgrade soils in the field at the time of construction.

As noted above, the existing subgrade soils were observed to have high “fines” content. These conditions, where the soils are considered susceptible to frost because water is not allowed to drain freely either due to subsoil conditions, site grades, or other factors, will allow for frost heave to have a greater impact on the pavement performance. Localized undercutting may be required to remove fine grained soils replace with well compacted and drainable granular engineered fill to promote drainage below the new pavement. The new fill material must be hydraulically connected to free-draining ditches or structures in order to avoid collection of water below the pavement. In addition, the subgrade should be graded to provide for positive drainage to these ditches or structures.

Where these looser soils are encountered, they will require some densification, which could be performed by in-place compaction. The purpose of the compaction is to uniformly compact the subgrade surface. The pavement subgrade areas should also be thoroughly field tested for adequate compaction as required by current MDOT Construction Specifications. Loose or soft areas of subgrades that cannot be adequately compacted should be undercut a minimum of 9 inches and replaced with well compacted engineered fill.

Once rough grade has been achieved, the exposed pavement subgrade should be visually checked for the presence of debris, organic matter, and other unsuitable materials. If unsuitable or highly



organic subgrade soils (organic contents greater than about 4%) are encountered during construction, the material should be removed and replaced with engineered fill. If encountered, the on-site geotechnical engineer can determine the depth and extent of the undercut. Depending on the depth of undercut, we recommend utilizing engineered fill such as MDOT Class II sand, or an aggregate base material such as MDOT 4G or 21AA type material. The MDOT 21AA crushed aggregate is a dense graded aggregate and it is very good for stability, but it does not drain well. If this material is to be used in an area where drainage is a consideration, then the MDOT 21AA should not be used.

Any existing clay soils with relatively high moisture contents (more than 4 percent over optimum) tend to become disturbed by construction traffic and may be difficult to compact, especially if earthwork is performed during the typically wet spring and fall seasons. It may be necessary to disc and aerate clayey subgrade soils during earthwork operations to achieve the desired amount of compaction in some areas of the site. This may also be required to stabilize the soils for placement of fill, aggregate base, or for support of paving equipment. Preferably, site earthwork should be performed during the typically drier May to September construction season.

The top 12 inches of pavement subgrade should be compacted to a minimum of 95 percent of the maximum dry density as determined by AASHTO T-180 (Modified Proctor). It may be necessary in some areas to remove disturbed subgrade soils and replace them with a stabilization layer of engineered crushed aggregate fill. The thickness and extent of the required aggregate stabilization layer can be determined in the field by the site geotechnical engineer. We recommend crushed aggregate or crushed concrete with a maximum particle size of 3 inches and no more than 7 percent passing the No. 200 sieve for this purpose. The top surface of the aggregate stabilization layer should be “choked off” with a layer of MDOT 21AA material, if the bottom layer of aggregate is larger than MDOT 21AA gradation.



4.3 SIGN FOUNDATION RECOMMENDATIONS

As we understand, three decorative entryway signs are proposed to be installed along Eureka and Telegraph Roads. The signs will be independent structures. Considering the potential vertical loads for these signs, we anticipate shallow, spread footing foundations will be feasible for the support of the proposed structures. Alternatively, due to the depths of fill soils encountered at the sign locations proposed at the Eureka Road and Telegraph Road intersection, helical pile and drilled shaft foundation recommendations are provided below.

4.3.1 Spread Footings

The spread footings will likely be a slab-type footing bearing on soils at or near standard frost depth of 3.5 feet below final site grades. The estimated settlement of the spread footings is based on the anticipated light loading conditions of similar structures, available soil boring information, the assumption that the bearing soils are undisturbed, and that any engineered fill is properly compacted. To reduce the amount of differential settlement, foundations should be constructed on uniform bearing soils, or the structural design of the sign should account for additional differential settlement. Differential settlement is expected to be about half of the total settlement based on uniform bearing soils.

Proposed Sign West of Allen Road

The first proposed sign will be located at the east end of the project corridor, within the median of Eureka Road, just east of the CN Railroad bridge and west of Allen Road. We anticipate this sign will be a small, low structure (either a concrete, masonry, or metal sign). For our calculations, we estimated the effective footing size to be 10 feet by 15 feet.

Based on soil boring SB-24, the anticipated foundation bearing soils at 3.5 feet below final site grade will consist of very stiff to medium lean clay. For foundations bearing on this material, we recommend a maximum allowable bearing pressure of 2,000 psf. The maximum net allowable soil bearing pressure incorporates a minimum factor of safety of 3 on the ultimate bearing capacity.



This section of Eureka Road is depressed in order to facilitate the grade separation of Eureka Road under the CN Railroad. We anticipate up to 10 feet of soil was excavated from the pre-construction ground surface to the existing Eureka Road surface level. As such, the clay soils at the bearing level have already “experienced” the pressure and consolidation resulting from the historical presence of the excavated soils. This is beneficial in terms of controlling overall settlement from the new structure foundations and allowing higher than normal foundation loads while controlling consolidation settlement. Based on the recommended allowable bearing pressures, we estimate a total settlement of less than half inch, assuming some disturbance of the bearing soils during construction. To reduce the amount of differential settlement, foundations should be constructed on uniform bearing soils, or the structural design of the sign should account for additional differential settlement. Differential settlement is expected to be about half of the total settlement based on uniform bearing soils. We recommend full-time monitoring and inspection of the subgrade soils be performed by a qualified geotechnical engineer.

Proposed Sign at Telegraph Road North of Eureka Road

One entryway sign is proposed to be located within the median of Telegraph Road on the north side of Eureka Road. This sign is proposed to be an arch-shaped sign with aesthetic tieback features. We anticipate this sign will be about 20 feet tall. For our calculations, we estimated the effective footing size to be 10 feet by 30 feet. The aesthetic tieback cables will be anchored in the ground independently of the footing; however, they are not planned to carry any load.

Based on soil boring SB-25 and hand auger probes HA-25 and HA-25A, the anticipated foundation bearing soils at 3.5 feet below final site grade will consist of very stiff lean clay fill over hard natural lean clay. Generally, we do not recommend constructing new foundations on undocumented fill soils since we do not have knowledge of the manner and quality control of the fill placement which can result in the potential for settlement, foundation cracking, or faulting. As such, we recommend that the footings bear deeper, through the fill material, on the natural clay soils encountered at a depth of about 5 feet below existing grade. As an alternative, the existing fill material can be removed with a 1.5-foot undercut and backfilled with properly compacted, granular engineered fill to the 3.5 bearing depth; the foundation could bear directly on the engineered fill.



For foundations bearing on the engineered fill or the natural hard clay, we recommend a maximum allowable bearing pressure of 3,000 psf. The maximum net allowable soil bearing pressure incorporates a minimum factor of safety of 3 on the ultimate bearing capacity. Due to the increased potential of premature cracking, faulting or differential settlement of foundations constructed on undocumented fill soils, we recommend full-time monitoring and inspection of the fill soils be performed by a qualified geotechnical engineer to ensure the foundation is bearing on suitable soils.

Based on the recommended allowable bearing pressure and a footing depth of 3.5 to 5 feet below finished grade bearing on the lean clay fill, we estimate a total settlement of less than 1 inch, assuming the bearing soils are undisturbed. To reduce the amount of differential settlement, foundations should be constructed on uniform bearing soils, or the structural design of the sign should account for additional differential settlement. Differential settlement is expected to be about half of the total settlement based on uniform bearing soils. We recommend full-time monitoring and inspection of the subgrade soils be performed by a qualified geotechnical engineer.

The foundation footing should account for the potential lateral loads imposed on the structure, which may be critical due to the potential height and unique shape of the proposed sign structure. The effective footing should not apply loads in excess of the maximum net allowable bearing pressure, and the eccentricity of the loading should not exceed one-third of the footing width. The anticipated lateral loads need to be sufficiently resisted to prevent overturning of the structure. This can be achieved by increasing the size and/or depth of the footing until the loads from the structure and soil embedment can sufficiently counter overturning action due to the lateral forces.

Proposed Sign at Telegraph Road South of Eureka Road

Another sign identical to the entryway sign in the median of Telegraph Road north of Eureka Road is proposed to be located on the opposite side of Eureka Road, also within the Telegraph Road median. Being a similar sign structure, we estimated the effective footing size to also be 10 feet by 30 feet for our calculations.



Based on soil boring SB-26, the anticipated foundation bearing soils at 3.5 feet below final site grade will consist of medium dense to very loose poorly graded sand fill with asphalt millings (pieces). As discussed above, we do not recommend constructing new foundations on undocumented fill soils due to the potential for settlement, foundation cracking, or faulting. Ideally, fill soils containing asphalt, concrete, organics, or apparent deleterious material should be completely removed prior to construction. However, the fill materials were found to extend to a depth of about 10 feet below existing grade which is likely not economically feasible for the nature of this project.

4.3.2 Helical Piles

As an alternative to the remove and replace method of improvement, intermediate foundations, such as helical piles, could be considered for support of the sign structures. Helical piles are essentially steel shafts with auger flights at the bottom that are screwed into the ground to a specified bearing resistance. They are easily installed with small construction equipment. The installation also generally can be performed without generating a significant amount of soil cuttings. However, the disadvantage is that these piles cannot penetrate obstructions, such as buried concrete or boulders, if encountered.

The capacity of helical piles is derived from the soil resistance in the helices (whether in compression or tension). These can be designed with two or more helices to achieve higher capacities. We preliminarily estimate an ultimate axial vertical load (both compression and tension) of 25 to 45 kips can be achieved per helical pile consisting of two or three helices per pile with different combination of helix diameters (ranging between 10 and 14 inches in diameter). We recommend the allowable load should utilize a minimum factor of safety of 2 on the ultimate capacity. The helices would need to bear at a depth of 10 to 15 feet below existing grades and should be embedded in the natural lean clay. Based on the estimated capacity of the piles and the existing soil conditions, we estimate total settlement for the helical pile foundations will be less than one inch. These preliminary estimated capacities were determined from the Chance® HeliCAP helical anchor software product by Hubbell Power Systems, Inc. The estimated tip depths are based on the soil conditions encountered at SB-26 during our field investigation.



To achieve the required total vertical capacity and for stability concerns, multiple helical piles may need to be installed in groups. For helical pile group installation, we recommend the individual piles be spaced at least 5 flight diameters apart and no closer than 3 feet, measured from center to center of the piles. The purpose of the spacing is to provide sufficient room for installation equipment, and also to prevent overstressing of the foundation soils.

Since these pile elements are constructed of steel, the potential for corrosion does exist. We recommend using a corrosion inhibitor coating that meets ASTM standards and as specified by the helical pile manufacturer.

It should be noted that a vertical helical pile has very little capacity to resist lateral loads. If significant lateral loads are expected due to the height and shape of the proposed structure, the helical piles will need to be designed with a batter. Battered helical piles may also be utilized for the proposed sign at Telegraph Road north of Eureka Road to counter the overturning moment due to potential lateral loads.

While our estimates indicate the helical piles are a feasible foundation option and serve as a reasonable basis for estimating the type and length of anchors required for this project, the final design will need to be performed by a qualified and experienced specialty engineer. The capacity of the helical piles is based on the depth of the pile flights, and the number and diameter of the flights. The installation and feasibility of some pile elements may be limited by excessive torque during installation. *The final design will need to be conducted by the specialty contractor, because of the proprietary nature of the piles and installation procedures.*

4.3.3 Drilled Shafts

The soils encountered in borings SB-25 and SB-26 were analyzed to determine the general engineering properties of each soil layer/strata to be used in the design for a drilled shaft foundation. In borings SB-25 and SB-26, the fill soils encountered within the upper 5 feet and 10 feet, respectively, were neglected in the analysis. Otherwise, we have summarized the general soil profile encountered in these soil borings and tabulated general engineering properties



of each soil layer/strata to be used in the design for drilled shafts. This information is presented in Table 4.3.3.

The estimated soil parameters are based on the assumption that the drilled shafts will be in direct contact with the native soils. If a permanent casing is used, then the actual skin friction values will be significantly lower, reflecting the behavior between the steel casing and the surrounding soils. The skin friction values provided in the table would need to be reduced by 70% along the zone with casing.

4.3.3: Estimated Soil Parameters for Drilled Shaft Design			
	Hard Clay (SB-25: 5 to 12.5 ft.) (SB-26: N/A)	Very Stiff Clay (SB-25: 12.5 to 20 ft.) (SB-26: 10 to 17 ft.)	Stiff Clay (SB-25: N/A) (SB-26: 17 to 20 ft.)
Recommended Max. Allowable Bearing Pressure for Vertical Compression Loads (using FS=3)	9,000 psf	4,500 psf	2,500 psf
Unit Weight ^A	135 pcf	130 pcf	125 pcf
Cohesion	4,500 psf	2,250 psf	1,250 psf
Lateral modulus of subgrade reaction, k_h	300 kcf	150 kcf	100 kcf
Skin Friction ^C	1,800 psf	1,000 psf	750 psf
Friction Angle	0°	0°	0°
Strain Factor, ϵ_{50} ^B	0.004	0.005	0.007
P_y Modulus, k^B	800 pci	400 pci	200 pci

^A. For materials below the long-term groundwater level, the buoyant unit weight applies (subtract 62.4 pcf)

^B. Values obtained from applicable tables in LPile 2016 User Manual for cyclic conditions.

^C. The skin friction values provided are ultimate values and are for uniform rectangular distribution, and assume direct contact between the concrete and the soil. If permanent steel casing is used, these values are not applicable.

For vertical compression loads, we recommend the maximum allowable end bearing pressures as indicated in the soil parameter table above. In general, these values are conservative as we anticipate the vertical load will not control the design of the drilled shaft foundations. However, it may be possible to utilize skin friction along the drilled shafts for vertical load design. Additionally, the recommended soil bearing pressures for the drilled shafts may be increased if



the embedment depth of the shaft is at least three times the diameter of the shaft. The values provided in the soil parameter table include a factor of safety of at least 3.

We estimate total settlement for the drilled shaft foundation should be less than 1 inch, provided the drilled shaft bearing soils are not significantly disturbed. If the drilled shaft bearing surface is significantly disturbed during drilled shaft construction operations, the drilled shaft settlement could exceed 1 inch. These estimates are based on the soil conditions revealed during our exploration, assumed light vertical loading conditions, and our experience with similar soils. The contractor will need to sufficiently clean the bottom of the drilled shaft excavation to remove any disturbed soil before placing the concrete.

For overturning considerations, the maximum soil pressure at the toe of the drilled shaft base should not exceed the maximum net allowable soil pressures. Although, if codes allow, it may be possible to increase the allowable bearing pressures by 33 percent for short term wind loading conditions.

Given the boring depths of 30 feet below existing grades, the maximum length of the drilled shafts should not exceed 20 feet.

4.4 CONSTRUCTION RECOMMENDATIONS

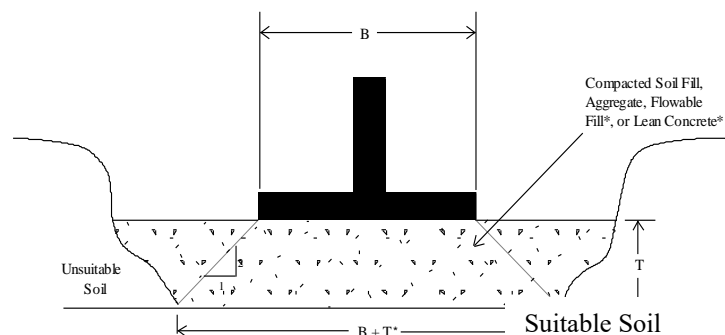
4.4.1 Preparation Recommendations for Bearing Soils

Visual inspection should be performed for all soils below any new foundations. Any disturbed soils will need to be undercut a minimum of 9 inches below the bottom of the bedding material or sign foundations and be replaced with an engineered fill or aggregate stabilization layer (if needed), compacted in place. The required thickness of the undercut or aggregate stabilization layer could vary, and should be determined by the engineering inspector in the field at the time of construction. We recommend crushed aggregate, with a gradation of MDOT 21AA for this purpose.



If an open-graded aggregate is used for stabilization instead of the dense graded MDOT 21AA, a non-woven geotextile fabric will need to be placed between the natural materials and the open graded aggregate to prevent the migration of the fine soil particles into the stabilization material. In addition, the separator fabric may be required between the open graded aggregate and the proposed culvert bedding material if they are not compatible in grain size.

For any improvement type to be over-excavated through the existing soils and constructed on granular engineered fill, the plan area of soil removal should extend out from the edge of the footing a distance of one foot for every two feet of excavation below the footing level. In other words, the soil to be undercut should be removed at a minimum 1H:2V slope from the edge of the footing to the edge of the undercut excavation to provide suitable bearing for the footing. However, lean concrete or flowable fill may be used to raise the bottom of the trench if desired. Then, for an improvement type constructed on the lean concrete or flowable fill, the foundation trench can be excavated vertically to reach suitable bearing soils and does not need to be extended laterally. This is pictured on the "Typical Foundation Undercutting Diagram" shown below.



* When using flowable fill or lean concrete, the minimum width of this layer can be reduced from $B + T$ to B .

Typical Foundation Undercutting Diagram

4.4.2 Drilled Shaft Construction Considerations

Based on the subsurface information from soil borings SB-25 and SB-26, we anticipate the long-term groundwater level is situated at about 10 to 12 feet below existing grades, and will likely be encountered within the zones of the shaft excavations. Additionally, perched groundwater may



be encountered within the fill soils. Temporary casing is recommended through the fill soils to prevent surface water infiltration, the caving of fill material into the excavation, and to keep the shaft sides vertical. The casing should extend through the fill soils and into the natural clay, creating a seal in the natural soil. Within these predominately clay soil profiles, we do not believe a permanent casing is required. It should be noted that while temporary casing is recommended, we understand contractors often are not equipped to remove deep casing. As a result, there have been issues with removing the temporary casing, especially if it is full-depth or nearly full depth, compromising the integrity of the drilled shaft. As such, consideration should be given to just leaving casing in place, unless it is 5 feet deep or less. The drilled shaft operations should be observed by a qualified geotechnical engineer to verify proper bearing material has been reached and that the bearing surface has been properly cleaned.

If the drilled shaft is constructed in the “dry” (i.e. no more than 2 inches of water covering the base of the shaft excavation), the concrete may be placed by the free-fall method. This method consists of using a vertical section of concrete chute to direct the concrete flow out of the truck in a vertical stream of concrete with a relatively small diameter. The stream is directed to avoid hitting the sides of the drilled shaft excavation or the reinforcing cage which could cause concrete segregation.

If the drilled shaft is constructed using the “wet” method, a tremie pipe connected either to a hopper or concrete pump should be used to displace the water in the drilled shaft excavation upwards as the concrete is placed. If this method is used, detailed procedures should be submitted by the contractor for review and approval by the engineer.

The structural concrete should consist of the materials and requirements detailed in the current MDOT Standard Specifications for Construction. Further, the drilled shaft concrete should be placed in accordance with the Drilled Shaft Foundation and the MDOT Standard Specifications for Construction. We recommend concrete with a 5 to 7-inch slump, or self-compacting concrete (SCC) be used for all drilled shaft concrete in order to reduce the potential for arching of the concrete, and to provide a workable material. A positive head of concrete, relative to water



trapped outside the temporary casing, should always be maintained within the casing to prevent perched water and/or soil from infiltrating the drilled shaft.

To reduce lateral movement of the shaft and allow the development of adhesion of the upper soils to the sides of the drilled shaft, it is necessary to place concrete in intimate contact with the soil. Any voids or enlargements in the drilled shaft due to over-excavation or caving soil conditions must be filled with concrete at the time the drilled shaft concrete is placed unless a permanent casing is used. *If any casing is left in place permanently (rather than being removed after the concrete is poured), then the concrete would not be in direct contact with the soils. In this case, there would be a significant reduction in skin friction and the design will need to reflect this.* In addition, we recommend the construction methods assure the drilled shaft excavation is not left open overnight prior to placing of concrete.

4.4.3 Excavation Considerations

We understand the new culverts, head walls, wing walls, and sign foundations will be installed using an open cut excavation method. Considering the proximity to the drain and the necessity to control groundwater flow, a temporary earth retention system will be required. Depending on the proximity of the sign foundations to Telegraph Road, Eureka Road or underground utilities, temporary earth retention may also be required for construction of sign foundations. While the actual earth retention method and design is ultimately selected by the contractor, we expect that driven sheeting will likely be the method of choice, though there are other options. The use of sheeting will be beneficial for groundwater control where the toe of the sheeting is embedded in a clay layer, cutting off groundwater flow.

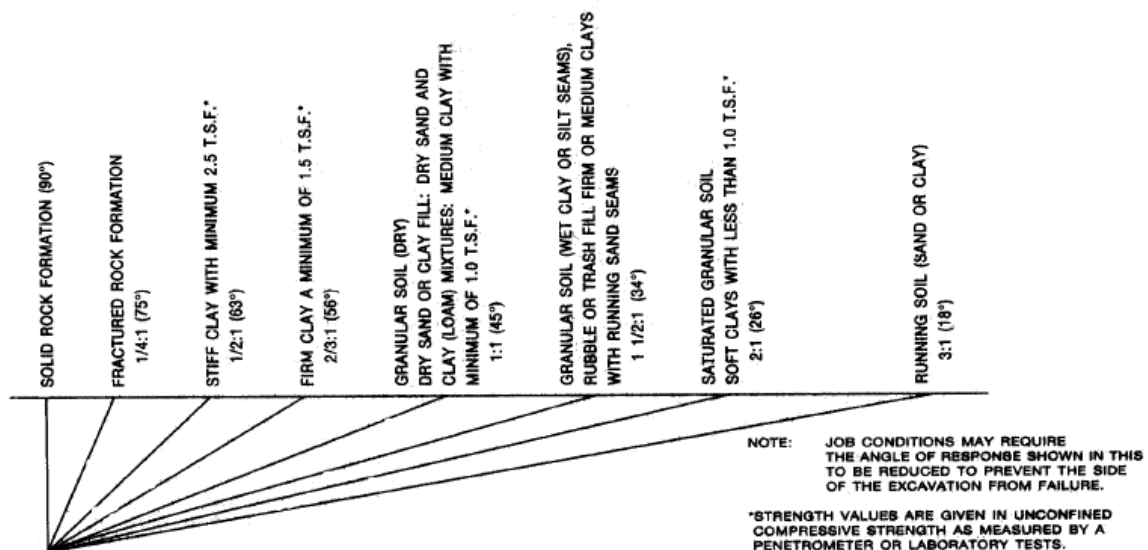
Excavation is recognized as one of the most hazardous construction operations. An excavation is any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal. Trenching and excavation hazards are addressed in specific standards for the general industry in OSHA Part 1926 Subpart P “Excavations”, specifically 29 CFR 1926.650, .651, and .652. The project must comply with the most stringent trenching and excavation requirements of these



standards, MIOSHA Construction Safety Standard Part 9 “Excavation, Trenching, and Shoring”, or other OSHA approved requirements.

We anticipate excavations in site fill soils and granular soils will be prone to caving and sloughing of the excavation sidewalls, especially in areas where the soil conditions are in a loose condition (N value of 9 or less). Appropriate measures will be required to maintain the stability of excavation sidewalls. The required measures will depend on the subsurface materials encountered for the full depth of the excavation, the depth and width of excavation, and groundwater conditions at specific locations. In general, excavation walls should be sloped back to a stable angle in accordance with published MIOSHA guidelines. The side of an excavation more than 5 feet deep shall be sloped as prescribed in the following MIOSHA table (from Part 9), unless the excavation is made entirely in stable rock or supported by a protective system as prescribed in the referenced standards. An excavation less than 5 feet may also require protection if a competent person determines that hazardous earth movement is anticipated.

MAXIMUM ALLOWABLE ANGLE OF REPOSE FOR THE SIDE OF AN EXCAVATION IN EXCESS OF 5' DEPTH



Sloping or benching systems for excavations less than 20 feet deep shall be in accordance with maximum allowable slopes and based on the soil or rock type encountered as prescribed in the



standards. If sufficient room is not available for sloping the excavation walls, then shoring, by means such as trench boxes, sliding trench shields or sheeting, will be required to maintain the stability of the sidewalls. The design of support systems, shield systems, and other protective systems shall be in accordance with OSHA 29 CFR 1926.652. Excavations 20 feet deep or greater require that sloping or benching systems, or a protective system, be designed by a registered professional engineer (or approved by a registered professional engineer in accordance with OSHA 29 CFR 1926.652).

Construction traffic, stockpiles of soil and construction materials should be kept away from the edges of the excavations for a distance equal to the depth of the excavation. If such clearances cannot be maintained, the resulting surcharge loads should be considered in the design of the shoring system. However, no loads shall be placed within 2 feet of an excavation edge for any unsupported excavation in which a worker is required to enter (unless a proper shoring system is in place).

Proper testing for atmospheric hazards such as low oxygen, hazardous fumes, and toxic gases should occur prior to worker entry when excavations are greater than 4 feet deep. Daily inspections of an excavation, adjacent area, and any protective system should be made by a competent person prior to the start of work, following a rainstorm or other water intrusion, or during/after any occurrence that could change the conditions of the trench. In all cases, MIOSHA and other applicable requirements must be followed and adequate protection provided for workers.

The temporary earth retention system (TERS) should be designed to accommodate potential undercut depths (for soils containing greater than 4 percent organics or uncontrolled fill soils) estimated at a maximum of about 3 feet below the proposed excavation. The embedment depth of the sheeting will also be dependent on the base stability and the prevention of groundwater flow up into the excavation. In addition to the earth loads, a uniformly distributed surcharge load of 360 psf (to account for construction and road traffic), as well as groundwater hydrostatic loading, will need to be included in the design.



4.4.3 Groundwater Considerations

We estimate the long-term groundwater level in this area of Eureka Road is situated at a depth of about 7 to 10 feet below existing grades. We anticipate perched groundwater may also be encountered in the sand fill seams/layers above the less permeable clay layers encountered in our soil borings. It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation, and percolation in the area.

We anticipate standard sump pit and pumping techniques alone will not be sufficient to control the groundwater during construction of the new structure. With the presence of water in the drain, we anticipate the use of temporary sheeting toed into the underlying clay bearing soils to temporarily seal off the groundwater from the excavation, or reduce the amount of groundwater infiltration. This is generally the most efficient option, since it could minimize groundwater flow to allow use of sump pit and pumping within the sheeting area.

If granular layers are encountered and sheeting does not sufficiently seal out significant water flow, more elaborate dewatering procedures may be necessary. These special dewatering procedures could include, but are not limited to, downhole pumps in slotted casings or well points. The loss of fines through dewatering should be carefully monitored to protect against the settlement of surrounding structures, pavement, and utilities to remain in place. If specialized dewatering methods are utilized, adjacent structures and utilities should be monitored for potential settlement during dewatering.

If groundwater is not adequately controlled, bottom instability of the excavation or disturbance of the subgrade may occur. The dewatering design criteria will be developed by the contractor upon completion of the anticipated TERS design, and will be submitted for review and approval. The design should include recommended depth of dewatering below the proposed excavation to maintain stability based on the selected geometry of the TERS. In general, we recommend at least dewatering to a depth of about 2 feet below the base of the excavation. The design will need to consider the area of impact and drawdown, the anticipated extent of impact, monitoring



plan, and withdrawal and discharge regulations. We recommend an experienced dewatering contractor design the system.

4.4.4 Protection of Existing Structures

While on site, Somat observed various utilities throughout this stretch of the Frank and Poet drain and at the locations of the sign foundations. These underground utilities were identified during our MISSDIG clearance around the soil boring locations, or indicated on the existing drawing. However, Somat did not perform a detailed utility investigation. Any utilities within 50 feet of the construction operations should be evaluated and protected.

Consideration should be given to the additive loading of new structures on bearing soils. Shallow foundations will apply concentrated loads directly to the bearing soils below the foundations; any existing structures or utilities below the proposed foundations could have additional loads imposed on them, resulting in settlement and potential damage of the existing structure or utility.

In addition, if the water mitigation plan includes driving of sheeting through the existing loose to medium dense granular fill layers, this has potential to cause a “shakedown” consolidation of these granular layers. In previous experience, this consolidation generally radiates about 25 feet away from the driven sheet pile. *Therefore, any structures which are to remain (utilities, roadways, culverts, etc.) that are supported by the loose to medium dense soils and are within the influence of this potential shakedown area should be monitored and protected during sheeting installation.*

Care should be exercised when excavating near existing pavement, utilities, and structures that are to remain, to protect them from damage. Mechanical excavations near existing utilities may also pose a physical hazard to workers if the utility is damaged. The contractor should be aware of existing utility locations before excavating and be prepared to expose them for verification and to support or brace them, as required.



4.5 ENGINEERED FILL REQUIREMENTS

Any fill placed within the pavement areas should be an approved material, free of frozen soil, organics, or other deleterious materials. Also, fill should never be placed on a frozen base. It is recommended that all required earthwork operations be performed under strict compliance with MDOT Standard Specifications for Construction 2012. The fill should be placed and compacted as required by current MDOT Construction Specifications.

5.0 GENERAL QUALIFICATIONS

All earthwork and below grade construction activities, including testing and observation of subgrade and bearing soils, should be monitored by a qualified engineering inspector, under the direction of a qualified geotechnical engineer, to verify conditions are as presented in this report. Earthwork operations around the proposed project area and in the vicinity of existing structures should also be closely monitored.

This report and the attached Logs of Test Borings are instruments of service, which have been prepared in accordance with generally accepted soil and foundation engineering practices. We make no warranties either expressed or implied as to the professional advice included in this report.

The contents of this report have been prepared in order to aid in the evaluation of expected subsoil properties to assist the engineer in the design of *this* project at the site specified herein. The contents of this report should not be relied upon for other projects or purposes. In the event that any changes are made in the geotechnically related aspects of this project, however slight, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified in writing by our office.

Since the information obtained from the soil borings is specific to the exact test locations, soil and water conditions could be different from those occurring at other locations of the site. This



report does not reflect variations which may occur between the soil borings. The nature and extent of these variations may not become evident until the time of construction. If significant variations become evident, it may be necessary for us to re-evaluate the recommendations provided in this report.

This report and the associated Logs of Test Borings should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only, and to supply them with facts relative to the subsurface investigation, laboratory tests, etc.

Somat is not responsible for failure to provide services that other project participants, apart from our client, have assigned to Somat either directly or indirectly. Somat is not responsible for failing to comply with the requirements of design manuals or other documents specified by other project participants, that impart responsibilities to the geotechnical engineer without our knowledge and written consent. We are not liable for services related to this project that are not outlined in our scope of services, detailed in our project proposal.

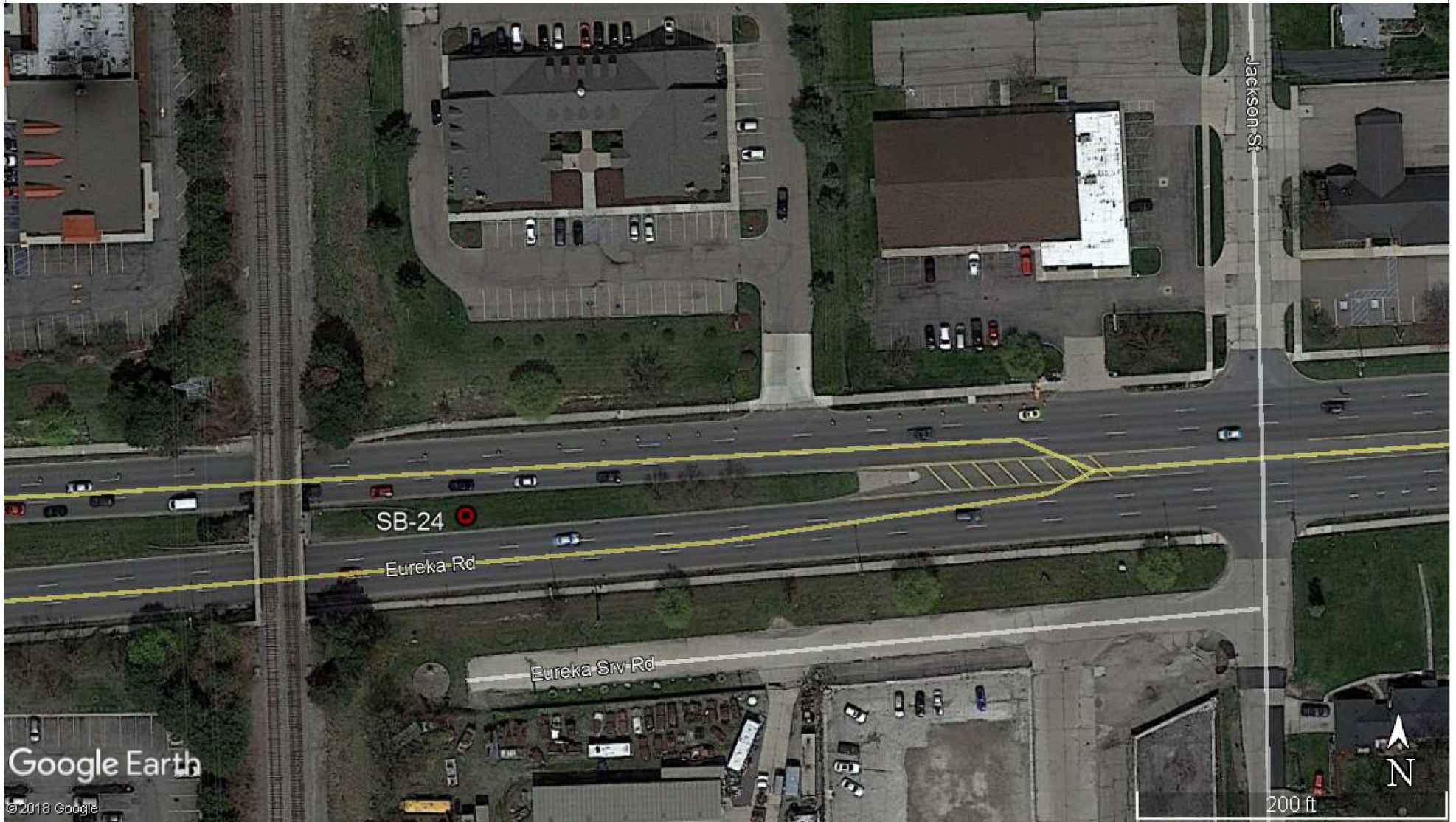
The discussions and recommendations submitted in this report are based on the soil information contained in the Logs of Test Borings and test results appended to this report. We expect that the Logs of Test Borings included in this report along with our discussions and conclusions will assist you in the design of the proposed project. If you have any questions regarding this report, please contact us.

Please review the important information regarding geotechnical reports included in Appendix D.



APPENDIX A

SOIL BORING LOCATION DIAGRAMS



Adapted from GoogleEarth satellite imagery

Legend:

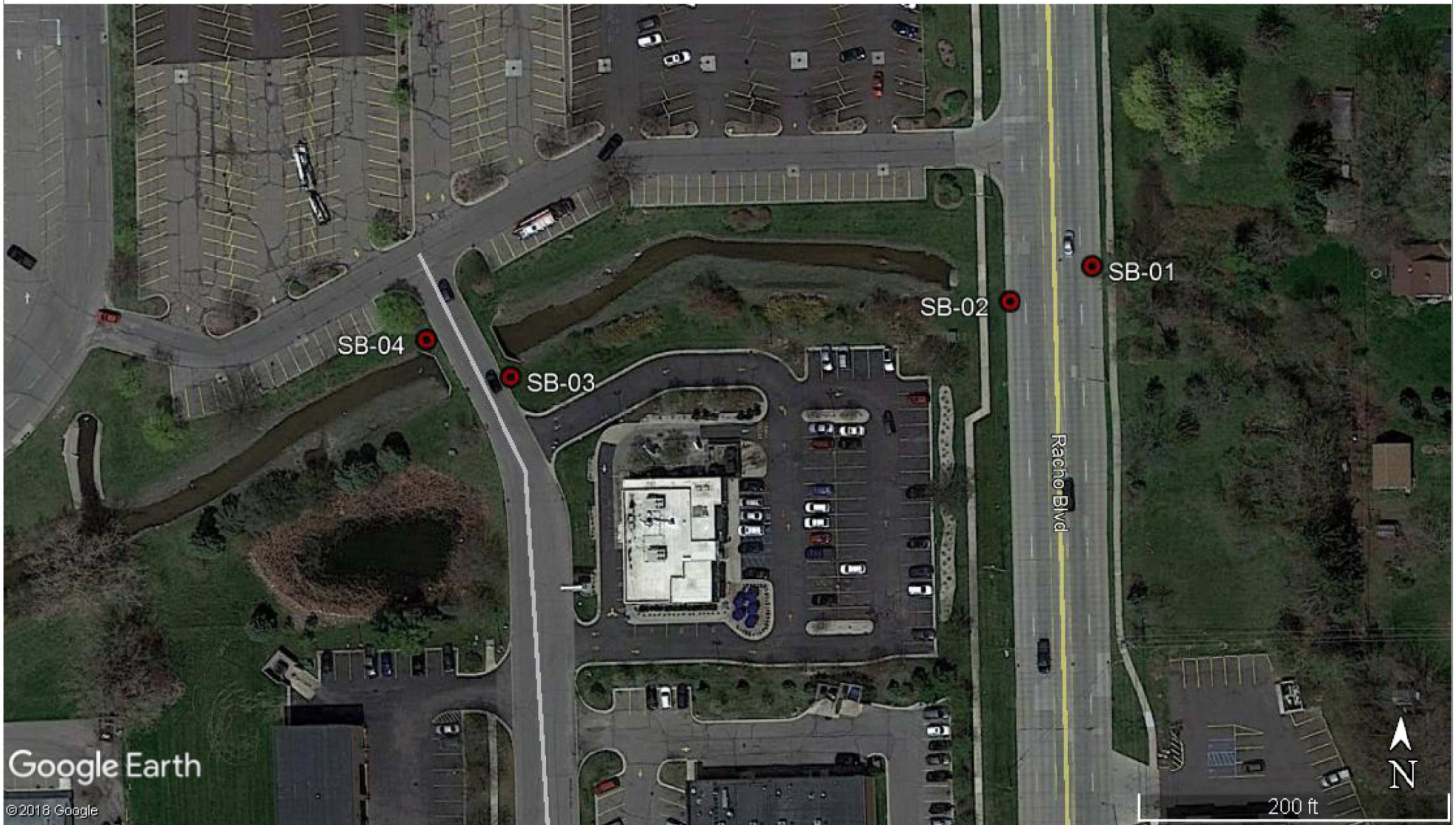


Approximate Soil Boring Locations



Somat Project No.: 2018019 A&B
 Date: 08/30/2019

Soil Boring Location Diagram
 Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan



Adapted from GoogleEarth satellite imagery

Legend:



Approximate Soil Boring Locations



Somat Project No.: 2018019 A&B

Date: 08/30/2019

Soil Boring Location Diagram

*Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan*



Adapted from GoogleEarth satellite imagery

Legend:



Approximate Soil Boring Locations

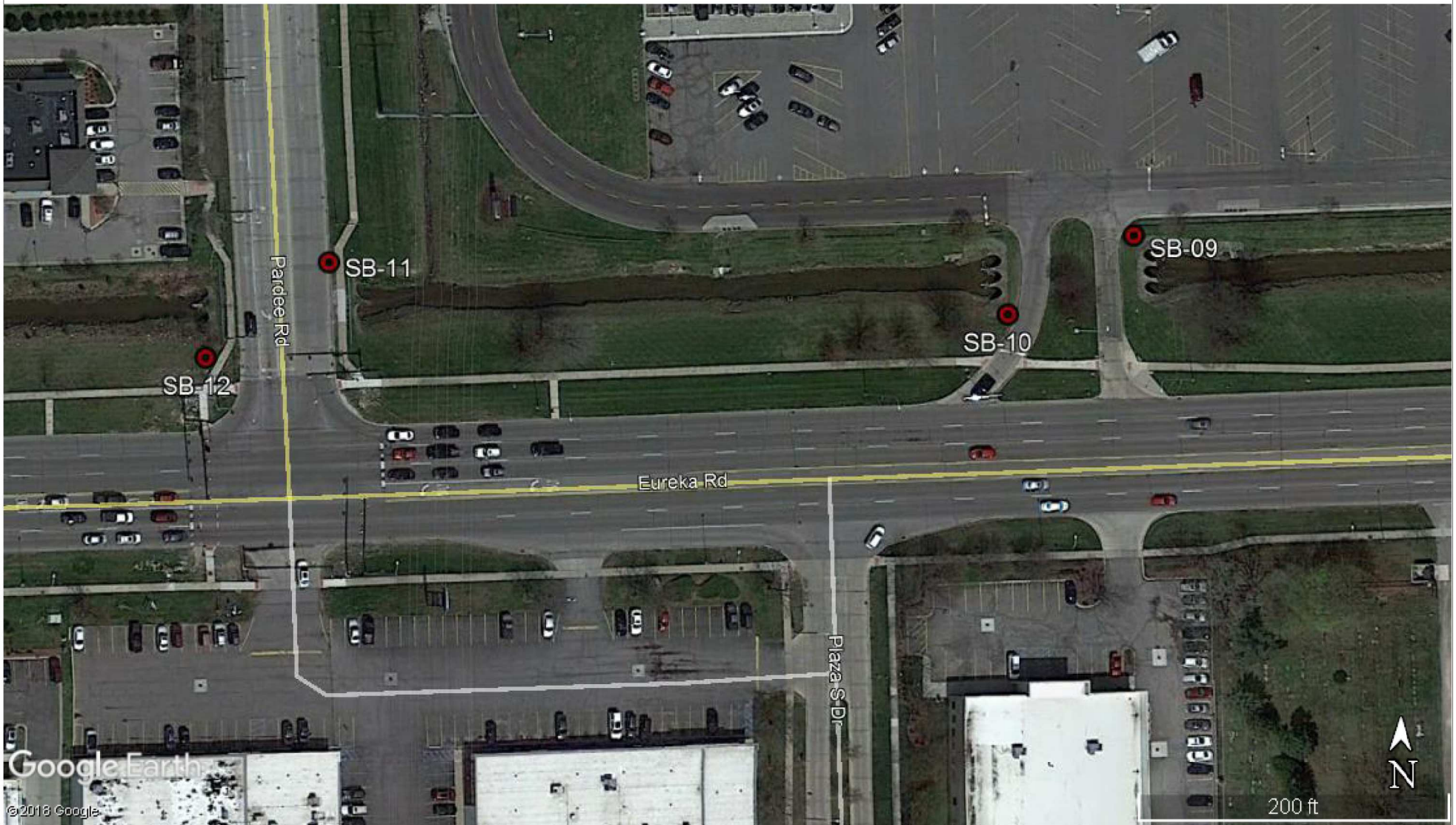


Somat Project No.: 2018019 A&B

Date: 08/30/2019

Soil Boring Location Diagram

*Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan*



Adapted from GoogleEarth satellite imagery

Legend:



Approximate Soil Boring Locations

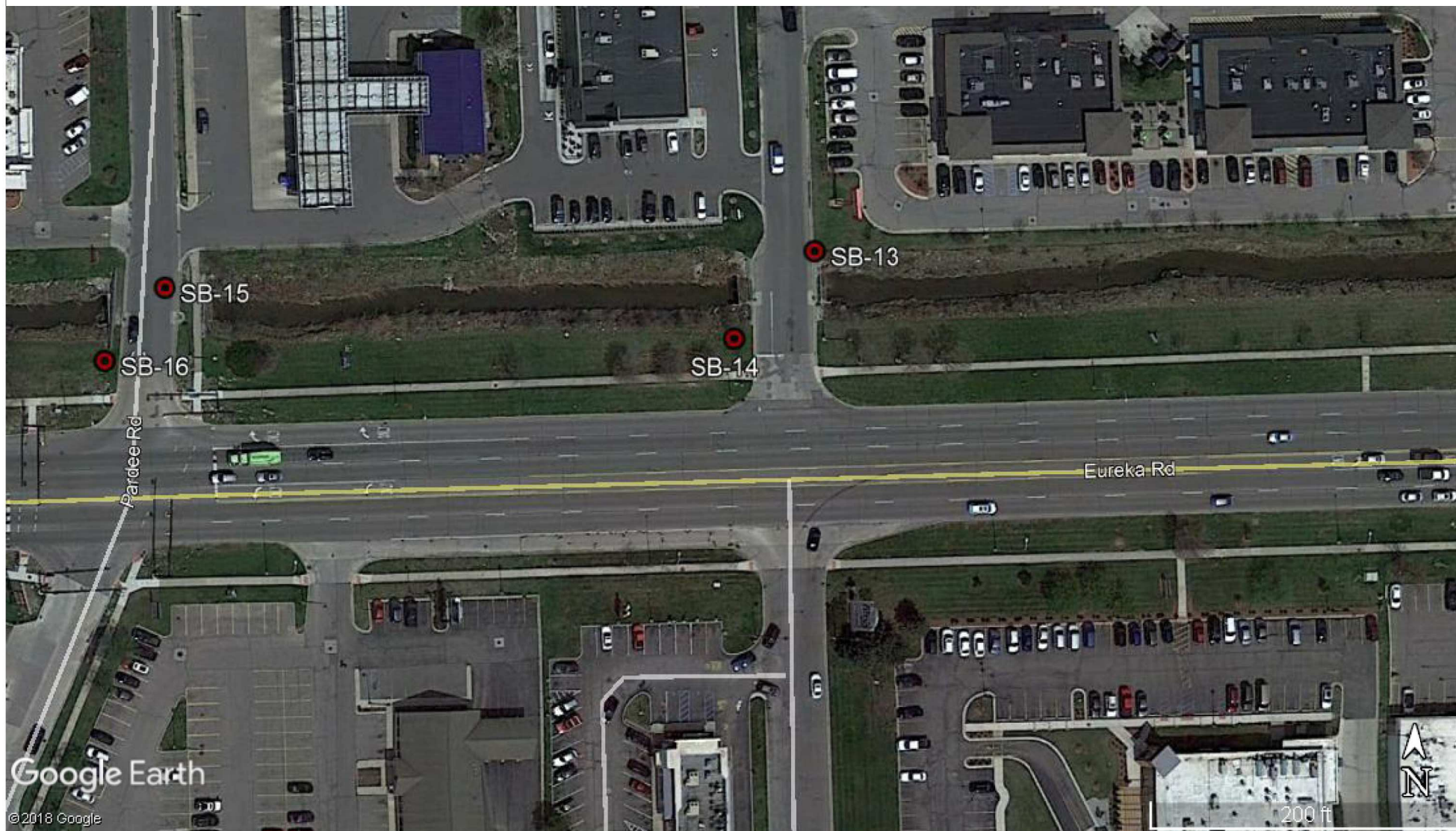


Somat Project No.: 2018019 A&B

Date: 08/30/2019

Soil Boring Location Diagram

*Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan*



Adapted from GoogleEarth satellite imagery

Legend:



Approximate Soil Boring Locations



Somat Project No.: 2018019 A&B

Date: 08/30/2019

Soil Boring Location Diagram

*Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan*



Adapted from GoogleEarth satellite imagery

Legend:

- Approximate Soil Boring Locations
- Approximate Sediment Sample Locations

SE Somat Engineering, INCORPORATED
 Somat Project No.: 2018019 A&B
 Date: 08/30/2019

Soil Boring Location Diagram
 Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan



Adapted from GoogleEarth satellite imagery

Legend:

- Approximate Soil Boring Locations
- Approximate Sediment Sample Locations
- Approximate Hand Auger Locations

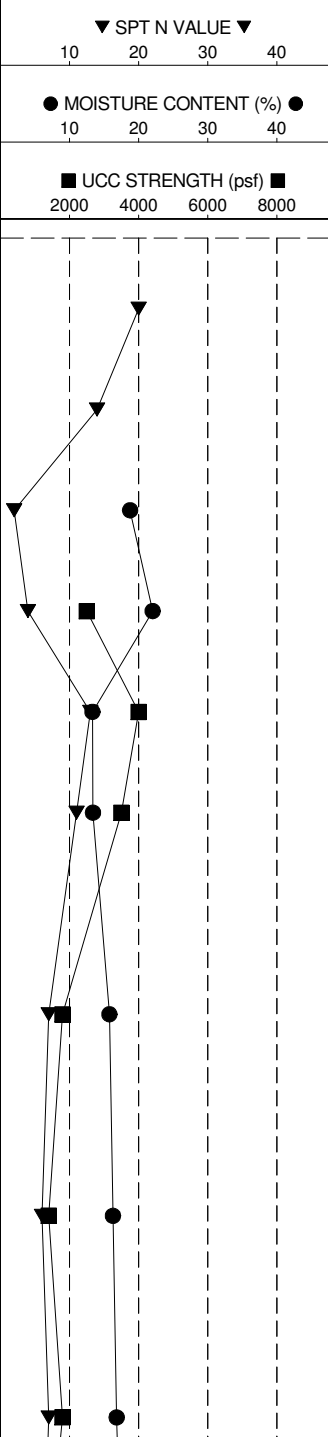
SE Somat Engineering, INCORPORATED
 Somat Project No.: 2018019 A&B
 Date: 08/30/2019

Soil Boring Location Diagram
 Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan

APPENDIX B

LOGS OF TEST BORINGS
AND GENERAL NOTES

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
603.7	Ground Surface Elevation 604 ft	0															
603.6	3.25 inches of PORTLAND CEMENT CONCRETE	0.3															
602.9	1.75 inches of ASPHALTIC CEMENT CONCRETE	0.4															
	8.5 inches of PORTLAND CEMENT CONCRETE	1.1															
	FILL - Medium dense crushed slag aggregate, trace sand, moist to wet	5.0	SS1	18	7-10-10	20	2.5										
599.0	FILL - Lean clay with sand, trace crushed aggregate, dark gray (CL)	7.5	SS2	18	6-6-8	14	5.0										
596.5	(No recovery on SPT sample attempt at 7.5 ft., direct pushed to retrieve sample)		DP3	0	4-1-1	2	7.5	<	18.8								
	Stiff to very stiff LEAN CLAY, few sand, trace gravel, gray (CL)	10.0	SS4	10	2-1-3	4	10.0	2500*	22.0								
		12.5	SS5	18	5-6-7	13	12.5	4000*	13.3								
		15.0	SS6	16	3-5-6	11	15.0	3500*	13.4								
589.0	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	20.0	SS7	18	1-3-4	7	20.0	1800#	15.8								
		25.0	SS8	18	2-3-3	6	25.0	1400#	16.3								
		30.0	SS9	14	2-3-4	7	30.0	1800#	16.8								



GROUNDWATER READINGS

First Encountered: 3.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426442.6
Northing: 256953.7

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

PROJECT NO. 2018019A DATE STARTED: 5/15/2018 DATE COMPLETED: 5/15/2018 LOG OF TEST BORING SB-01

ELEVATION ft	LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼				
	Ground Surface Elevation 604 ft	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
														● MOISTURE CONTENT (%) ●			
														10	20	30	40
■ UCC STRENGTH (psf) ■																	
2000 4000 6000 8000																	
		30															
	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	1-2-4	6	35.0	1200#	17.5								
		40	SS11	18	1-2-5	7	40.0	1200#	18.7								
		45	SS12	18	1-3-2	5	45.0	1200#	19.1								
556.5		47.5															
554.0	Very soft LEAN CLAY, trace sand, trace gravel, gray (CL)	50	SS13	18	1-2-2	4	50.0	400#	29.3								
	End of Boring at 50 ft.	50															
		55															
		60															

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 3.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426442.6
Northing: 256953.7

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

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Engineer on Rig: S. Panetta

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA								
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	▼ SPT N VALUE ▼ 10 20 30 40 ● MOISTURE CONTENT (%) ● 10 20 30 40 ■ UCC STRENGTH (psf) ■ 2000 4000 6000 8000
604.0	Ground Surface Elevation 604 ft	0												
603.7	3.75 inches of PORTLAND CEMENT CONCRETE	0.3												
603.5		0.5												
602.9	1.75 inches of ASPHALTIC CEMENT CONCRETE	1.1	SS1	18	6-6-10	16	2.5							
601.5	7.5 inches of PORTLAND CEMENT CONCRETE	2.5												
599.0	FILL - Medium dense poorly graded fine to medium sand with silt, few gravel/crushed aggregate, gray, moist (SP-SM)	5.0	SS2	18	9-6-3	9	5.0	2000*	19.5					
597.0	FILL - Stiff lean clay with sand, trace organics, trace roots, trace gravel, dark brown/black (CL) (Organic Content = 2.9%)	7.0	SS3	18	4-3-3	6	7.5							
	SILTY FINE SAND, brown-gray, moist (SM) (Possible Fill)	10	SS4	18	3-5-6	11	10.0	4500*	23.0					
	Very stiff LEAN CLAY, trace sand, trace gravel, brown changing to gray below 12.5 ft. (CL)	15	SS5	18	3-5-7	12	12.5	5500*	21.1					
		18.0	SS6	18	4-7-7	14	15.0	5500*	12.4					
586.0		20	SS7	18	3-3-4	7	20.0	2500*	15.1					
	Stiff to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	25	SS8	18	2-3-5	8	25.0	2000#	15.7					
		30	SS9	12	3-4-6	10	30.0	1800#	16.7					

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426389.9
Northing: 256930.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta/S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 604 ft	30																
	Stiff to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-3-3	6	35.0	1600#	18.4									
		40	SS11	18	2-2-3	5	40.0	800#	20.3									
		45	SS12	18	2-3-3	6	45.0	1200#	19.1									
		50	SS13	18	2-2-2	4	50.0	600#	37.2									
554.0	End of Boring at 50 ft.	50																
		55																
		60																

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426389.9
Northing: 256930.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta/S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:

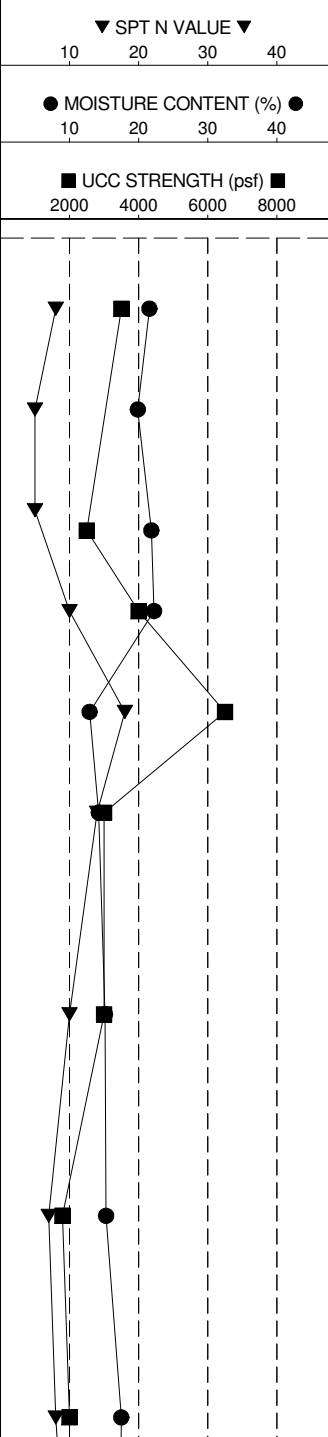


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/11/2018 DATE COMPLETED: 5/11/2018 LOG OF TEST BORING SB-03

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼				
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	MOISTURE CONTENT (%)	UCC STRENGTH (psf)		
600.3	Ground Surface Elevation 601 ft 8 inches of clayey sandy TOPSOIL, trace roots	0															
598.5	FILL - Stiff lean clay, trace sand, trace gravel, occasional clayey sand seams, brown (CL)	2.5	SS1	10	2-3-5	8	2.5	3500*	21.6								
595.0	FILL - Sandy lean clay, trace gravel, occasional silty fine sand layers, gray (CL)	5	SS2	12	2-2-3	5	5.0	<	19.9								
594.0	Poorly graded FINE SAND, trace silt, trace gravel, brown, wet (SP) (Possible Fill)	6.0	SS3	12	5-3-2	5	7.5	2500*	21.8								
588.5	Stiff to very stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	12.5	SS4	18	2-4-6	10	10.0	4000*	22.2								
			SS5	12	6-8-10	18	12.5	6500*	12.9								
			SS6	18	4-6-8	14	15.0	3000*	14.2								
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	20	SS7	18	2-4-6	10	20.0	3000*	15.1								
576.0		25.0	SS8	18	3-3-4	7	25.0	1800#	15.3								
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	30	SS9	18	3-4-4	8	30.0	2000*	17.5								



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426069.7
Northing: 256877.8

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

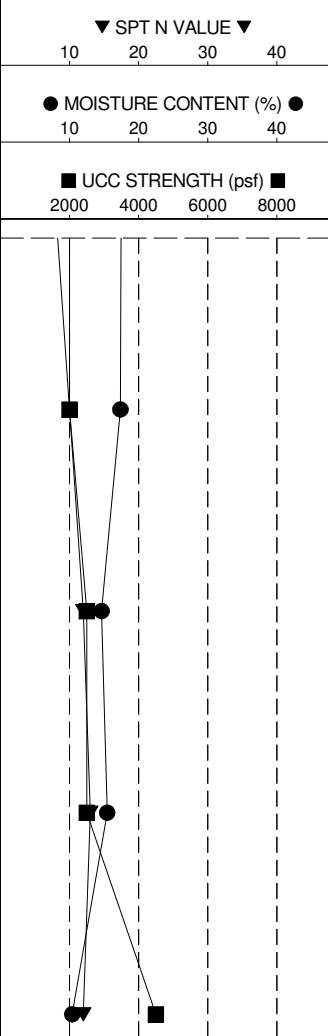
Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whooley
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 601 ft	30																
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-4-6	10	35.0	2000*	17.4									
		40	SS11	18	3-5-7	12	40.0	2500*	14.7									
556.0		45.0	SS12	18	4-6-7	13	45.0	2500*	15.4									
	Very stiff LEAN CLAY, few sand, trace gravel, gray (CL)																	
551.0	50.0	SS13	18	3-5-7	12	50.0	4500*	10.4										
	End of Boring at 50 ft.	50																
		55																
		60																



GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426069.7
Northing: 256877.8

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

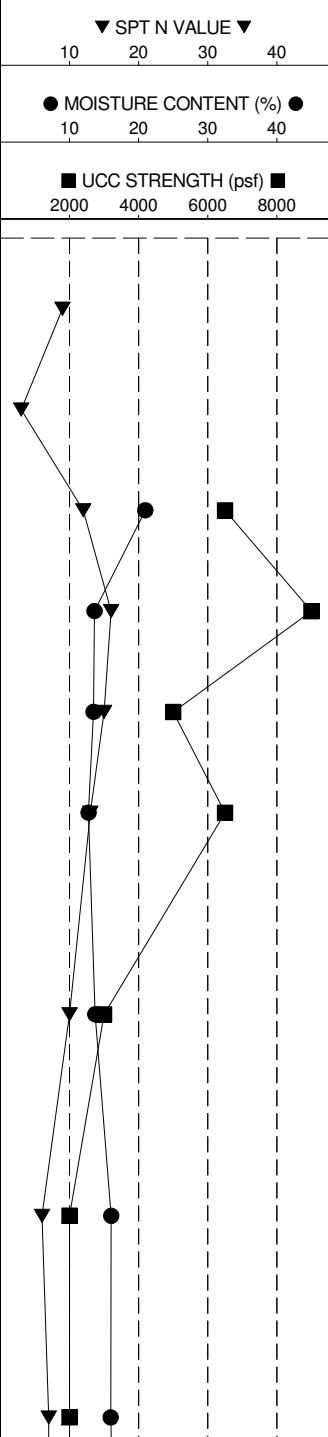
Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
601.0	Ground Surface Elevation 602 ft 12 inches of sandy TOPSOIL	0																
596.0	FILL - Loose to very loose poorly graded fine sand, trace silt, trace gravel, occasional sandy lean clay layers, brown, moist to wet (SP)	5	SS1	15	3-5-4	9	2.5											
592.0	Very stiff to hard LEAN CLAY, few sand, trace gravel, brown (CL)	10	SS3	18	3-5-7	12	7.5	6500*	21.0									
584.5	Very stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	15	SS4	18	5-6-10	16	10.0	9000*	13.6									
	Very stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	17.5	SS5	18	5-6-9	15	12.5	5000*	13.5									
		20	SS6	18	4-6-7	13	15.0	6500*	12.7									
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	25	SS7	18	3-4-6	10	20.0	3000*	13.7									
		27.5	SS8	18	2-2-4	6	25.0	2000*	16.0									
		30	SS9	18	2-3-4	7	30.0	2000*	16.0									



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426015.0
Northing: 256901.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta/S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 602 ft	30															
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-3-4	7	35.0	2000*	16.6					▼	■	●	
		40	SS11	18	2-4-5	9	40.0	2500*	17.4					▼	■	●	
		45	SS12	18	3-3-4	7	45.0	2000*	18.1					▼	■	●	
		50	SS13	18	2-3-3	6	50.0	2000*	18.0					▼	■	●	
552.0	End of Boring at 50 ft.	50															
		55															
		60															

GROUNDWATER READINGS

First Encountered: 5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13426015.0
Northing: 256901.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

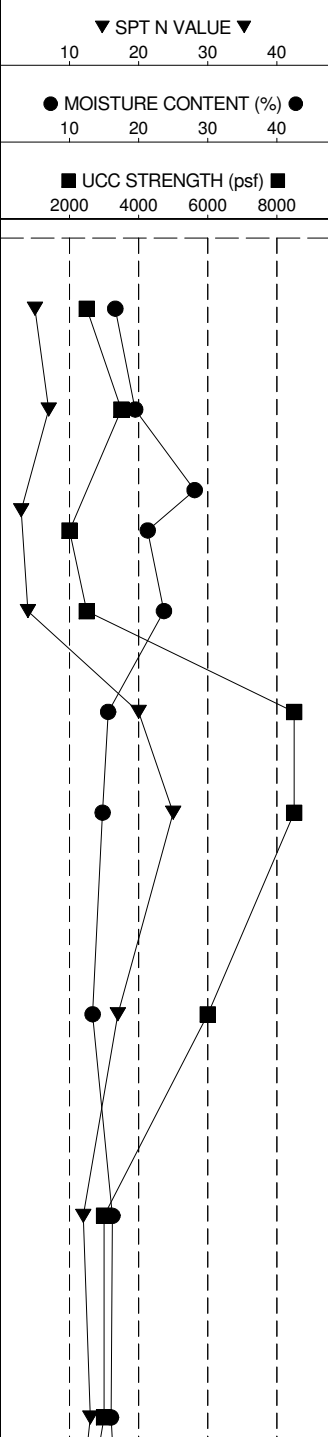
Drill Rig: CME 55
Engineer on Rig: S. Panetta/S. Cosner
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA						SPT N VALUE		
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	MOISTURE CONTENT (%)
606.3	Ground Surface Elevation 607 ft 8 inches of sandy TOPSOIL with roots, trace gravel	0												
602.5	FILL - Stiff lean clay, few sand, trace organics, trace gravel, brown and dark brown (CL) (Organic Content = 1.8 to 2.2%)	0.7	SS1	4	3-2-3	5	2.5	2500*	16.6					
600.0	FILL - Poorly graded fine sand, trace silt, brown, wet (SP)	4.5	SS2	18	2-3-4	7	5.0	3500*	19.5					
598.5	Stiff LEAN CLAY, few sand, few to trace organics, black and gray (CL) (Possible Fill)	7.0	SS3	18	2-1-2	3	7.5	2000*	21.3					
597.0	Hard LEAN CLAY, few sand, trace gravel, brown (CL) (Possible Fill)	8.5	SS4	12	2-2-2	4	10.0	2500*	23.7					
592.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	10.0	SS5	18	3-7-13	20	12.5	8500*	15.6					
		15.0	SS6	18	7-10-15	25	15.0	8500*	14.8					
		20.0	SS7	18	4-8-9	17	20.0	6000*	13.3					
		25.0	SS8	18	3-5-7	12	25.0	3000*	16.2					
		30.0	SS9	18	4-5-8	13	30.0	3000*	16.0					



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 3.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425580.6
Northing: 256614.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

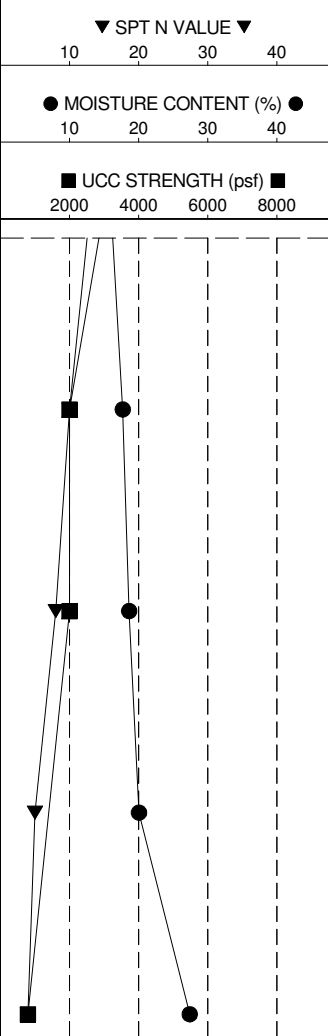
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 607 ft	30																
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-4-6	10	35.0	2000*	17.7									
		40	SS11	18	2-3-5	8	40.0	2000*	18.6									
562.0		45.0	SS12	18	2-2-3	5	45.0	<	20.1									
	Soft LEAN CLAY, trace sand, trace gravel, gray (CL)																	
557.0		50.0	SS13	18	1-2-2	4	50.0	800#	27.4									
	End of Boring at 50 ft.	50																
		55																
		60																



GROUNDWATER READINGS

First Encountered: 3.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425580.6
Northing: 256614.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
606.3	Ground Surface Elevation 607 ft	0															
604.5	8 inches of sandy TOPSOIL with roots FILL - Very loose poorly graded fine sand, trace silt, brown, moist to wet (SP)	0.7	SS1	12	2-1-1	2	2.5										
599.0	Alternating layers of CLAYEY SAND and SANDY LEAN CLAY, trace gravel, occasional organic pockets, black and gray (SC) (CL) (Possible Fill) (Organic Content = 2.4 to 2.6%)	5	SS2	18	4-1-1	2	5.0	<	20.2								
597.0	Driller reported GRAVEL	10.0	NR4	0	3-3-1	4	10.0										
593.5	Very stiff LEAN CLAY, trace sand, trace gravel, brown (CL)	13.5	SS5	10	1-3-3	6	12.5	4000*	21.2								
592.5	SILTY FINE SAND, trace gravel, wet (SM)	14.5	SS6	18	3-10-12	22	15.0	3000*	16.5								
592.0	Stiff LEAN CLAY, few sand, trace gravel, brown (CL)	15.0															
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	20	SS7	18	2-8-8	16	20.0	4500*	13.6								
		25	SS8	18	2-5-6	11	25.0	3000*	16.1								
		30	SS9	18	2-7-9	16	30.0	2500*	14.1								

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 1 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425492.4
Northing: 256623.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

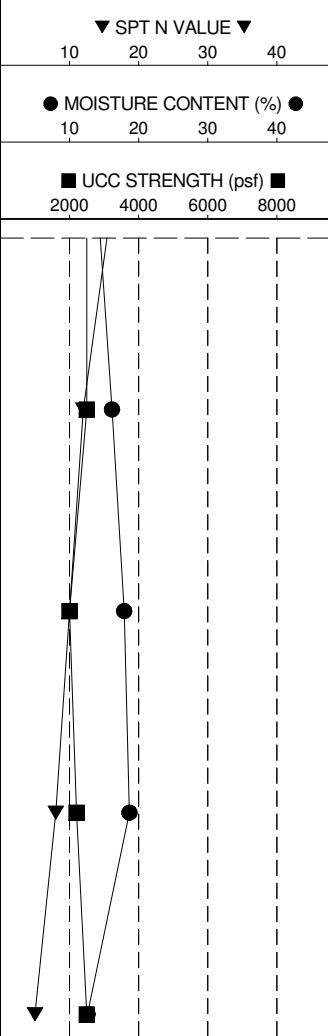
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼							
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40			
	Ground Surface Elevation 607 ft	30																		
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	13	4-5-7	12	35.0	2500*	16.1											
		40	SS11	17	2-5-5	10	40.0	2000*	17.9											
562.0		45.0	SS12	18	2-3-5	8	45.0	2200#	18.7											
	Stiff LEAN CLAY, few sand, trace gravel, gray (CL)																			
557.0	50.0	SS13	18	2-2-3	5	50.0	2500*	12.6												
	End of Boring at 50 ft.	50																		
		55																		
		60																		



GROUNDWATER READINGS

First Encountered: 1 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425492.4
Northing: 256623.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

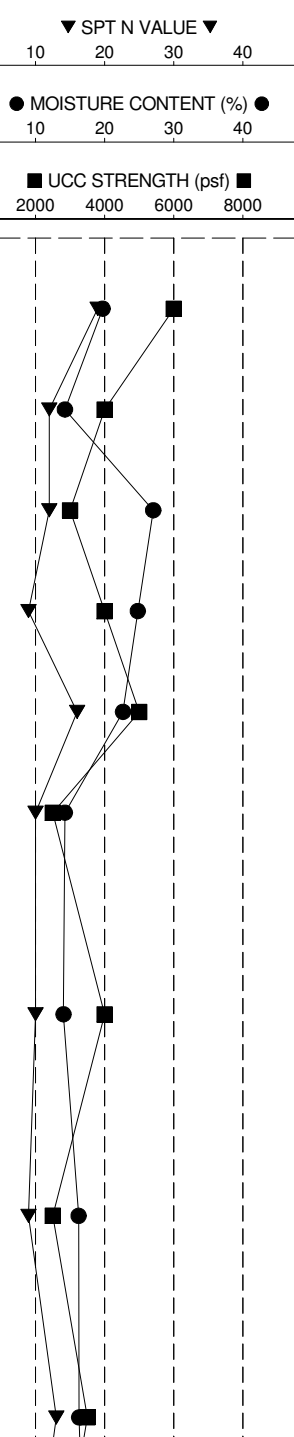
Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA						▼ SPT N VALUE ▼						
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
607.0	Ground Surface Elevation 608 ft 12 inches of sandy clayey TOPSOIL, trace roots	0																
603.5	FILL - Very stiff lean clay, trace organics, trace sand, trace gravel, brown (CL)	1.0	SS1	18	13-10-9	19	2.5	6000*	19.7									
602.0	FILL - Poorly graded fine sand, trace silt, trace gravel, brown, moist (SP)	4.5	SS2	18	3-6-6	12	5.0	4000*	14.3									
598.0	FILL - Stiff to very stiff lean clay, trace organics, trace sand, trace gravel, mottled brown and gray (CL) (Organic Content at 7.5 ft. = 4.2%)	6.0	SS3	18	5-5-7	12	7.5	3000*	27.0									
593.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown and gray (CL)	10.0	SS4	12	3-4-5	9	10.0	4000*	24.8									
		15.0	SS5	18	3-8-8	16	12.5	5000*	22.7									
			SS6	18	4-4-6	10	15.0	2500*	14.2									
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	20.0	SS7	18	3-4-6	10	20.0	4000*	14.0									
		25.0	SS8	18	2-3-6	9	25.0	2500*	16.2									
		30.0	SS9	18	2-5-8	13	30.0	3500*	16.3									



GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425138.9
Northing: 256490.6

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: H. Verduce

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 10 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



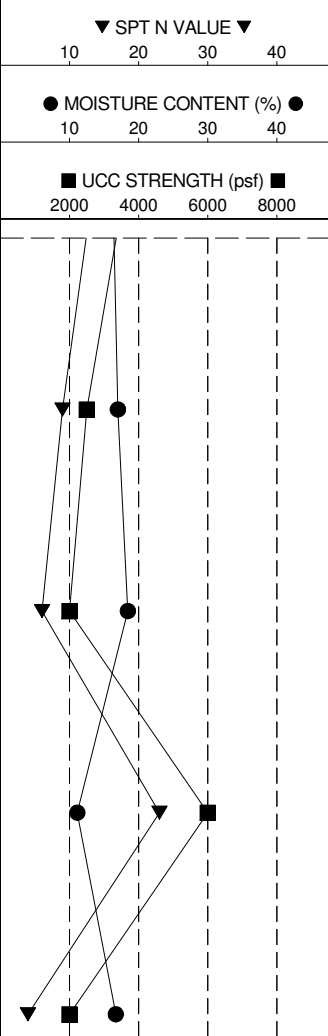
Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

PROJECT NO. 2018019A DATE STARTED: 5/17/2018 DATE COMPLETED: 5/17/2018 LOG OF TEST BORING SB-07

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼				
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 608 ft	30															
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-4-5	9	35.0	2500*	17.0								
568.0		40.0	SS11	18	3-3-3	6	40.0	2000*	18.4								
	Very stiff LEAN CLAY, few sand, trace gravel, gray (CL)	45	SS12	18	5-7-16	23	45.0	6000*	11.1								
563.0		45.0	SS13	18	1-2-2	4	50.0	2000*	16.7								
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	50															
558.0		50.0															
	End of Boring at 50 ft.	50															
		55															
		60															



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425138.9
Northing: 256490.6

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: H. Verduce

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 10 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

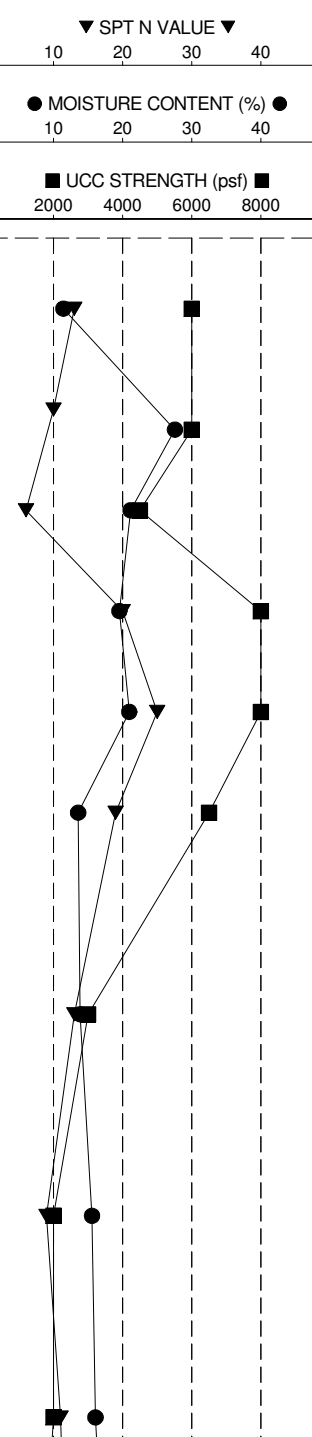
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 608 ft	0															
607.0	12 inches of sandy clayey TOPSOIL with roots	1.0															
605.5	FILL - Very stiff lean clay with sand, trace roots, trace gravel, occasional fine sand seams, brown (CL)	2.5	SS1	12	5-7-6	13	2.5	6000*	11.4								
603.5	FILL - Medium dense poorly graded fine sand, trace silt, brown, moist (SP)	4.5	SS2	18	4-6-4	10	5.0	6000*	27.6								
600.5	Very stiff LEAN CLAY, few sand, trace gravel, mottled brown and gray to brown (CL) (Possible Fill)	7.5	SS3	18	2-4-2	6	7.5	4500*	21.1								
595.5	Hard LEAN CLAY, trace sand, trace gravel, brown (CL)	12.5	SS4	18	4-8-12	20	10.0	8000*	19.5								
			SS5	18	6-10-15	25	12.5	8000*	21.0								
			SS6	18	6-9-10	19	15.0	6500*	13.6								
			SS7	18	4-5-8	13	20.0	3000*	13.8								
			SS8	18	2-4-5	9	25.0	2000*	15.6								
578.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	30.0	SS9	18	3-5-6	11	30.0	2000*	16.1								



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425041.8
Northing: 256430.6

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 608 ft	30																
	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	NR10	0	5-5-7	12	35.0											
		40	SS11	18	2-2-3	5	40.0	1200#	19.4									
		45	SS12	9	2-2-3	5	45.0	1000#	19.5									
		50	SS13	12	2-5-5	10	50.0	1600#	14.1									
558.0	End of Boring at 50 ft.	50																
		55																
		60																

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13425041.8
Northing: 256430.6

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA								
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	▼ SPT N VALUE ▼ 10 20 30 40 ● MOISTURE CONTENT (%) ● 10 20 30 40 ■ UCC STRENGTH (psf) ■ 2000 4000 6000 8000
	Ground Surface Elevation 607 ft	0												
606.0	12 inches of sandy clayey TOPSOIL, trace roots	1.0												
604.5	FILL - Hard lean clay, few sand, trace gravel, brown (CL)	2.5	SS1	12	5-9-10	19	2.5	9000*	12.9					
	FILL - Stiff lean clay, trace sand, trace gravel, brown with pockets of gray (CL)	5	SS2	16	7-5-4	9	5.0	2000*	23.4					
598.5		8.5	SS3	14	4-3-3	6	7.5	3000*	26.8					
597.0	Stiff LEAN CLAY, trace sand, trace gravel, brown with seams of gray (CL) (Possible Fill)	10.0	SS4	18	2-2-4	6	10.0	3500*	23.3					
		15	SS5	18	7-6-8	14	12.5	4000*	17.2					
		20	SS6	18	6-7-10	17	15.0	8500*	11.9					
	Hard to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	25	SS7	18	5-7-8	15	20.0	3500*	13.8					
		30	SS8	18	3-4-7	11	25.0	3000*	14.9					
		30	SS9	18	3-7-8	15	30.0	<	18.5					

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13424288.8
Northing: 256450.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: H. Verduce

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

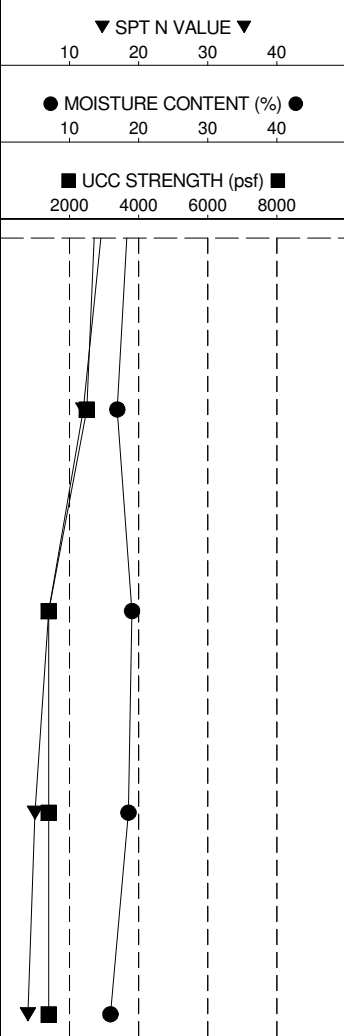
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 607 ft	30															
572.0	Hard to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-5-7	12	35.0	2500*	16.9								
	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	40	SS11	18	1-3-4	7	40.0	1400#	19.0								
		45	SS12	18	2-2-3	5	45.0	1400#	18.5								
557.0	End of Boring at 50 ft.	50	SS13	18	2-2-2	4	50.0	1400#	15.9								
		55															
		60															



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13424288.8
Northing: 256450.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

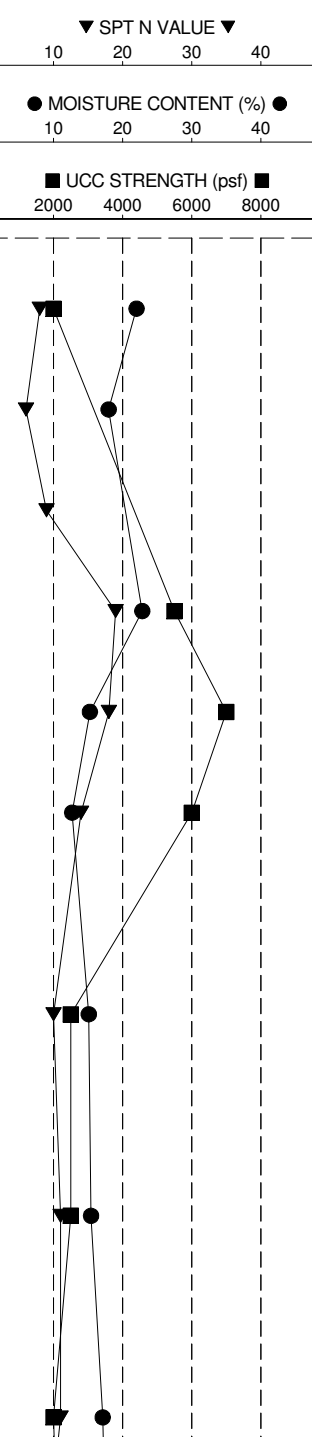
Drilling Company: DLZ
Drill Rig: CME 55
Engineer on Rig: H. Verduce
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA													
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200							
605.0	Ground Surface Elevation 606 ft 12 inches of sandy TOPSOIL, trace roots, trace gravel (CL)	0																		
602.5	FILL - Stiff lean clay, trace sand, trace gravel, occasional fine sand partings, brown with pockets of black (CL)	1.0	SS1	14	3-4-4	8	2.5	2000*	22.0											
601.5	FILL - Lean clay, trace sand, trace gravel, fine sand layer 4 to 4.5 ft., brown (CL)	3.5																		
597.5	FILL - Loose poorly graded fine to medium sand with silt, trace gravel, brown with pockets of black, moist to wet (SP-SM)	4.5	SS2	18	3-3-3	6	5.0	<	18.0											
		5																		
		8.5	SS3	16	4-6-3	9	7.5													
		10	SS4	18	6-8-11	19	10.0	5500*	22.8											
		15	SS5	18	5-8-10	18	12.5	7000*	15.3											
		20	SS6	18	5-6-8	14	15.0	6000*	12.7											
		25	SS7	18	3-4-6	10	20.0	2500*	15.1											
		30	SS8	18	3-5-6	11	25.0	2500*	15.4											
			SS9	18	3-5-6	11	30.0	2000*	17.1											
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown changing to to gray below 12.5 ft. (CL)																			



GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13424208.2
Northing: 256398.3

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 45

Engineer on Rig: H. Verduce

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:

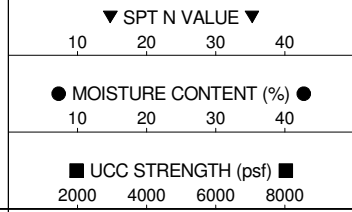


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼						
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 606 ft	30																
569.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown changing to to gray below 12.5 ft. (CL)	35	SS10	18	3-3-5	8	35.0	2200#	17.8									
37.0		40	SS11	18	3-3-4	7	40.0	1800#	18.2									
		45	SS12	18	0-3-3	6	45.0	1400#	21.6									
556.0		50	SS13	18	1-1-1	2	50.0	1200#	16.4									
	End of Boring at 50 ft.	50																
		55																
		60																



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13424208.2
Northing: 256398.3

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 45

Engineer on Rig: H. Verduce

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:

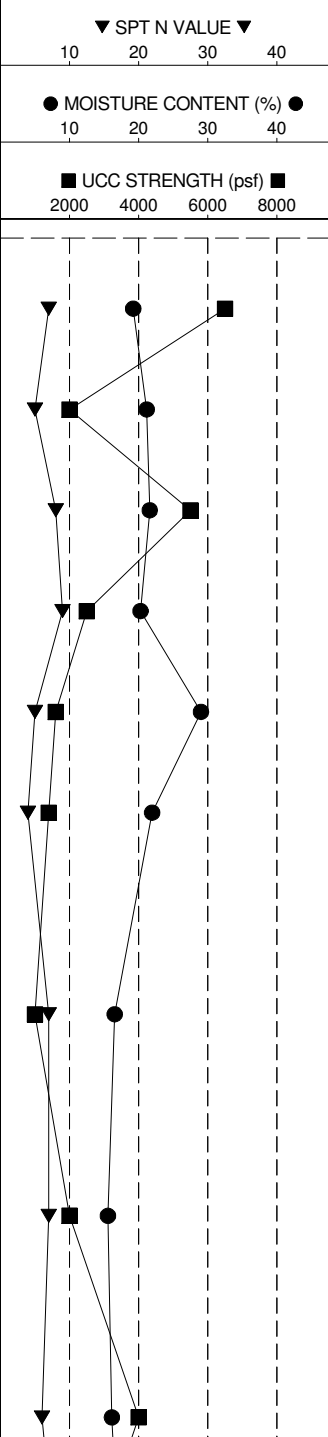


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/16/2018 DATE COMPLETED: 5/16/2018 LOG OF TEST BORING SB-11

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA												
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200						
604.3	Ground Surface Elevation 605 ft 8 inches of clayey TOPSOIL with sand, trace roots	0																	
602.5	FILL - Very stiff lean clay, trace roots, trace sand, trace gravel, brown (CL)	2.5	SS1	12	2-4-3	7	2.5	6500*	19.2										
600.0	FILL - Stiff lean clay, few sand, trace roots, trace gravel, brown (CL)	5.0	SS2	12	2-2-3	5	5.0	2000*	21.2										
597.5	FILL - Very stiff lean clay, trace sand, trace gravel, brown with seams of gray (CL)	7.5	SS3	18	4-3-5	8	7.5	5500*	21.6										
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	10.0	SS4	18	2-4-5	9	10.0	2500*	20.3										
		12.5	SS5	18	2-3-2	5	12.5	1600#	29.0										
		15.0	SS6	18	1-2-2	4	15.0	1400#	21.9										
585.0		20.0	SS7	10	2-3-4	7	20.0	1000#	16.5										
	Stiff to very stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	25.0	SS8	18	2-3-4	7	25.0	2000#	15.6										
575.0		30.0	SS9	18	3-5-1	6	30.0	4000*	16.1										



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423771.2
Northing: 256425.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 605 ft	30															
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-3-6	9	35.0	2000*	17.5								
		40	SS11	18	2-3-3	6	40.0	2000*	16.6								
		45	SS12	18	2-3-4	7	45.0	1600#	19.9								
		50	SS13	18	3-6-6	12	50.0	2000*	16.5								
555.0	End of Boring at 50 ft.	50															
		55															
		60															

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423771.2
Northing: 256425.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

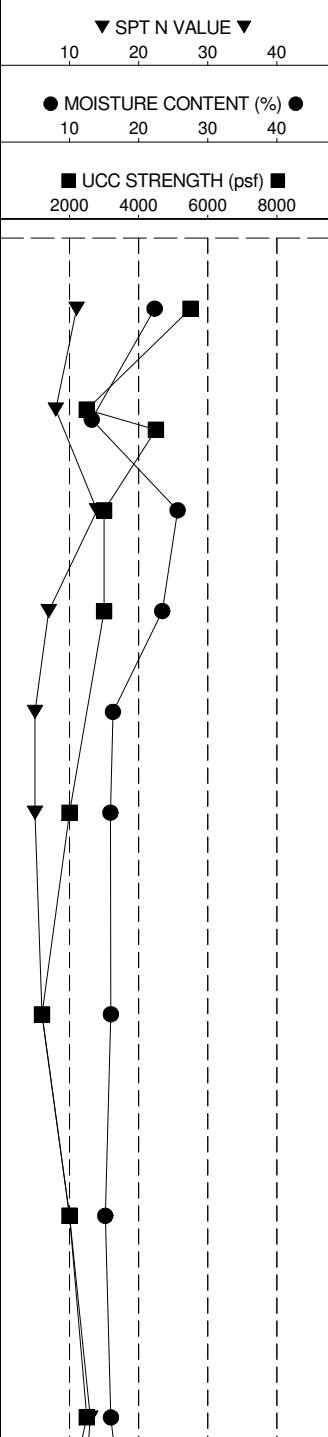


Somat Engineering, Inc.

Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan

PROJECT NO. 2018019A DATE STARTED: 5/15/2018 DATE COMPLETED: 5/15/2018 LOG OF TEST BORING SB-12

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA							
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
604.6	Ground Surface Elevation 605 ft	0											
	5 inches of clayey TOPSOIL, with roots	0.4											
602.8	FILL - Very stiff lean clay, trace sand, trace gravel, mottled brown and gray (CL)	2.3	SS1	12	3-4-7	11	2.5	5500*	22.3				
601.0	FILL - Poorly graded fine sand, trace silt, brown, moist (SP)	4.0	SS2	18	2-4-4	8	5.0	2500* 4500*	13.2				
600.0	FILL - Stiff to very stiff lean clay, few sand, trace roots, trace gravel, mottled brown and gray (CL)	5.0	SS3	18	3-6-8	14	7.5	3000*	25.6				
597.5	Stiff LEAN CLAY, trace sand, trace gravel, brown with pockets of dark brown (CL) (Possible Fill)	7.5	SS4	18	2-3-4	7	10.0	3000*	23.4				
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	10	SS5	12	1-2-3	5	12.5	<	16.3				
		15	SS6	18	2-2-3	5	15.0	2000*	15.9				
		20	SS7	18	2-2-4	6	20.0	1200#	16.0				
		25	SS8	18	2-4-6	10	25.0	2000*	15.2				
		30	SS9	10	3-5-8	13	30.0	2500*	16.0				



GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423693.0
Northing: 256363.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

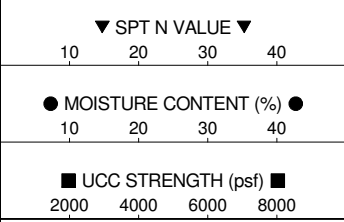


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 605 ft	30															
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	12	4-5-6	11	35.0	1200#	19.3								
		40	SS11	18	3-4-6	10	40.0	2500*	17.5								
		45	SS12	12	2-4-5	9	45.0	2000*	18.3								
		50	SS13	18	3-4-5	9	50.0	2000*	19.2								
555.0	End of Boring at 50 ft.	50															
		55															
		60															



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423693.0
Northing: 256363.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

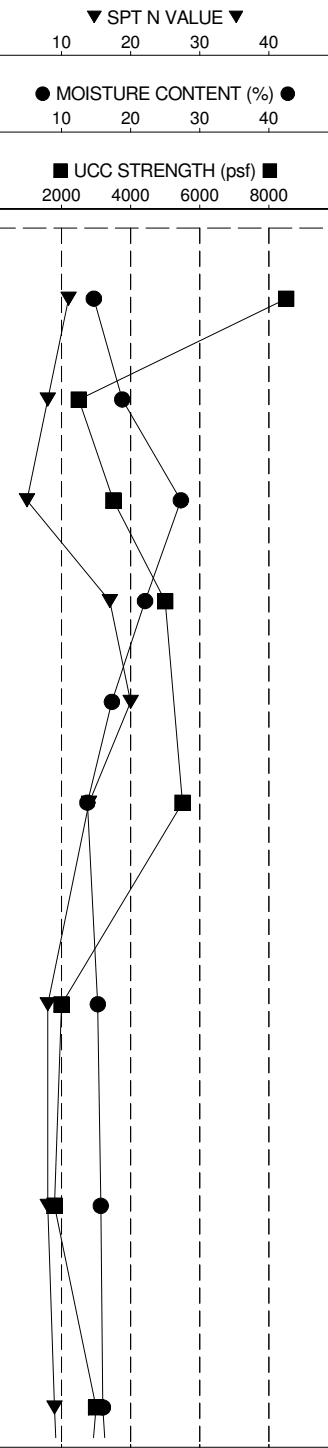


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/16/2018 DATE COMPLETED: 5/16/2018 LOG OF TEST BORING SB-13

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA												
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200						
608.3	Ground Surface Elevation 609 ft 8 inches of clayey TOPSOIL, with sand, trace roots	0																	
604.0	FILL - Hard to stiff sandy lean clay with sand, trace organics, trace gravel, brown and dark brown (CL) (Organic Content = 2.1 to 2.5%)	0.7	SS1	18	3-5-6	11	2.5	8500*	14.7										
601.5	FILL - Stiff lean clay, few sand, trace gravel, mottled brown and gray (CL)	5.0	SS2	18	2-4-4	8	5.0	2500*	18.8										
		7.5	SS3	18	2-2-3	5	7.5	3500*	27.3										
596.5	Very stiff LEAN CLAY, trace sand, trace gravel, brown (CL) (No recovery on SPT sample attempt at 12.5 ft., direct pushed to retrieve sample.)	12.5	SS4	18	4-7-10	17	10.0	5000*	22.1										
			DP5	0	8-9-11	20	12.5	<	17.3										
			SS6	18	4-7-7	14	15.0	5500*	13.7										
	Very stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS7	12	2-3-5	8	20.0	2000*	15.2										
584.0		25.0	SS8	18	1-3-5	8	25.0	1800#	15.7										
	Stiff to soft LEAN CLAY, trace sand, trace gravel, gray (CL)		SS9	18	2-4-5	9	30.0	3000*	16.0										
		30																	



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423240.2
Northing: 256397.8

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

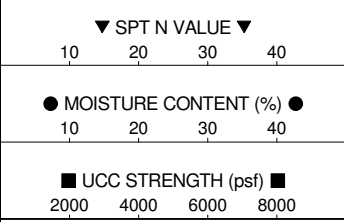
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 609 ft	30																
	Stiff to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	8	2-4-6	10	35.0	2500*	17.9									
		40	SS11	18	1-2-3	5	40.0	1600#	19.0									
		45	SS12	18	2-2-3	5	45.0	800#	21.5									
		50	SS13	8	1-2-1	3	50.0	1000*	15.3									
559.0	End of Boring at 50 ft.	50																
		55																
		60																



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423240.2
Northing: 256397.8

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

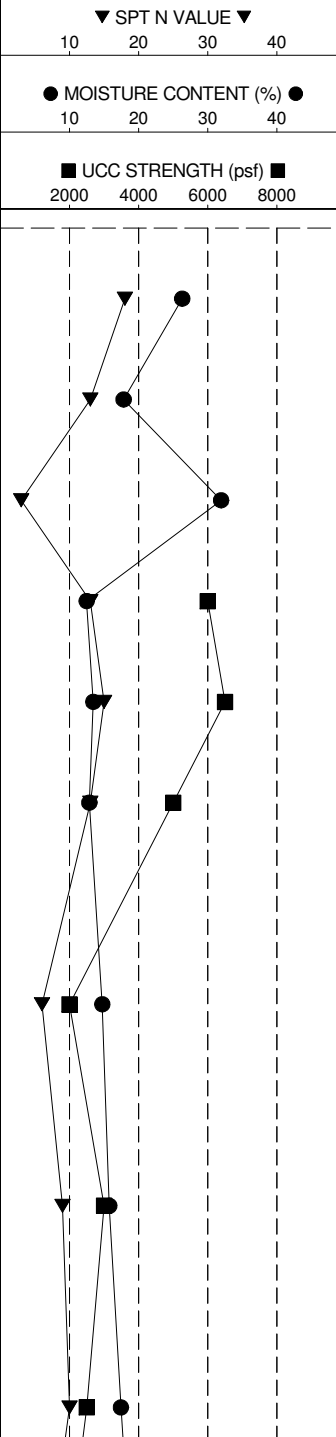


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/17/2018 DATE COMPLETED: 5/17/2018 LOG OF TEST BORING SB-14

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA											
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200					
606.3	Ground Surface Elevation 607 ft 8 inches of TOPSOIL	0																
604.5	FILL - Lean clay, few sand, few organics, trace gravel, occasional layers of concrete debris, brown (CL) (Organic Content = 6.3%)	0.7	SS1	6	12-8-10	18	2.5	<	26.3									
602.0	FILL - Medium dense poorly graded fine sand, trace organics, black, moist (SP) (Organic Content = 4.9%)	2.5	SS2	10	5-6-7	13	5.0		17.8									
599.5	FILL - Very loose poorly graded fine sand, trace silt, trace gravel, occasional gray lean clay layers, brown, moist to wet (SP)	5.0	SS3	18	3-2-1	3	7.5	<	31.9									
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	7.5	SS4	18	3-5-8	13	10.0		6000*	12.5								
		10	SS5	18	3-6-9	15	12.5		6500*	13.4								
		15	SS6	18	2-6-7	13	15.0		5000*	12.9								
		20	SS7	18	2-2-4	6	20.0		2000*	14.7								
		25	SS8	18	2-3-6	9	25.0		3000*	15.8								
577.0		30.0	SS9	16	3-3-7	10	30.0		2500*	17.4								



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423189.7
Northing: 256341.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼					
		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 607 ft	30															
	Medium to very soft LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	15	3-2-4	6	35.0	<	19.5								
		40	SS11	18	1-1-2	3	40.0	1000#	19.8								
		45	SS12	18	1-2-2	4	45.0	400#	21.3								
		50	SS13	18	0-1-2	3	50.0	1000#	19.3								
557.0	End of Boring at 50 ft.	50															
		55															
		60															

GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13423189.7
Northing: 256341.4

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

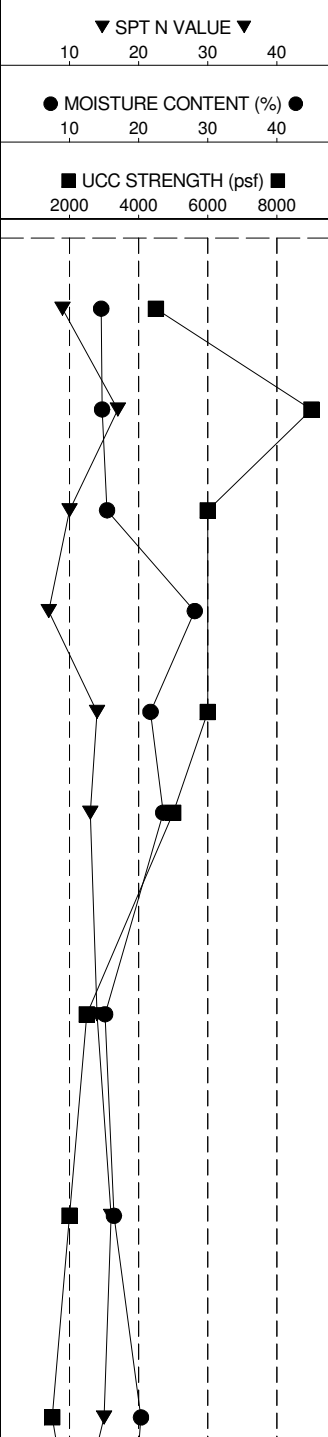
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼						
		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
607.6	Ground Surface Elevation 608 ft 5 inches of ASPHALTIC CEMENT CONCRETE	0																
	FILL - Very stiff to hard lean clay, few sand, trace organics, trace gravel, trace roots above 5 ft., brown and gray (CL) (Organic Content = 1.8 to 2.3%)		SS1	12	5-4-5	9	2.5	4500*	14.6									
			SS2	18	4-8-9	17	5.0	9000*	14.7									
			SS3	12	2-4-6	10	7.5	6000*	15.4									
600.5		(Organic Content at 10 ft. = 2.8%)	10	SS4	18	2-3-4	7	10.0	<	28.1								
				SS5	18	4-6-8	14	12.5	6000*	21.7								
				SS6	8	4-6-7	13	15.0	5000*	23.6								
		Very stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	20	SS7	18	3-9-5	14	20.0	2500*	15.2								
				SS8	10	4-8-8	16	25.0	2000*	16.4								
				SS9	6	4-7-8	15	30.0	1500*	20.3								
		30																



GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422825.8
Northing: 256369.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 75

Engineer on Rig: S. Woolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA							▼ SPT N VALUE ▼						
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40		
	Ground Surface Elevation 608 ft	30																	
	Very stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-3-5	8	35.0	2500*	17.9										
		40	SS11	18	1-2-3	5	40.0	1200#	18.3										
		45	SS12	18	1-2-4	6	45.0	1000#	18.1										
		50	SS13	18	2-3-4	7	50.0	1600#	15.3										
558.0	End of Boring at 50 ft.	50																	
		55																	
		60																	

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422825.8
Northing: 256369.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 75
Engineer on Rig: S. Woolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout/Core/Patch
Checked By: ALOG
QA/QC By: KB
Remarks:

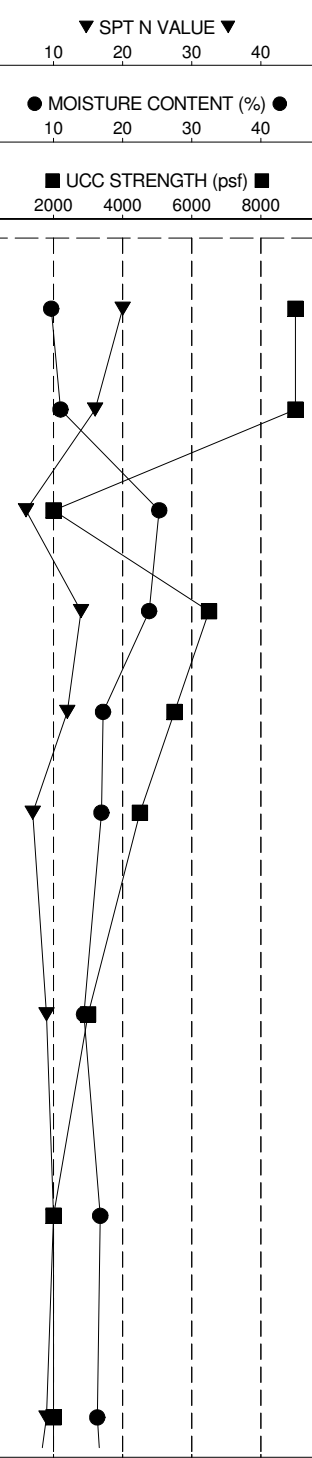


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/17/2018 DATE COMPLETED: 5/17/2018 LOG OF TEST BORING SB-16

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
607.8	Ground Surface Elevation 608 ft 3 inches of TOPSOIL	0																
	FILL - Hard lean clay, few sand, trace organics, trace gravel, occasional fine black sand layers, brown and gray (CL) (Organic Content at 2.5 ft = 1.9%)	0.3	SS1	5	3-9-11	20	2.5	9000*	9.7									
603.0		5.0	SS2	10	3-8-8	16	5.0	9000*	11.0									
	FILL - Stiff lean clay, trace sand, trace gravel, occasional fine to medium sand layers, brown and gray (CL)	7.5	SS3	10	3-4-2	6	7.5	2000*	25.3									
600.5			SS4	18	3-6-8	14	10.0	6500*	23.8									
			SS5	18	3-5-7	12	12.5	5500*	17.2									
			SS6	10	2-3-4	7	15.0	4500*	16.9									
			SS7	18	13-3-6	9	20.0	3000*	14.4									
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown changing to gray below 12.5 ft. (CL)		SS8	8	2-4-6	10	25.0	2000*	16.8									
			SS9	10	3-3-6	9	30.0	2000*	16.3									



GROUNDWATER READINGS

First Encountered: 6 ft.
 Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422788.0
 Northing: 256322.0

Coordinates/GSE determined by:
 Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:

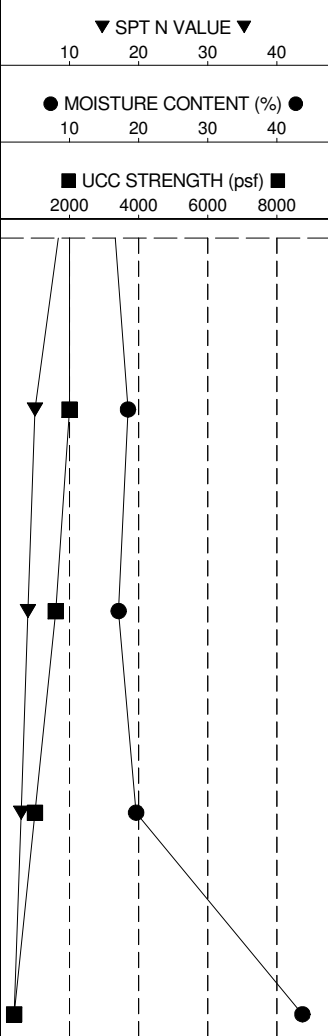


Somat Engineering, Inc.

**Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼						
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 608 ft	30																
573.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown changing to gray below 12.5 ft. (CL)	35	SS10	18	2-2-3	5	35.0	2000*	18.5									
		40	SS11	18	1-2-2	4	40.0	1600#	17.1									
		45	SS12	18	0-1-2	3	45.0	1000#	19.6									
558.0		50	SS13	18	1-1-1	2	50.0	400#	43.7									
	End of Boring at 50 ft.	50																
		55																
		60																



GROUNDWATER READINGS

First Encountered: 6 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422788.0
Northing: 256322.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

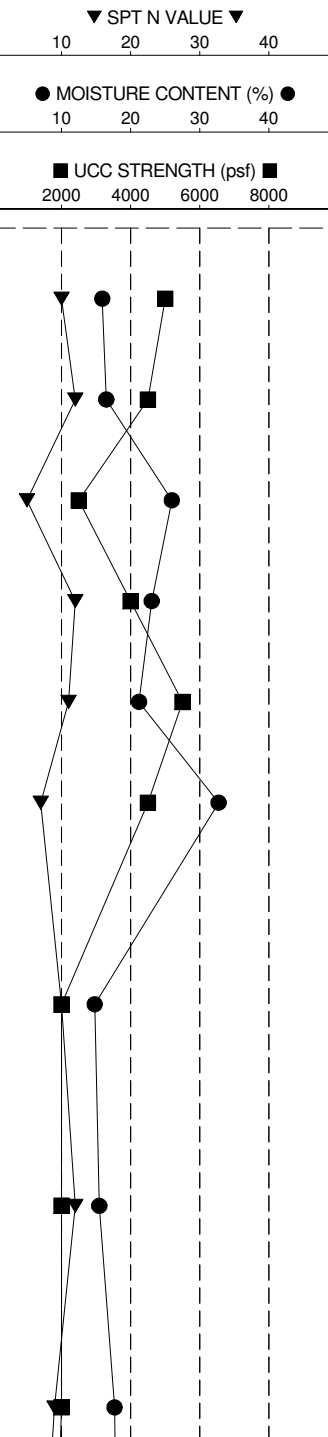
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
607.3	Ground Surface Elevation 608 ft 8 inches of TOPSOIL	0																
603.0	FILL - Very stiff lean clay, few sand, trace organics, trace roots, trace gravel, brown (CL) (Organic Content at 2.5 ft = 2.4%)	0.7	SS1	18	2-3-7	10	2.5	5000*	15.9									
600.5	FILL - Stiff lean clay, trace sand, trace gravel, occasional fine sand partings, mottled brown and gray (CL)	5.0	SS2	18	4-6-6	12	5.0	4500*	16.5									
		7.5	SS3	12	3-2-3	5	7.5	2500*	26.0									
			SS4	18	2-5-7	12	10.0	4000*	23.1									
			SS5	18	3-5-6	11	12.5	5500*	21.2									
			SS6	18	3-3-4	7	15.0	4500*	32.7									
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, brown changing to gray below 15 ft. (CL)		SS7	18	3-4-6	10	20.0	2000*	14.8									
			SS8	18	3-5-7	12	25.0	2000*	15.5									
578.0		30.0	SS9	18	3-4-5	9	30.0	2000*	17.7									



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422591.0
Northing: 256307.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼						
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40		
	Ground Surface Elevation 608 ft	30																	
	Medium to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-3-4	7	35.0	1800#	18.1										
		40	SS11	18	0-2-3	5	40.0	1200#	20.1										
		45	SS12	18	0-1-3	4	45.0	1200#	20.3										
558.0		50.0	50	SS13	12	2-2-3	5	50.0	600#	21.8									
	End of Boring at 50 ft.	55																	
		60																	

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422591.0
Northing: 256307.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

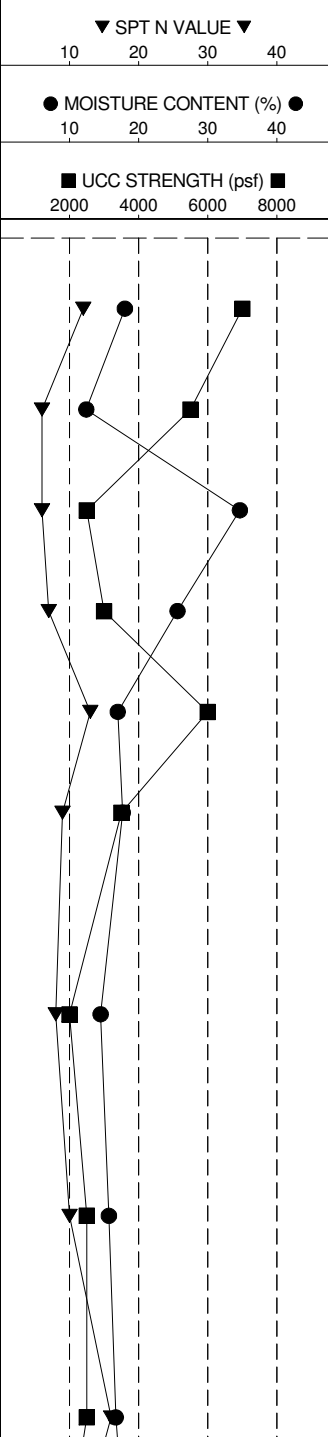


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/18/2018 DATE COMPLETED: 5/18/2018 LOG OF TEST BORING SB-18

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA							
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
608.5	Ground Surface Elevation 609 ft 6 inches of TOPSOIL	0											
606.5	FILL - Very stiff lean clay, trace sand, trace gravel, brown with pockets of dark brown (CL)	0.5	SS1	18	4-6-6	12	2.5	7000*	18.0				
604.0	FILL - Very stiff lean clay with sand, trace topsoil, trace gravel, brown (CL) (Organic Content = 1.8%)	2.5	SS2	18	3-3-3	6	5.0	5500*	12.4				
599.0	Stiff LEAN CLAY, trace sand, trace gravel, mottled brown and gray (CL) (Possible Fill)	5.0	SS3	12	3-3-3	6	7.5	2500*	34.7				
		10.0	SS4	12	2-3-4	7	10.0	3000*	25.6				
		15.0	SS5	18	4-6-7	13	12.5	6000*	17.0				
		20.0	SS6	18	4-4-5	9	15.0	3500*	17.7				
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	25.0	SS7	18	2-4-4	8	20.0	2000*	14.5				
		30.0	SS8	17	3-5-5	10	25.0	2500*	15.7				
579.0		30.0	SS9	18	3-8-8	16	30.0	2500*	16.7				



GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422521.9
Northing: 256350.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 750X

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:

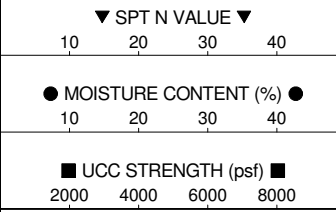


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

ELEVATION ft	LOG OF SOIL PROFILE	FIELD DATA						LABORATORY DATA						▼ SPT N VALUE ▼			
		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 609 ft	30															
	Medium to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-4-4	8	35.0	1600#	19.1								
		40	SS11	18	1-2-2	4	40.0	800#	20.4								
		45	SS12	18	2-3-3	6	45.0	1400#	19.0								
559.0		50	SS13	12	4-3-7	10	50.0	1400#	19.9								
	End of Boring at 50 ft.	50															
		55															
		60															



GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422521.9
Northing: 256350.9

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 750X
Engineer on Rig: S. Whoolery
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:

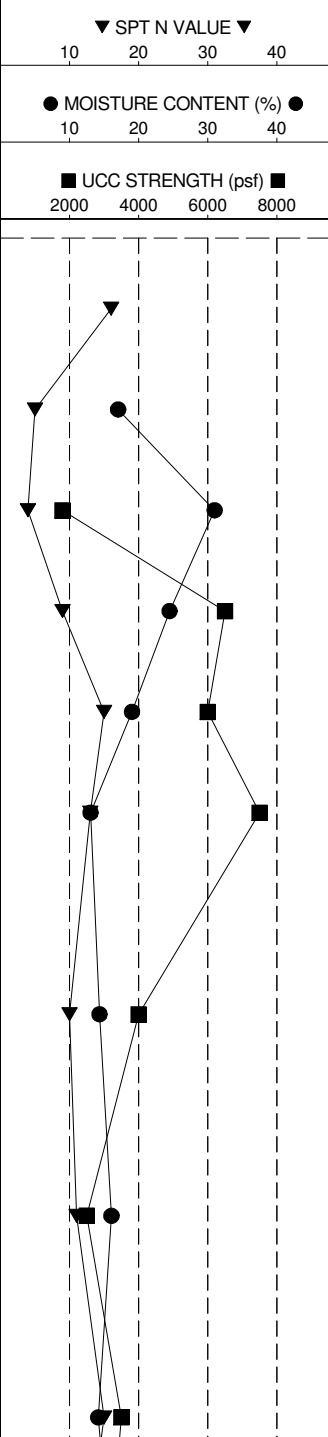


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/16/2018 DATE COMPLETED: 5/16/2018 LOG OF TEST BORING SB-19

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA							
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 608 ft	0											
607.0	12 inches of TOPSOIL	1.0											
605.5	FILL - Medium dense sand and crushed limestone aggregate/concrete debris	2.5	SS1	1	16-9-7	16	2.5						
603.0	FILL - Lean clay, few sand, trace gravel, dark brown (CL)	5.0	SS2	2	3-3-2	5	5.0	<	17.0				
600.5	FILL - Medium lean clay, trace sand, trace gravel, brown-gray (CL)	7.5	SS3	9	2-2-2	4	7.5	1800#	31.0				
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	10.0	SS4	18	3-3-6	9	10.0	6500*	24.5				
		12.5	SS5	18	3-6-9	15	12.5	6000*	19.0				
		15.0	SS6	18	3-5-8	13	15.0	7500*	13.0				
		20.0	SS7	18	3-4-6	10	20.0	4000*	14.3				
		25.0	SS8	18	3-4-7	11	25.0	2500*	16.1				
		30.0	SS9	18	3-6-9	15	30.0	3500*	14.1				



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422005.8
Northing: 256269.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta/S. Cosner

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

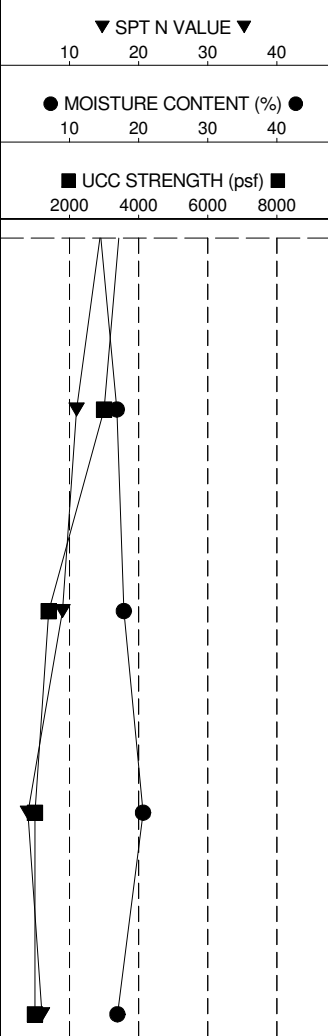
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼						
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
	Ground Surface Elevation 608 ft	30																
573.0	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	35.0	SS10	10	4-5-6	11	35.0	3000*	16.8									
	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	40	SS11	18	4-4-5	9	40.0	1400#	17.9									
		45	SS12	18	1-3-1	4	45.0	1000#	20.6									
558.0		50.0	SS13	18	4-2-4	6	50.0	1000#	16.9									
	End of Boring at 50 ft.	50																
		55																
		60																



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13422005.8
Northing: 256269.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

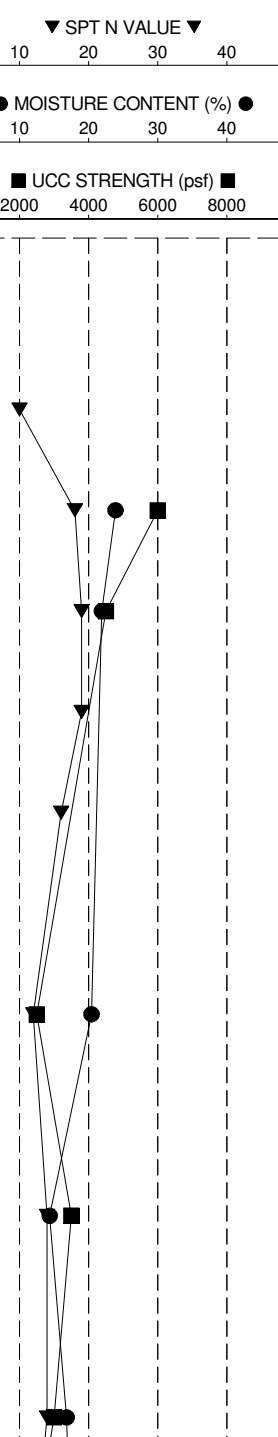
Drilling Company: DLZ
Drill Rig: CME 55
Engineer on Rig: S. Panetta/S. Cosner
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA			LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
606.7	Ground Surface Elevation 607 ft	0															
605.7	4 inches of ASPHALTIC CEMENT CONCRETE	0.3															
605.7	11.5 inches of PORTLAND CEMENT CONCRETE	1.3	HA1	18				2.5									
	FILL - Poorly graded fine to medium sand with silt, trace gravel, brown, moist (SP)																
601.0		5	NR2	0	3-4-6	10	5.0										
597.0	Very stiff LEAN CLAY, trace sand, trace gravel, brown (CL)	10.0	SS3	18	5-6-12	18	7.5	6000*	23.9								
			SS4	10	6-8-11	19	10.0	4500*	21.9								
	(Driller reported gravel at 10 ft.)																
	(Clayey medium sand layer at approximately 12.5 ft.)		SS5	2	5-8-11	19	12.5	<									
			NR6	0	5-6-10	16	15.0										
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS7	3	3-5-7	12	20.0	2500*	20.4								
			SS8	18	3-6-8	14	25.0	3500*	14.4								
			SS9	18	4-6-8	14	30.0	3000*	16.8								



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421976.2
Northing: 256229.3

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 75

Engineer on Rig: S. Woolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

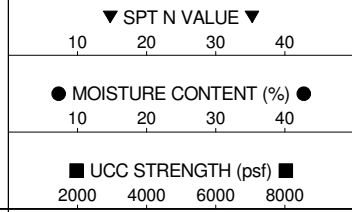
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼						
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40		
	Ground Surface Elevation 607 ft	30																	
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	2-5-6	11	35.0	2000*	17.7										
		40	SS11	18	2-3-6	9	40.0	1400#	18.3										
		45	SS12	18	3-3-5	8	45.0	1600#	18.4										
		50	SS13	18	2-5-6	11	50.0	1200#	17.6										
557.0	End of Boring at 50 ft.	50																	
		55																	
		60																	



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421976.2
Northing: 256229.3

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 75
Engineer on Rig: S. Whooley
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout/Core/Patch
Checked By: ALOG
QA/QC By: KB
Remarks:

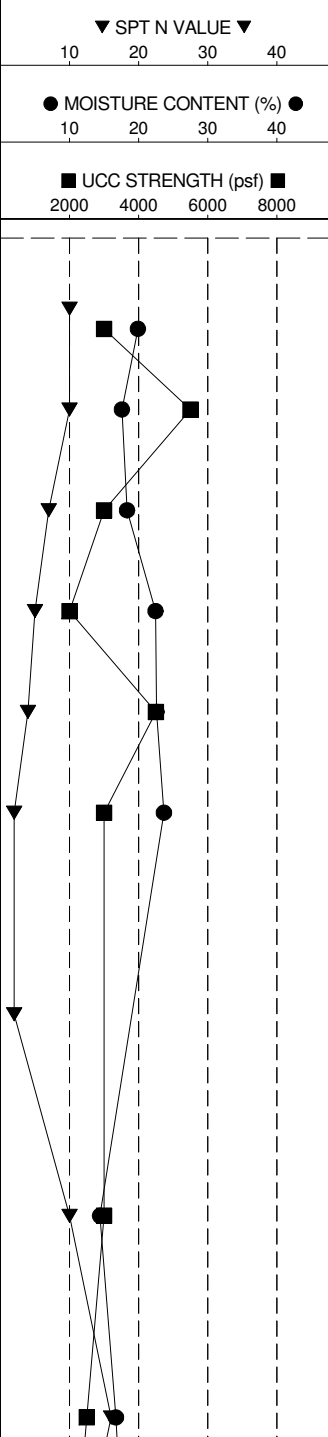


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 5/21/2018 DATE COMPLETED: 5/21/2018 LOG OF TEST BORING SB-21

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA							
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
607.7	Ground Surface Elevation 608 ft	0											
	4 inches of TOPSOIL	0.3											
606.0	FILL - Mixed sand and crushed limestone aggregate/concrete (strong HCl reaction), occasional asphalt layers	2.0	SS1	12	6-6-4	10	2.5	3000*	19.9				
603.0	FILL - Stiff to very stiff lean clay, trace organics, trace sand, trace gravel, occasional fine sand partings, brown (CL) (Organic Content at 2.5 ft. = 3.8%)	5.0	SS2	18	5-5-5	10	5.0	5500*	17.6				
			SS3	18	3-3-4	7	7.5	3000*	18.3				
			SS4	18	2-2-3	5	10.0	2000*	22.4				
	Stiff to very stiff LEAN CLAY, trace sand, trace gravel, occasional organic pockets, dark brown to brown-gray (CL) (Organic Content at 7.5 ft. = 2.0%; Organic Content at 10 ft. = 2.5%)	10.0	SS5	12	1-2-2	4	12.5	4500*	22.6				
			SS6	3	1-1-1	2	15.0	3000*	23.7				
589.5		18.5											
	Very loose poorly graded FINE SAND, trace silt, brown, wet (SP)	20.0	SS7	18	1-1-1	2	20.0						
584.5		23.5											
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	25.0	SS8	18	2-4-6	10	25.0	3000*	14.4				
			SS9	18	4-6-10	16	30.0	2500*	16.7				
		30.0											



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 18.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421694.4
Northing: 256255.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 75

Engineer on Rig: S. Woolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA					LABORATORY DATA					▼ SPT N VALUE ▼					
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40
	Ground Surface Elevation 608 ft	30															
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	3-4-6	10	35.0	2000*	18.2								
		40	SS11	18	3-4-6	10	40.0	2400#	17.6								
		45	SS12	3	3-3-6	9	45.0	2000*	17.3								
		50	SS13	18	2-2-3	5	50.0	1200#	19.7								
558.0	End of Boring at 50 ft.	50															
		55															
		60															

GROUNDWATER READINGS

First Encountered: 18.5 ft.
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421694.4
Northing: 256255.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 75

Engineer on Rig: S. Whoolery

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout

Checked By: ALOG

QA/QC By: KB

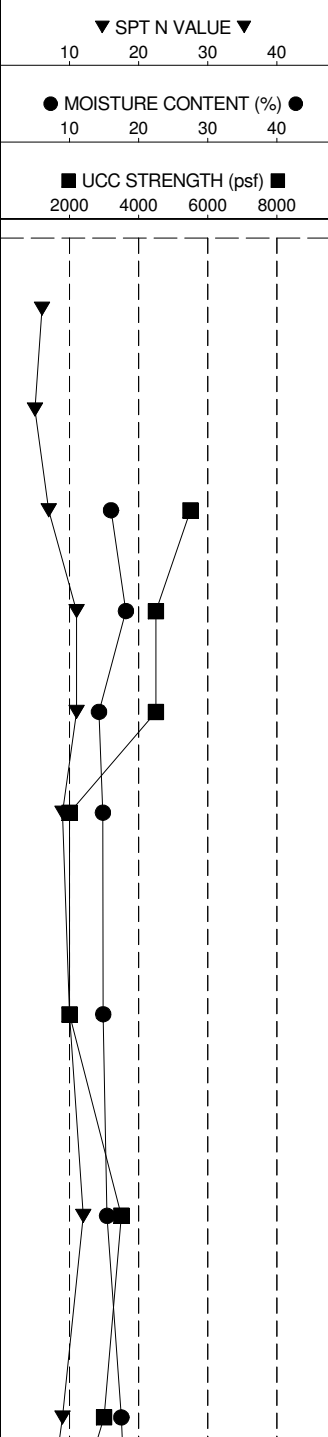
Remarks:



Somat Engineering, Inc.

Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼					
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
605.3	Ground Surface Elevation 606 ft 8.5 inches of PORTLAND CEMENT CONCRETE	0																
601.0	FILL - Loose mixed sand and crushed limestone aggregate/concrete (Strong HCl reaction)	5	SS1	7	4-3-3	6	2.5											
598.5	FILL - Very stiff lean clay, trace sand, trace gravel, brown (CL)	7.5	SS2	10	2-2-3	5	5.0											
	Very stiff to stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	10	SS3	18	2-4-3	7	7.5	5500*	16.0									
		15	SS4	18	3-5-6	11	10.0	4500*	18.2									
		20	SS5	18	3-5-6	11	12.5	4500*	14.3									
		25	SS6	16	3-3-6	9	15.0	2000*	14.8									
		30	SS7	17	2-4-6	10	20.0	2000*	14.9									
		35	SS8	9	4-5-7	12	25.0	3500*	15.4									
576.0			30	SS9	16	2-4-5	9	30.0	3000*	17.5								



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421660.1
Northing: 256224.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ

Drill Rig: CME 55

Engineer on Rig: S. Panetta

Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR

Method Notes: WR drilling started at 7.5 ft.

Hammer Type: Automatic

Backfilled With: Grout/Core/Patch

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	FIELD DATA				LABORATORY DATA						▼ SPT N VALUE ▼						
			SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40		
	Ground Surface Elevation 606 ft	30																	
	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	35	SS10	18	1-3-2	5	35.0	1200#	18.8										
		40	SS11	18	1-2-3	5	40.0	1600#	14.4										
		45	SS12	18	3-2-3	5	45.0	1400#	19.5										
		50	SS13	18	2-3-4	7	50.0	1600#	19.7										
556.0	End of Boring at 50 ft.	50																	
		55																	
		60																	

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION

Easting: 13421660.1
Northing: 256224.2

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: DLZ
Drill Rig: CME 55
Engineer on Rig: S. Panetta
Drilling Method: 2 1/4 in. HSA & 3 1/4 in. WR
Method Notes: WR drilling started at 7.5 ft.
Hammer Type: Automatic
Backfilled With: Grout/Core/Patch
Checked By: ALOG
QA/QC By: KB
Remarks:

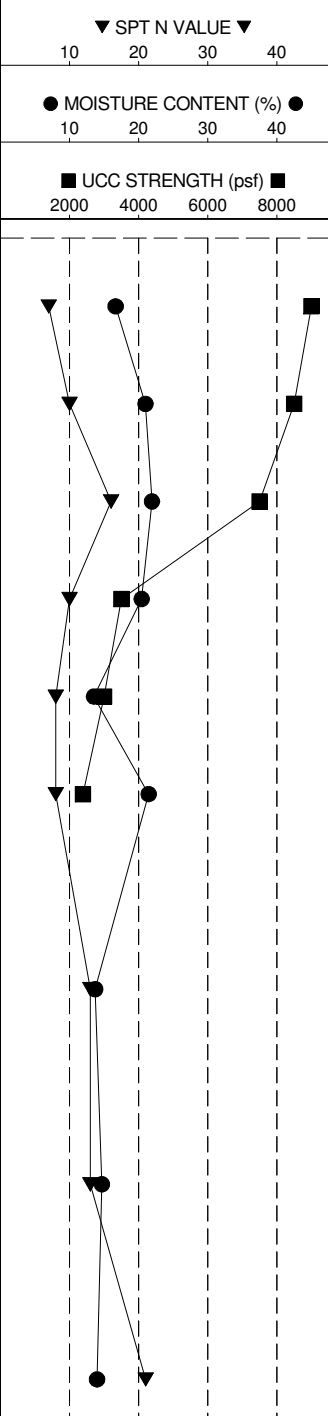


Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

PROJECT NO. 2018019A DATE STARTED: 8/14/2019 DATE COMPLETED: 8/14/2019 LOG OF TEST BORING SB-23

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA					▼ SPT N VALUE ▼							
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	10	20	30	40	
607.5	Ground Surface Elevation 608 ft 6 inches of sandy TOPSOIL	0																
605.0	FILL - Mixed hard lean clay and clayey fine sand, trace topsoil, trace roots, trace gravel, brown (CL) (SC)	3.0	SS1	15	6-4-3	7	2.5	9000+*	16.7									
603.0	FILL - Hard lean clay, trace sand, trace gravel, occasional silt partings, occasional sand pockets, brown (CL)	5.0	SS2	14	5-5-5	10	5.0	8500*	21.0									
600.5	Very stiff LEAN CLAY, trace sand, trace gravel, frequent silt partings, brown (CL)	7.5	SS3	18	7-7-9	16	7.5	7500*	21.9									
		10.0	SS4	18	4-5-5	10	10.0	3500*	20.4									
		12.5	SS5	18	3-4-4	8	12.5	3000*	13.5									
		15.0	SS6	18	3-3-5	8	15.0	2390	21.4	111								
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL) (Driller reported possible cobble in borehole causing poor sample recovery)	20.0	SS7	6	5-5-8	13	20.0	<	13.7									
		25.0	SS8	6	4-6-7	13	25.0	<	14.7									
	(No recovery after two attempts at 30 ft., sample obtained from auger cuttings)	30.0	AU9	0	7-9-12	21	30.0	<	14.0									
578.0	End of Boring at 30 ft.	30.0																



LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION

Easting: 13421469.7
Northing: 256337.5

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: 7NT

Drill Rig: CME 75

Engineer on Rig: P. Cody

Drilling Method: 2 1/4 inch HSA

Method Notes: ----

Hammer Type: Automatic

Backfilled With: Cuttings

Checked By: ALOG

QA/QC By: KB

Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA								
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	▼ SPT N VALUE ▼ 10 20 30 40 ● MOISTURE CONTENT (%) ● 10 20 30 40 ■ UCC STRENGTH (psf) ■ 2000 4000 6000 8000
591.5	Ground Surface Elevation 592 ft 6 inches of sandy TOPSOIL	0												
589.5	FILL - Lean clay with sand, trace gravel, brown (CL)	0.5	SS1	1	8-8-7	15	2.5	<	11.5					
	Very stiff to medium LEAN CLAY, few sand, trace gravel, gray (CL)	5	SS2	13	3-3-4	7	5.0	4500*	13.1					
		10	SS3	14	3-3-3	6	7.5	1810	14.8	126				
		15	SS4	17	2-3-3	6	10.0	2500*	14.7					
		20	SS5	18	2-2-3	5	12.5	2500*	15.2					
		25	SS6	18	2-2-3	5	15.0	2000*	15.3					
		30	SS7	18	2-2-3	5	20.0	2000*	15.8					
		35	SS8	18	2-3-3	6	25.0	1400#	17.1					
		30.0	SS9	18	3-3-4	7	30.0	1800#	17.3					
562.0		End of Boring at 30 ft.	30											

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION

Easting: 13430531.9
Northing: 256605.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: 7NT
Drill Rig: CME 75
Engineer on Rig: P. Cody
Drilling Method: 2 1/4 inch HSA
Method Notes: ----
Hammer Type: Automatic
Backfilled With: Cuttings
Checked By: ALOG
QA/QC By: KB
Remarks:



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA								
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	▼ SPT N VALUE ▼ 10 20 30 40 ● MOISTURE CONTENT (%) ● 10 20 30 40 ■ UCC STRENGTH (psf) ■ 2000 4000 6000 8000
610.5	Ground Surface Elevation 611 ft 6 inches of sandy TOPSOIL	0												
608.5	FILL - Hard lean clay with sand, trace organics, trace gravel, brown and dark brown (CL) (Organic Content = 4.6%)	0.5	SS1	8	7-6-7	13	2.5	9000+*	17.1					
606.0	FILL - Stiff lean clay, few sand, trace gravel, trace organics, mottled brown and gray and dark brown (CL) (Organic Content = 4.0%)	2.5	SS2	9	3-2-3	5	5.0	3500*	25.4					
	Hard LEAN CLAY, few sand, trace gravel, brown (CL)	5.0	SS3	16	6-11-14	25	7.5	9000+*	12.9					
		10.0	SS4	18	11-13-15	28	10.0	9000+*	12.0					
598.5		12.5	SS5	16	7-10-11	21	12.5	9000+*	12.6					
		15.0	SS6	16	8-8-9	17	15.0	7140	12.2	129				
		20.0	SS7	18	5-6-9	15	20.0	6500*	13.3					
	Very stiff LEAN CLAY, few sand, trace gravel, gray (CL)	25.0	SS8	18	5-6-8	14	25.0	4500*	13.5					
581.0		30.0	SS9	16	6-7-11	18	30.0	5000*	14.9					
	End of Boring at 30 ft.	30.0												

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 27.5 ft.
Upon Completion: 22 ft.

BORING LOCATION INFORMATION

Easting: 13421045.1
Northing: 256271.0

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: 7NT

Drill Rig: CME 75

Engineer on Rig: P. Cody

Drilling Method: 2 1/4 inch HSA

Method Notes: ----

Hammer Type: Automatic

Backfilled With: Cuttings

Checked By: ALOG

QA/QC By: KB

Remarks:

Hole collapse at 24 ft.



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**

LOG OF SOIL PROFILE			FIELD DATA				LABORATORY DATA										
ELEVATION (ft.)	SOIL DESCRIPTION	DEPTH (ft.)	SAMPLE NO.	DCP RESULTS (AVG. MM/BLOW)	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMP. STREN. psf				DRY DENSITY pcf				
									2000	4000	6000	8000	30	60	90	120	
									DCP PENETRATION RESISTANCE				MOISTURE CONTENT %				
									20	40	60	80	10	20	30	40	
	Ground Surface Elevation 611 ft	0															
610.25	9 inches of sandy TOPSOIL	0.8															
608.67	FILL - Poorly graded fine sand, few gravel and crushed aggregate, trace silt, brown, moist (SP)	2.3	HA1		2.0												
	End of Boring at 2.33 ft. (Hand auger terminated due to refusal on gravel)	3															
		4															
		5															
		6															
		7															
		8															
		9															
		10															

BORING COORDINATES
 E(x) Coordinate 13421064.22
 N (y) Coordinate 256240.51

GROUNDWATER READINGS
 First Encountered: none
 Upon Completion: none
 Remarks:

Engineer: P. Cody
 Auger Method: Hand Auger
 Backfilled With: Cuttings
 Date Started: 08-23-19
 Date Completed: 08-23-19
 Checked By: ALOG

Torvane
 * Pocket Penetrometer
 <> Disturbed Sample



Somat Engineering, Inc.

Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA				
ELEVATION (ft.)		DEPTH (ft.)	SAMPLE NO.	DCP RESULTS (AVG. MM/BLOW)	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	UNCONFINED COMP. STREN. psf 2000 4000 6000 8000	DRY DENSITY pcf 30 60 90 120
									DCP PENETRATION RESISTANCE 20 40 60 80	MOISTURE CONTENT % 10 20 30 40
	Ground Surface Elevation 611 ft	0								
610.5	6 inches of sandy TOPSOIL	0.5								
	FILL - Poorly graded fine sand, few gravel and crushed aggregate, trace silt, brown, moist (SP)	1	HA1		2.0					
608.83		2.2	HA2		3.0	5500*	14.6			
		3								
	Very stiff to stiff LEAN CLAY, few sand, trace gravel, mottled brown and gray (CL)	4	HA3		5.0	3000*	16.9			
		5								
		6								
		7								
603		8.0								
	End of Boring at 8 ft.	8								
		9								
		10								

LOG OF AUGER PROBE EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 9/3/19

BORING COORDINATES
 E(x) Coordinate 13421072.62
 N (y) Coordinate 256240.62

GROUNDWATER READINGS
 First Encountered: none
 Upon Completion: none

Remarks:
 Located 8 ft. east of HA-23.

Engineer: P. Cody
 Auger Method: Hand Auger
 Backfilled With: Cuttings
 Date Started: 08-23-19
 Date Completed: 08-23-19
 Checked By: ALOG

Torvane
 * Pocket Penetrometer
 <> Disturbed Sample



Somat Engineering, Inc.

**Eureka Road Corridor
 Drain & Streetscape Improvements
 Allen Road to Telegraph Road (US-24)
 Taylor, Michigan**

LOG OF SOIL PROFILE		FIELD DATA				LABORATORY DATA								
ELEVATION ft		DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200	▼ SPT N VALUE ▼ 10 20 30 40 ● MOISTURE CONTENT (%) ● 10 20 30 40 ■ UCC STRENGTH (psf) ■ 2000 4000 6000 8000
611.5	Ground Surface Elevation 612 ft 6 inches of sandy TOPSOIL	0												
609.0	FILL - Mixed clay, sand, and gravel, trace asphalt millings, brown (CL)(SP)(GP)	0.5	SS1	7	6-10-10	20	2.5							
607.0	FILL - Medium dense poorly graded fine sand with asphalt millings, trace gravel, occasional lean clay layers, brown and black, moist (SP)	3.0	SS2	16	12-8-6	14	5.0							
603.5	FILL - Loose poorly graded fine to coarse sand with silt and gravel, dark brown, moist (SP-SM)	5.0	SS3	14	3-4-3	7	7.5							
602.0	FILL - Very loose poorly graded medium to coarse sand with asphalt millings, trace gravel, occasional clay pockets, black, wet (SP)	8.5	SS4	7	2-1-1	2	10.0							
597.0	Very stiff LEAN CLAY, few sand, trace gravel, brown (CL)	10.0	SS5	14	4-9-12	21	12.5	4730	13.9	122				
		15.0	SS6	18	12-13-12	25	15.0	7000*	12.0					
		20.0	SS7	18	4-4-5	9	20.0	2500*	14.2					
		25.0	SS8	18	4-4-6	10	25.0	2500*	14.8					
		30.0	SS9	18	4-5-8	13	30.0	4500*	15.2					
582.0	Stiff to very stiff LEAN CLAY, few sand, trace gravel, gray (CL)	30.0												
	End of Boring at 30 ft.													

LOG OF TEST BORING EUREKA ROAD CULVERT REPLACEMENTS.GPJ SOMAT.GDT 8/30/19

GROUNDWATER READINGS

First Encountered: 8 ft.
Upon Completion: 21 ft.

BORING LOCATION INFORMATION

Easting: 13421071.2
Northing: 256072.7

Coordinates/GSE determined by:
Est. by GPS unit with +/- 10 ft. accuracy

KEY

- # Torvane
- * Penetrometer
- <> Disturbed Sample

Drilling Company: 7NT

Drill Rig: CME 75

Engineer on Rig: P. Cody

Drilling Method: 2 1/4 inch HSA

Method Notes: ----

Hammer Type: Automatic

Backfilled With: Cuttings

Checked By: ALOG

QA/QC By: KB

Remarks:

Hole collapse at 24 ft.



Somat Engineering, Inc.

**Eureka Road Corridor
Drain & Streetscape Improvements
Allen Road to Telegraph Road (US-24)
Taylor, Michigan**



GENERAL NOTES

Unified Soil Classification System (USCS) ASTM D2488 (Modified)

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon – 1 3/8" I.D., 2" O.D. (standard)
 S : Split Spoon – non-standard size, as noted
 ST: Thin-Walled Tube – 3" O.D., (unless otherwise noted)
 LS: Liner Sample
 PA: Power Auger
 HA: Hand Auger
 AU: Auger Sample
 BS: Bulk Sample
 HSA: Hollow Stem Auger
 DP: Direct Push

PS: Piston Sample
 PT: Pitcher Sample
 WS: Wash Sample
 RC: Rock Core with diamond bit, NX size, (unless otherwise noted)
 RB: Rock Bit/Roller Bit
 WR: Wash Rotary
 NR: No Recovery
 VS: Vane Shear Test

Standard Penetration Test Resistance, N-Value: Sum of 2nd and 3rd 6-inch increments, in blows per foot of a 140-pound hammer falling 30 inches and driving an 18-inch long, 2-inch OD split spoon.

WATER LEVEL MEASUREMENT:

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of a groundwater table. In low permeability soils (clays and silts), the accurate determination of groundwater levels may not be possible with only short-term observations. Groundwater levels at times and locations other than when and where individual borings were performed could vary.

DESCRIPTIVE SOIL CLASSIFICATION:

Soil classification is based on the Unified Soil Classification (USC) System and ASTM Standards D-2487 and D-2488. Coarse-grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are generally described as: clays, if they are plastic, and silts, if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their apparent in-place density and fine-grained soils on the basis of their apparent in-place density (silty soils) or consistency (clayey soils).

DESCRIPTORS OF MINOR CONSTITUANTS

Primary Constituent	Fine Grained (Silt & Clay)		Coarse Grained (Sand & Gravel)	
	Relative Portion of Coarse Grained Soils as a % of Dry Weight	Relative Portion of Fine Grained Soils as a % of Dry Weight	Relative Portion of Fine Grained Soils as a % of Dry Weight	Relative Portion of Coarse Grained Soils as a % of Dry Weight
Trace	<5%	<5%	<5%	<5%
Few	≥5% - <15%	N/A	≥5% - <15%	≥5% - <15%
With	≥15% - <30%	≥5% - 12%	≥15%	≥15%
Modifier	≥30%	>12%	N/A	N/A

FINE-GRAINED SOILS

COARSE-GRAINED SOILS

Unconfined Compressive Strength Q_u , psf	Consistency	N-Value	Apparent Density
< 500	Very Soft	0 – 4	Very Loose
500 - <1,000	Soft	5 – 9	Loose
1,000 - <2,000	Medium	10 – 29	Medium Dense
2,000 - <4,000	Stiff	30 – 49	Dense
4,000 - <8,000	Very Stiff	50 – 80	Very Dense
≥ 8,000	Hard	>80	Extremely Dense

DEFINITIONS OF PAVEMENT CONDITION

Condition	Description
Good	ACC Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks and Transverse cracks (open 1/4 inch). No patching or very few patches in excellent condition.
	PCC Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (1/4 inch wide) longitudinal or transverse joints.
Fair	ACC Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2 inch deep or less).
	PCC Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (1/2 inch with fair ride. Several slabs have multiple transverse or meander cracks with moderate spalling.
Poor	ACC Alligator cracking (over 25% of surface). Severe distortions (over 2 inches deep) Extensive patching in poor condition. Potholes.
	PCC Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements or frost heaves.

DEFINITIONS OF STRUCTURAL AND DEPOSITIONAL FEATURES

Term	Definition
Parting	≤ 1/16 inch (1.6 mm) thick
Seam	> 1/16 inch (1.6 mm) → 1/2 inch (12.7 mm) thick
Layer	> 1/2 inch (12.7 mm) to ≤ 12 inches (305 mm) thick
Pocket	Small, erratic deposits of limited lateral extent
Lens	Lenticular deposit
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Varved	Alternating partings or seams (1 mm – 12 mm) of silt and/or clay and sometimes fine sand
Stratified	Alternating layers of varying material or color with layers ≥ 6 mm thick
Laminated	Alternating layers of varying material or color with layers < 6 mm thick
Fissured	Contains shears or separations along planes of weakness
Slickensided	Shear planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Homogeneous	Same color and appearance throughout
Occasional	One or less per foot (305 mm) of thickness
Frequent	More than one per foot (305 mm) of thickness
Interbedded	Applied to strata of soil lying between or alternating with other strata of a different nature

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Size Range
Boulders	≥ 12" (300 mm)
Cobbles	< 12" - 3" (300 mm – 75 mm)
Gravel - Coarse	< 3" - 3/4" (75 mm – 19 mm)
Gravel - Fine	< 3/4" - #4 (19 mm – 4.75 mm)
Sand - Coarse	< #4 - #10 (4.75 mm – 2 mm)
Sand - Medium	< #10 - #40 (2 mm - 0.425 mm)
Sand - Fine	< #40 - #200 (0.425 mm - 0.074 mm)
Silt	< 0.074 mm - 0.005 mm
Clay	< 0.005 mm



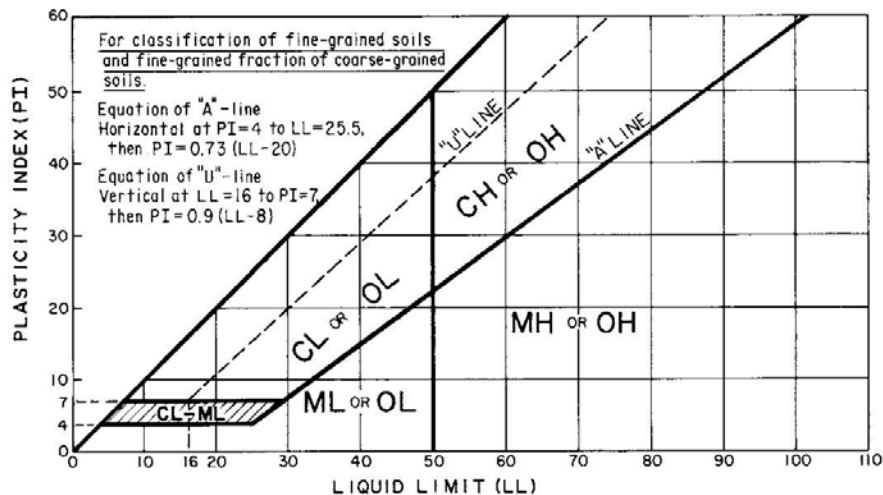
GENERAL NOTES

Unified Soil Classification System (USCS) ASTM D2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A			Soil Classification			
			Group Symbol	Group Name ^B		
COARSE-GRAINED More than 50 % retained on No. 200 sieve	Gravels (More than 50 % of coarse fraction retained on No. 4 sieve)	Clean Gravels (Less than 5% fines ^C)	$Cu \geq 4$ and $1 \leq Cc \leq 3^D$	GW	Well-graded gravel ^E	
		Gravels with Fines (More than 12 % fines ^C)	$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3]^D$ Fines classify as ML or MH	GP	Poorly graded gravel ^E	
	Sands (50 % or more of coarse fraction passes No. 4 sieve)	Clean Sands (Less than 5 % fines ^H)	$Cu \geq 6$ and $1 \leq Cc \leq 3^D$	SW	Well-graded sand ^I	
		Sands with Fines (More than 12 % fines ^H)	$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3]^D$ Fines classify as ML or MH	SP	Poorly graded sand ^I	
		Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line ^J $PI < 4$ or plots below "A" line ^J	CL	Lean clay ^{K,L,M}
			organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	OL	Organic clay ^{K,L,M,N} Organic silt ^{K,L,M,O}
FINE-GRAINED SOILS 50 % or more passes the No. 200 sieve	Silts and Clays Liquid limit more than 50	inorganic	PI plots on or above "A" line PI plots below "A" line	CH	Fat clay ^{K,L,M}	
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	MH	Elastic silt ^{K,L,M}	
	Silts and Clays Liquid limit more than 50	inorganic	PI plots on or above "A" line PI plots below "A" line	OH	Organic clay ^{K,L,M,P} Organic silt ^{K,L,M,Q}	
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75			
HIGHLY ORGANIC SOILS Primarily organic matter, dark in color, and organic odor			Pt	Peat		

- ^A Based on the material passing the 3-in. (75-mm) sieve.
- ^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
- ^C Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
- ^D $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2 / (D_{10} \times D_{60})$
- ^E If soil contains ≥ 15 % sand, add "with sand" to group name.
- ^F If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
- ^G If fines are organic, add "with organic fines" to group name.

- ^H Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
- ^I If soil contains ≥ 15 % gravel, add "with gravel" to group name.
- ^J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
- ^K If soil contains 15 to <30 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.
- ^L If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sand" to group name.
- ^M If soil contains ≥ 30 % plus No. 200, predominantly gravel, add "gravelly" to group name.
- ^N $PI \geq 4$ and plots on or above "A" line.
- ^O $PI < 4$ or plots below "A" line.
- ^P PI plots on or above "A" line.
- ^Q PI plots below "A" line.



Order of Classification: 1) Consistency or Apparent Density, 2) Type of Soil, 3) Minor Soil Type(s), 4) Inclusions, 5) Layered Soils, 6) Color, 7) Water Content, 8) USCS Symbol, 9) Geological Name

APPENDIX C

RESULTS OF GRAIN SIZE ANALYSIS

APPENDIX D

**“IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING
REPORT”**

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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*.



Telephone: 301/565-2733

e-mail: info@geoprofessional.org www.geoprofessional.org



MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY
WATER RESOURCES DIVISION
PERMIT

Issued To:

Chris Gibbs
City of Taylor
25605 Northline Road
Taylor, MI 48180-4596

Permit No: WRP043022 v.1
Submission No.: HQ3-7NZW-NDRT2
Site Name: 82-Eureka Road-Taylor
Issued: DRAFT
Revised:
Expires: DRAFT

This permit is being issued by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), Water Resources Division, under the provisions of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA); specifically:

- | | |
|---|---|
| <input checked="" type="checkbox"/> Part 301, Inland Lakes and Streams | <input type="checkbox"/> Part 323, Shorelands Protection and Management |
| <input type="checkbox"/> Part 303, Wetlands Protection | <input type="checkbox"/> Part 325, Great Lakes Submerged Lands |
| <input type="checkbox"/> Part 315, Dam Safety | <input type="checkbox"/> Part 353, Sand Dunes Protection and Management |
| <input checked="" type="checkbox"/> Part 31, Water Resources Protection (Floodplain Regulatory Authority) | |

EGLE certifies that the activities authorized under this permit are in compliance with the State Coastal Zone Management Program and certifies without conditions under the Federal Clean Water Act, Section 401 that the discharge from the activities authorized under this permit will comply with Michigan's water quality requirements in Part 31, Water Resources Protection, of the NREPA and associated administrative rules, where applicable.

Permission is hereby granted, based on permittee assurance of adherence to State of Michigan requirements and permit conditions, to:

Authorized Activity:

Complete improvement activities to the Wayne County Frank and Poet Drain as part of a larger Eureka Road corridor improvement project. Proposed activities include enclosing 700 linear feet of the Frank & Poet Drain by placing a 700-foot long by 8-foot by 22-foot concrete box culvert with 717 cubic yards of material in the existing drain channel; improve 3,910 linear feet of the drain by excavating 19,244 cubic yards of material from an area measuring 3,910 feet long by 64 feet wide to create a low flow channel and floodplain terrace within the existing drain channel alignment; place 798 cubic yards of fill material including riprap, fabric wrapped soil lifts and plantings in the drain to construct grade control, floodplain terrace and habitat structures; replace the existing Racho Road culvert with a 135-foot long by 8-foot by 22-foot concrete box culvert. Floodplain activities include placing a total of 4,753 cubic yards of material in the 100-year floodplain that extends the full project limits from Telegraph Road to Allen Road and complete a compensating cut of 23,983 cubic yards of

material within this same area. Mitigation is proposed and includes 400 lineal feet of stream channel restoration using natural channel design principles located off site. The project includes the Frank & Poet Drain, and 100-year floodplain located on Eureka Road between Telegraph Road and Allen Road within City of Taylor, Wayne County. The project is located on the north side of Eureka Road between Telegraph Road and Racho Road in City of Taylor, Wayne County.

All work shall be completed in accordance with EGLE approved plans and specific conditions of this permit.

Waterbody Affected: Frank & Poet Drain
Property Location: Wayne County, Taylor, Town/Range/Section 03S10E27,
Property Tax No. N/A

Authority granted by this permit is subject to the following limitations:

- A. Initiation of any work on the permitted project confirms the permittee's acceptance and agreement to comply with all terms and conditions of this permit.
- B. The permittee, in exercising the authority granted by this permit, shall not cause unlawful pollution as defined by Part 31 of the NREPA.
- C. This permit shall be kept at the site of the work and available for inspection at all times during the duration of the project or until its date of expiration.
- D. All work shall be completed in accordance with the approved plans and specifications submitted with the application and/or plans and specifications attached to this permit.
- E. No attempt shall be made by the permittee to forbid the full and free use by the public of public waters at or adjacent to the structure or work approved.
- F. It is made a requirement of this permit that the permittee give notice to public utilities in accordance with 2013 PA 174 (Act 174) and comply with each of the requirements of Act 174.
- G. This permit does not convey property rights in either real estate or material, nor does it authorize any injury to private property or invasion of public or private rights, nor does it waive the necessity of seeking federal assent, all local permits, or complying with other state statutes.
- H. This permit does not prejudice or limit the right of a riparian owner or other person to institute proceedings in any circuit court of this state when necessary to protect his rights.
- I. Permittee shall notify EGLE within one week after the completion of the activity authorized by this permit by completing and forwarding the attached preaddressed postcard to the office addressed thereon.
- J. This permit shall not be assigned or transferred without the written approval of EGLE.
- K. Failure to comply with conditions of this permit may subject the permittee to revocation of permit and criminal and/or civil action as cited by the specific state act, federal act, and/or rule under which this permit is granted.
- L. All dredged or excavated materials shall be disposed of in an upland site (outside of floodplains, unless exempt under Part 31 of the NREPA, and wetlands).
- M. In issuing this permit, EGLE has relied on the information and data that the permittee has provided in connection with the submitted application for permit. If, subsequent to the issuance of a permit, such information and data prove to be false, incomplete, or inaccurate, EGLE may modify, revoke, or suspend the permit, in whole or in part, in accordance with the new information.
- N. The permittee shall indemnify and hold harmless the State of Michigan and its departments, agencies, officials, employees, agents, and representatives for any and all claims or causes of action arising from acts or omissions of the permittee, or employees, agents, or representative of the permittee, undertaken in connection with this permit. The permittee's obligation to indemnify the State of Michigan applies only if the state: (1) provides the permittee or its designated representative written notice of the claim or cause of action within 30 days after it is received by

- the state, and (2) consents to the permittee's participation in the proceeding on the claim or cause of action. It does not apply to contested case proceedings under the Administrative Procedures Act, 1969 PA 306, as amended, challenging the permit. This permit shall not be construed as an indemnity by the State of Michigan for the benefit of the permittee or any other person.
- O. Noncompliance with these terms and conditions and/or the initiation of other regulated activities not specifically authorized shall be cause for the modification, suspension, or revocation of this permit, in whole or in part. Further, EGLE may initiate criminal and/or civil proceedings as may be deemed necessary to correct project deficiencies, protect natural resource values, and secure compliance with statutes.
- P. If any change or deviation from the permitted activity becomes necessary, the permittee shall request, in writing, a revision of the permitted activity from EGLE. Such revision request shall include complete documentation supporting the modification and revised plans detailing the proposed modification. Proposed modifications must be approved, in writing, by EGLE prior to being implemented.
- Q. This permit may be transferred to another person upon written approval of EGLE. The permittee must submit a written request to EGLE to transfer the permit to the new owner. The new owner must also submit a written request to EGLE to accept transfer. The new owner must agree, in writing, to accept all conditions of the permit. A single letter signed by both parties that includes all the above information may be provided to EGLE. EGLE will review the request and, if approved, will provide written notification to the new owner.
- R. Prior to initiating permitted construction, the permittee is required to provide a copy of the permit to the contractor(s) for review. The property owner, contractor(s), and any agent involved in exercising the permit are held responsible to ensure that the project is constructed in accordance with all drawings and specifications. The contractor is required to provide a copy of the permit to all subcontractors doing work authorized by the permit.
- S. Construction must be undertaken and completed during the dry period of the wetland. If the area does not dry out, construction shall be done on equipment mats to prevent compaction of the soil.
- T. Authority granted by this permit does not waive permit requirements under Part 91, Soil Erosion and Sedimentation Control, of the NREPA, or the need to acquire applicable permits from the County Enforcing Agent (CEA).
- U. Authority granted by this permit does not waive permit requirements under the authority of Part 305, Natural Rivers, of the NREPA. A Natural Rivers Zoning Permit may be required for construction, land alteration, streambank stabilization, or vegetation removal along or near a natural river.
- V. The permittee is cautioned that grade changes resulting in increased runoff onto adjacent property is subject to civil damage litigation.
- W. Unless specifically stated in this permit, construction pads, haul roads, temporary structures, or other structural appurtenances to be placed in a wetland or on bottomland of the water body are not authorized and shall not be constructed unless authorized by a separate permit or permit revision granted in accordance with the applicable law.
- X. For projects with potential impacts to fish spawning or migration, no work shall occur within fish spawning or migration timelines (i.e., windows) unless otherwise approved in writing by the Michigan Department of Natural Resources, Fisheries Division.
- Y. Work to be done under authority of this permit is further subject to the following special instructions and specifications:
1. Authority granted by this permit does not waive permit or program requirements under Part 91 of the NREPA or the need to acquire applicable permits from the CEA. To locate the Soil Erosion Program Administrator for your county, visit

<https://www.michigan.gov/egle/about/organization/water-resources/soil-erosion/sesc-overview> and select "Soil Erosion and Sedimentation Control Agencies".

2. The authority to conduct the activity as authorized by this permit is granted solely under the provisions of the governing act as identified above. This permit does not convey, provide, or otherwise imply approval of any other governing act, ordinance, or regulation, nor does it waive the permittee's obligation to acquire any local, county, state, or federal approval or authorization necessary to conduct the activity.
3. No fill, excess soil, or other material shall be placed in any wetland, floodplain, or surface water area not specifically authorized by this permit, its plans, and specifications.
4. This permit does not authorize or sanction work that has been completed in violation of applicable federal, state, or local statutes.
5. The permit placard shall be kept posted at the work site in a prominent location at all times for the duration of the project or until permit expiration.
6. The proposed fill will change the 1% annual chance (100-year) flood elevations that are published in the community's Flood Insurance Rate Map and/or Flood Elevation Study.
7. The proposed fill and building are located within a 100-year floodplain included in the community's Flood Insurance Rate Map and/or flood elevation study. The permittee must apply to the Federal Emergency Management Agency (FEMA) for a Letter of Map Revision based on fill (LOMR-F) if engineered earthen fill is placed within the mapped 100-year floodplain. As part of the National Flood Insurance Program (NFIP) requirements the community must ensure that the requirements found in Section 65.5(a) of the FEMA's 44 CFR Part 65 are followed.
8. A registered professional engineer or land surveyor must submit an elevation certificate to the local building official upon placement of the lowest floor, including basement, prior to further vertical construction. When the project is located in a National Flood Insurance Program (NFIP) community, using the elevation certificate form, found at www.fema.gov/nfip, is encouraged. The form is required if the community participates in the Community Rating System. The form may be used in non-NFIP communities.
9. Provide a copy of the certification to this office within 15 days of when it was completed.
10. Under Appendix G of the Michigan Building Code 2009, a local building permit is required for development located in flood hazard areas.
11. The project is located within a community that participates in the National Flood Insurance Program (NFIP). As a participant in the NFIP, the community must comply with the Michigan Building Code (including Appendix G and listed supporting materials); the Michigan Residential Code; and Title 44 of the Code of Federal Regulations, Part 60, Criteria for Land Management and Use. The community is also responsible to ensure that its floodplain maps and studies are maintained to show changes to flood elevations and flood delineations as described in 44 CFR, Part 65, Identification and Mapping of Special Hazard Areas.

12. This permit does not waive the requirements of the Michigan Residential Code for the construction of, or substantial improvements to, buildings and structures.
13. A storm water discharge permit may be required under the Federal Clean Water Act for construction activities that disturb one or more acres of land and discharge to surface waters. For sites over five (5) acres, the permit coverage may be obtained by a Part 91, Soil Erosion and Sedimentation Control (SESC) permit, or coverage as an Authorized Public Agency (APA) and filing a "Notice of Coverage" form to EGLE's Water Resource Division. For sites with disturbance from one acre up to five acres, storm water coverage is automatic once the SESC permit is obtained or if work is being conducted by an APA. These one-to-five-acre sites are not required to apply for coverage, but are required to comply with storm water discharge permit requirements. Information on the storm water discharge permit is available from the Water Resource Division's Storm Water Permit Program at www.michigan.gov/soilerosion under the "Construction Storm Water Info".
14. Prior to the initiation of any permitted construction activities, a sedimentation barrier shall be constructed immediately down gradient of the construction site. Sedimentation barriers shall be specifically designed to handle the sediment type, load, water depth, and flow conditions of each construction site throughout the anticipated time of construction and unstable site conditions. The sedimentation barrier shall be maintained in good working order throughout the duration of the project. Upon project completion, the accumulated materials shall be removed and disposed of at an upland (non-wetland, non-floodplain) site and stabilized with seed and mulch. The sedimentation barrier shall then be removed in its entirety and the area restored to its original configuration and cover.
15. All fill/backfill shall consist of clean inert material that will not cause siltation nor contain soluble chemicals, organic matter, pollutants, or contaminants. All fill shall be contained in such a manner so as not to erode into any surface water, floodplain, or wetland. All raw areas associated with the permitted activity shall be stabilized with sod and/or seed and mulch, riprap, or other technically effective methods as necessary to prevent erosion.
16. All dredge/excavated spoils including organic and inorganic soils, vegetation, and other material removed shall be placed on upland (non-wetland, non-floodplain or non-bottomland), prepared for stabilization, and stabilized with sod and/or seed and mulch in such a manner to prevent and ensure against erosion of any material into any waterbody, wetland, or floodplain.
17. The permittee is advised of other potential requirements and legal liabilities under other statutes for placement of dredge material on upland and is responsible for compliance with all applicable local, state, and federal regulations. Please review the information under Dredging Documents at the attached link: https://www.michigan.gov/deq/0,4561,7-135-3312_4123-14201--,00.html
18. The permittee is responsible for acquiring all necessary easements or rights-of-way before commencing any work authorized by this permit. All construction operations relating to, or part of this project shall be confined to the existing right-of-way limits or other acquired easements.

STREAM MITIGATION

19. The permittee shall, as a primary condition of this permit, mitigate the loss of stream functions and services due to enclosure of 700 feet of stream. The authorization granted by this permit is contingent upon the completion of mitigation as follows:

- a. The permittee is required to provide 400 linear feet of stream mitigation, measured along the centerline of the stream, using natural channel design principles in accordance with plans approved by EGLE. If the permit conditions modify the mitigation plan, the permit conditions shall take precedence over the mitigation plan.
- b. The mitigation grading, planting, and introduction of hydrology shall be constructed prior to or concurrent with initiating any other permitted activities and shall be completed prior to expiration of this permit.
- c. The permittee shall provide a surety bond or letter of credit to EGLE in a form identical to the financial assurance models on EGLE's website at www.michigan.gov/deqwetlands in the amount of \$175,000 to ensure that the stream mitigation is constructed, the conservation easement is recorded, monitoring is completed, and corrective actions are performed as required to comply with the mitigation requirements and conditions of this permit. The financial assurance document shall be provided and accepted by EGLE **prior to final signature of this permit by EGLE.**

Prior to the transfer of this permit to another person, the new person must obtain and provide a financial instrument acceptable to EGLE in the name of the new person and in the amount required by this permit.

Upon request of the permittee and with the submittal of adequate proofs, EGLE may release portions of the financial instrument in accordance with the following guidelines:

Fifty (50) percent of the financial instrument may be released after the permittee demonstrates substantial compliance with Performance Standards a. through k., in this permit, for a minimum of two years after construction of the stream mitigation, EGLE concurs that the mitigation grading and planting have been completed, and a pattern, dimension, and profile indicative of a stable stream channel have been maintained after a minimum of two stream flow events that are equal to or greater than the bankfull flow.

The remaining 50 percent of the financial instrument will be released upon all of the following:

- i. Submittal of all the required monitoring reports,
 - ii. Substantial compliance with the performance standards as outlined in this permit,
 - i. Demonstration that a stable stream pattern, dimension, and profile have been maintained for 5 years and at least two bankfull flow events to demonstrate long-term stability of the restored stream channel, and
 - ii. Final approval by EGLE.
- d. The permittee shall execute a conservation easement over the stream mitigation area, including the associated riparian buffer as shown on the permit plans in a form similar to the conservation easement model on EGLE's website at www.michigan.gov/wetlands. The

original executed conservation easement and associated exhibits must be sent to EGLE for review and recording within 60 days of the issuance of this permit. Send to: Conservation Easement Coordinator, EGLE, Water Resources Division, P.O. Box 30458, Lansing, Michigan, 48909, with a copy of the executed easement mailed to the District Office's address above.

An acceptable executed conservation easement must be submitted to EGLE by the permittee prior to commencement of any permitted work within regulated areas.

The conservation easement boundary shall be demarcated by the placement of signs along the perimeter. The signs shall be placed at an adequate frequency, visibility, and height for viewing, made of a suitable material to withstand climatic conditions, and should be replaced as needed. The signs shall include the following language:

STREAM CONSERVATION EASEMENT
NO CONSTRUCTION OR PLACEMENT OF STRUCTURES ALLOWED.
NO MOWING, CUTTING, FILLING, DREDGING OR
APPLICATION OF CHEMICALS ALLOWED.
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Except as otherwise provided by this permit or approved in writing by EGLE, the following activities are prohibited in perpetuity within the mitigation area: alteration of topography, creation of paths, trails, or roads; placement of fill, dredging, or excavation; drainage of surface or groundwater; construction or placement of any structure; plowing, tilling, or cultivating the soils or vegetation; cutting, removal, or alteration of vegetation; including the planting of non-native plant species; construction of unauthorized utility or petroleum lines; storage or disposal of garbage, trash, debris, abandoned equipment; accumulation of machinery or other waste materials; use or storage of off-road vehicles; placement of billboards or signs; or the use of the stream for the dumping of storm water (except as otherwise allowed in this permit).

- e. Any planting or seeding of the mitigation site must consist of native Michigan plant materials according to the Floristic Quality Assessment for the State of Michigan, except for an annual cover crop for initial site stabilization upon approval of EGLE. Engineered plant material, such as jute and coconut fabric, shall be comprised of inert plant fiber that may be nonnative. Erosion control fabrics used within the mitigation riparian buffer shall be free of plastic unless otherwise approved by EGLE based on site conditions.
- f. The permittee shall notify EGLE's District Office, in writing and within 20 days of completion of each of the following items:
 - 1) final grading and construction
 - 2) seeding and plant installation
- g. The permittee shall provide "as-built" plans and specifications signed and sealed by a registered surveyor or licensed engineer within 60 days of final grading and construction.
- h. A licensed engineer shall be present on-site and shall provide oversight to the construction contractor during construction of all in-stream structures (i.e., vanes, wood, riffles, etc.) in

the mitigated stream channel to ensure proper placement and elevations of these structures.

- i. In the event the permitted activity is begun but not completed, the permittee or owner of record shall remain responsible for completion of the stream mitigation, as determined by EGLE. Such determinations shall be based upon the extent of the disturbance to the existing stream.
- j. Should the mitigated stream and associated riparian buffer area fail to become stable after two bankfull (or greater) flow events, including at least one flow event that results in over-bank flooding, and two complete growing seasons, or fail to progress satisfactorily towards a self-sustaining stream system as required by this permit, the permittee shall:
 - i. Assess the problem and its probable causes;
 - ii. Assess upstream and downstream impacts of the mitigation;
 - iii. Develop reasonable and necessary corrective measures as a revision to original plans;
 - iv. Submit proposed corrective measures, including a schedule for implementation, to EGLE for confirmation and approval within 60 days of identification of the problem; and
 - v. Upon EGLE approval, implement corrective measures according to the approved schedule.

Additional mitigation monitoring may be required to evaluate the success of the corrective measures.

20. Stream Mitigation Plan Required

The permittee is required to submit an approvable Stream Mitigation Plan to EGLE for the proposed mitigation site within **60 days of the issuance of this permit**. The applicant must receive approval of the stream mitigation plan from EGLE before undertaking any permitted activity. The stream mitigation plan must contain:

- a. The proposed stream mitigation design including:
 - i. A plan view with stationing showing all of the proposed conditions of the mitigation site including channel alignment, in-stream structures, the type and size of all wetland areas, property lines, directional arrows, scale, direction of flow, the riparian buffer and the conservation easement area.
 - ii. Pool and riffle cross-sections, as applicable, showing bankfull width and depth and flood prone width, longitudinal profile showing bankfull and existing ground elevations, and a plan, profile and cross-section of each type of in-stream structure.
 - iii. All specifications for materials and construction procedures including construction tolerances for elevations of all instream structures.
 - iv. A vegetative establishment plan which includes a plan view, methods, species list with scientific and common names, type of propagule (seed, bare root stock, etc.), and source of any plant or seed stock.
- b. A schedule for completion of the mitigation site (e.g., initiation, grading, planting, introduction of hydrology, completion) and the site preparation and soil erosion/sedimentation control methods to be used during construction including removal of all silt fence once vegetation is established.

Regulated activities authorized by this permit are prohibited until a final mitigation plan is submitted by the permittee and approved in writing by EGLE.

21. Stream Mitigation Performance Standards

The following performance standards will be used to evaluate the stream mitigation project:

- a. Construction has been completed in accordance with EGLE's approved plans and specifications included in the permit and mitigation plan.
- b. Restoration of the stream channel to a stable pattern, dimension, and profile based on reference stream parameters and the mitigation plan. Maintenance of stable stream parameters for two bankfull (or greater) flow events and at least one flow event that results in over-bank flooding.
- c. The stream and riparian buffer mitigation area shall be free of oil, grease, debris, and all other contaminants.
- d. Any in-stream structures (i.e., cross-vanes, wood, constructed riffles, etc.) shall perform as designed. The structures shall stay in place and there shall be no bank erosion, piping, undermining, end around, or other indication of instability associated with the in-stream structures including no buoyancy issues with wood structures.
- e. At the end of the monitoring period, the mitigated stream shall exhibit **floodplain connectivity** appropriate for proper stream functioning as evidenced by a weighted Bank Height Ratio of 1.0-1.2, and a weighted Entrenchment Ratio of >2.4 for Rosgen channel types C and E.
- f. At the end of the monitoring period, the mitigated stream shall exhibit **bank migration and lateral stability** appropriate for proper stream functioning as evidenced by a dominant Bank Erosion Hazard Index (BEHI) score and a Near Bank Stress (NBS) score combination (BEHI/NBS) of Moderate/Very Low, Low/Very High, Low/High, Low/Moderate, Low/Low, Low/Very Low, or any combination where the BEHI score is Very Low.
- g. At the end of the monitoring period, the mitigated stream shall exhibit a vegetated **Riparian Buffer** as evidenced by an average buffer width, measured horizontally from the water's edge, equal to or greater than 150 feet on each side of the channel.
- h. **Riparian Vegetation Cover:** The mean percent cover of native species in the herbaceous layer is not less than 70 percent at the end of the monitoring period.

Extensive areas of bare soil shall not exceed five percent of the mitigation area. Bare soil is defined as areas with less than 20 percent vegetative cover. For the purposes of these performance standards, extensive refers to areas greater than 0.01 acre (436 square feet) in size.

The total percent cover of native species in each plot shall be averaged to obtain a mean percent cover value. For the purposes of this standard, total percent cover is the percent cover of the ground surface covered by vegetation, bare soil, and open water, when viewed from above. Total percent cover cannot exceed 100 percent. Plots within identified bare

soil areas and areas without a predominance of native vegetation shall not be included in this average.

- i. **Riparian Vegetation Diversity:** The stream mitigation riparian buffer supports a predominance of native vegetation in each vegetative layer, represented by a minimum number of native species, at the end of the monitoring period. The minimum number of native species shall not be less than 15 species within the riparian buffer.

The total number of native plant species shall be determined by a sum of all species identified in sample plots.

- j. **Riparian Vegetation Density:** At the end of the monitoring period, the stream mitigation riparian buffer supports a minimum of:
- Three hundred (300) individual surviving, established, and free-to-grow trees per acre in the riparian buffer that are a minimum of 5 feet tall and that are classified as native species and consisting of at least three different species.
 - Five hundred (500) individual surviving, established, and free-to-grow trees or shrubs per acre that are a minimum of 4 feet tall are classified as native species and consisting of at least four different species.

Physiognomic classification of trees and shrubs shall be in accordance with the Michigan Floristic Quality Assessment (Michigan Department of Natural Resources, 2001).

- k. The **mean percent cover of invasive species** in the stream channel and associated riparian buffer including, but not limited to, *Phragmites australis* (Common Reed), *Lythrum salicaria* (Purple Loosestrife), *Frangula alnus* (Glossy Buckthorn), *Rhamnus cathartica* (Common Buckthorn), *Alliaria petiolata* (Garlic Mustard), and *Phalaris arundinacea* (Reed Canary Grass) shall in combination be limited to no more than ten (10) percent within each riparian vegetation zone. Invasive species shall not dominate the vegetation in any extensive area of the stream channel and associated riparian buffer.

If the mean percent cover of invasive species in the stream channel and associated riparian buffer is more than ten (10) percent within any riparian vegetation zone or if there are extensive areas of the stream channel or associated riparian buffer in which an invasive species is one of the dominant plant species, the permittee shall submit an evaluation of the problem to EGLE. If the permittee determines that it is infeasible to reduce the cover of invasive species to meet the above performance standard, the permittee must submit an assessment of the problem, a control plan, and the projected percent cover that can be achieved for review by EGLE. Based on this information, EGLE may approve an alternative invasive species standard. Any alternative invasive species standard must be approved in writing by EGLE.

If the stream mitigation does not satisfactorily meet these standards by the end of the monitoring period, or is not satisfactorily progressing during the monitoring period, the permittee will be required to take corrective actions.

22. Stream Mitigation Monitoring

The permittee shall monitor the stream mitigation for a minimum of five (5) years following grading, planting, and introduction of hydrology. A monitoring report, which compiles and summarizes all data collected during the monitoring period, shall be submitted annually by the permittee. Monitoring reports shall cover the period of January 1 through December 31 and be submitted to EGLE prior to January 31 of the following year. The permittee shall conduct the following activities and provide the information collected in the monitoring reports:

- a. Provide annual photographic documentation of the development of the mitigation stream channel and the associated riparian buffer from permanent photo stations located within the mitigated stream channel. At a minimum, photo stations shall be located at each cross-section and include each in-stream structure (i.e., cross-vanes, wood, or constructed riffles, etc.), if applicable. Photos must be labeled with the location, date photographed, and direction. A map of the locations of the photo stations shall be included.
- b. Stream pattern, dimension, and profile should be measured on an annual basis by conducting detailed longitudinal profile and cross-section surveys. A minimum of 2 riffles and 2 pool cross-sections per stream reach (equal to two meander wavelengths or 20-30 bankfull widths) shall be permanently monumented and each cross-section shall be surveyed annually. At a minimum, channel sinuosity, bankfull width, depth and cross-sectional area, as well as width to depth ratio, percent riffle, pool to pool spacing ratio, pool max depth ratio, bank height ratio, and entrenchment ratio shall all be reported. Current year cross-sections and profile shall be presented overlaid with survey results from all previous monitoring years and as-built surveys. The locations of permanent cross-sections shall be georeferenced and identified in the monitoring report on a plan view showing the location of the riparian buffer. Each cross-section shall be permanently and visibly staked sufficiently to locate the cross-section in the field.
- c. Determine Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) scores on an annual basis using the methodology in the *River Stability Field Guide* (Rosgen 2014). These scores should be calculated for all stream banks except depositional zones (e.g., point bars) and riffle sections that are not eroding and have a low potential to erode. The BEHI/NBS score combinations should be weighted by stream length and the dominant score (i.e., score combination representing the highest percentage of the total) reported.
- d. Sample vegetation in plots located within the riparian buffer area once between July 15 and August 31 according to sampling methods outlined in the *MiSQT Data Collection and Analysis Manual* (2020). Woody vegetation may be sampled earlier in the growing season to allow for accurate counts. The number of sample plots necessary within the riparian buffer area shall be determined using the *MiSQT Data Collection and Analysis Manual* or other approach approved by EGLE.

The herbaceous layer (all non-woody plants and woody plants less than 3.2 feet in height) shall be sampled using a 3.28 foot by 3.28-foot (one square meter) sample plot. The shrub and tree layer shall be sampled using a 30-foot radius sample plot. Plot shape may be adjusted based on width of riparian buffer area. The data recorded for each herbaceous layer sample plot shall include a list of all living plant species, and an estimate of percent cover in five (5) percent intervals for each species, bare soil areas, and open water areas relative to the total area of the plot. The number and species of surviving, established, and

free-to-grow trees and surviving, established, and free-to-grow shrubs shall be recorded for each 30-foot radius plot.

Provide plot data, the total percent cover of native species per plot, and the average percent cover of native species. Data for each plant species must include common name, scientific name, wetland indicator category from the U.S. Army Corps of Engineers 2012 National Wetland Plant List for Michigan (Lichvar, R.W. 2012), physiognomic classification, and whether the species is considered native according to the Michigan Floristic Quality Assessment (Michigan Department of Natural Resources, 2001). Nomenclature shall follow Voss and Reznicek 2012 or the *Flora of North America*, which can be found at www.fna.org.

The locations of sample plots shall be identified in the monitoring report on a plan view showing the location of the riparian buffer. Each sample plot shall be permanently and visibly staked to locate the sample plots in the field.

- e. Delineate any extensive (greater than 0.01 acre in size) bare soil areas, areas dominated by invasive species, and areas without a predominance of native vegetation, and provide their location on a plan view.
- f. Inspect the site, during all monitoring visits and inspections, for oil, grease, man-made debris, and all other contaminants and report findings. Rate (e.g., poor, fair, good, excellent) and describe the water clarity in the stream channel.
- g. Document substrate characteristics and any areas of erosion and/or deposition within the stream channel.
- h. Assess the stability and performance of any in-stream structures or large woody debris features. Describe any areas of bank erosion, piping, undermining, end around, or other indication of instability associated with the in-stream structures including any buoyancy issues with wood structures.
- i. Provide a written summary of data from previous monitoring periods and a discussion of changes or trends based on all monitoring results. This summary shall include identification of all performance standards and whether each standard has been met. A table containing this information shall be included and shall compare current year monitoring data to data from previous years' surveys.
- j. Provide a written summary of all the problem areas that have been identified and potential corrective measures to address them.
- k. Provide documentation (i.e., data, analyses, photos, etc.) that the mitigated stream channel has experienced two flow events equal to or greater than bankfull flow, and that at least one flow event during the five-year monitoring period has resulted in over-bank flooding (i.e., a flow event greater than bankfull flow).
- l. The Permittee shall conduct all other measurements needed to document that performance standards are met.

EGLE will determine if the performance standards have been met. If the performance standards have not been met, EGLE may require corrective actions and subsequent annual monitoring until final approval from EGLE can be granted.

Prior to final written approval of the mitigation by EGLE, the permittee shall submit the following:

- i. A written statement that the mitigation is complete and request for final approval of the mitigation.
- ii. A copy of the permit.
- iii. "As-built" plans and specifications signed and sealed by a registered surveyor or licensed engineer.
- iv. Complete all monitoring requirements including the submittal of all required monitoring reports.

23. This permit is being issued for the maximum time allowed and no extensions of this permit will be granted. Initiation of the construction work authorized by this permit indicates the permittee's acceptance of this condition. The permit, when signed by the EGLE, will be for a five-year period beginning at the date of issuance. If the project is not completed by the expiration date, a new permit must be sought.

24. Upon signing by the permittee named herein, this permit must be returned to the EGLE's Water Resources Division, for final execution. This permit shall become effective on the date of the EGLE representative's signature.

Permittee hereby accepts and agrees to comply with the terms and conditions of this permit.

X Christopher Mills 11/13/2024
 Permittee Date

X Christopher Gibbs City Engineer
 Printed Name and Title of Permittee

Issued By: _____
 Jeremy Richardson
 Warren District Office
 Water Resources Division
 248-763-1664

cc: City of Taylor Clerk
Chris Gibbs, City of Taylor
Wayne County Drain Office
Wayne County DPS, Permits
Wayne County CEA
Melanie Burdick, USEPA Region 5
Andrew Hartz, EGLE WRD, WDO
Anne Garwood, EGLE WRD, Lansing
Bethany Matousek, EGLE WRD, Lansing
Kate Kirkpatrick, EGLE WRD, Lansing
Sam Czubek, EGLE, Lansing
Kelly McRobb-Ackland, Wade Trim