

CITY OF ANN ARBOR  
INVITATION TO BID



LIFT STATIONS REPLACEMENT PROJECT  
PHASE I

ITB No. 4606

Due Date: Thursday December 5, 2019 at 2:00 p.m. (Local Time)

Public Services Area / Wastewater Treatment Services Unit

Issued By:

City of Ann Arbor  
Procurement Unit  
301 E. Huron Street  
Ann Arbor, MI 48104

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- City of Ann Arbor Non-Discrimination Ordinance Notice and Declaration Form*

## NOTICE OF PRE-BID CONFERENCE

A **mandatory** pre-bid conference for this project will be held on Tuesday, November 12, 2019, at 10:00 a.m. **at the** Ann Arbor Wastewater Treatment Plant, 49 Old Dixboro Rd, Ann Arbor, MI 48105 (734) 794-6450. **Failure to attend the meeting and sign the ITB No. 4606 sign-in sheet at the pre-bid meeting will automatically disqualify a bidder from submitting a valid bid.** Any bid submitted by a party not attending and signing the roster at the pre-bid meeting will not be opened or considered. Administrative and technical questions regarding this project will be answered at this time. The pre-bid meeting is for information only. Any answers furnished will not be official until verified in writing by the Financial Service Area, Procurement Unit. Answers that change or substantially clarify the bid will be affirmed in an addendum.

# INSTRUCTIONS TO BIDDERS

## General

Work to be done under this Contract is generally described through the detailed specifications and must be completed fully in accordance with the contract documents. All work to be done under this Contract is located in or near the City of Ann Arbor.

Any Bid which does not conform fully to these instructions may be rejected.

## Preparation of Bids

Bids should be prepared providing a straight-forward, concise description of the Bidder's ability to meet the requirements of the ITB. Bids shall be written in ink or typewritten. No erasures are permitted. Mistakes may be crossed out and corrected and must be initialed and dated in ink by the person signing the Bid.

Bids must be submitted on the "Bid Forms" provided with each blank properly filled in. If forms are not fully completed it may disqualify the bid. No alternative bid will be considered unless alternative bids are specifically requested. If alternatives are requested, any deviation from the specification must be fully described, in detail on the "Alternate" section of Bid form.

Each person signing the Bid certifies that he/she is the person in the Bidder's firm/organization responsible for the decision as to the fees being offered in the Bid and has not and will not participated in any action contrary to the terms of this provision.

## Questions or Clarifications / Designated City Contacts

All questions regarding this ITB shall be submitted via email. Emailed questions and inquiries will be accepted from any and all prospective Bidders in accordance with the terms and conditions of the ITB.

All questions shall be due on or before November 26, 2019, at 2:00 p.m. and should be addressed as follows:

Specification/Scope of Work questions emailed to **Chris Englert, PE at [cenglert@a2gov.org](mailto:cenglert@a2gov.org)**

Bid Process and Compliance questions emailed to [cspencer@a2gov.org](mailto:cspencer@a2gov.org)

Any error, omissions or discrepancies in the specification discovered by a prospective contractor and/or service provider shall be brought to the attention Chris Englert, PE at [cenglert@a2gov.org](mailto:cenglert@a2gov.org) after discovery as possible. Further, the contractor and/or service provide shall not be allowed to take advantage of errors, omissions or discrepancies in the specifications.

## Addenda

If it becomes necessary to revise any part of the ITB, notice of the Addendum will be posted to Michigan Inter-governmental Trade Network (MITN) [www.mitn.info](http://www.mitn.info) and/or City of Ann Arbor web site [www.A2gov.org](http://www.A2gov.org) for all parties to download. It is incumbent on Bidders to visit this site. Notices will not be sent.

Each Bidder must in its Bid, to avoid any miscommunications, acknowledge all addenda which it has received, but the failure of a Bidder to receive, or acknowledge receipt of; any addenda shall not relieve the Bidder of the responsibility for complying with the terms thereof.

The City will not be bound by oral responses to inquiries or written responses other than written addenda.

## Bid Submission

All Bids are due and must be delivered to the City of Ann Arbor Procurement Unit on or before **Thursday, December 5, 2019, at 2:00 p.m. (local time)**. Bids submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each Bidder must submit one (1) original Bid and **two (2)** Bid copies in a sealed envelope clearly marked: **ITB No. 4606 Lift Stations Replacement Project – Phase I**

### **Bids must be addressed and delivered to:**

City of Ann Arbor  
Procurement Unit,  
c/o Customer Services, 1<sup>st</sup> Floor  
301 East Huron Street  
Ann Arbor, MI 48107

All Bids received on or before the Due Date will be publicly opened and recorded immediately. No immediate decisions are rendered.

**The following forms provided within this ITB Document must be included in submitted bids.**

- **City of Ann Arbor Prevailing Wage Declaration of Compliance**
- **City of Ann Arbor Living Wage Ordinance Declaration of Compliance**
- **Vendor Conflict of Interest Disclosure Form**
- **City of Ann Arbor Non-Discrimination Ordinance Declaration of Compliance**

***Bids that fail to provide these forms listed above upon bid opening will be rejected as non-responsive and will not be considered for award.***

Hand delivered bids will be date/time stamped/signed by the Procurement Unit at the address above in order to be considered. Normal business hours are 9:00 a.m. to 3:00 p.m. Monday through Friday, excluding Holidays. The City will not be liable to any Bidder for any unforeseen circumstances, delivery or postal delays. Postmarking to the Due Date will not substitute for receipt of the Bid. Each Bidder is responsible for submission of their Bid.

Additional time for submission of bids past the stated due date and time will not be granted to a single Bidder; however, additional time may be granted to all Bidders when the City determines in its sole discretion that circumstances warrant it.

## Award

The City intends to award a Contract(s) to the lowest responsible Bidder(s). On multi-divisional contracts, separate divisions may be awarded to separate Bidders. The City may also utilize

alternatives offered in the Bid Forms, if any, to determine the lowest responsible Bidder on each division, and award multiple divisions to a single Bidder, so that the lowest total cost is achieved for the City. For unit price bids, the Contract will be awarded based upon the unit prices and the lump sum prices stated by the bidder for the work items specified in the bid documents, with consideration given to any alternates selected by the City. If the City determines that the unit price for any item is materially different for the work item bid than either other bidders or the general market, the City, in its sole discretion, in addition to any other right it may have, may reject the bid as not responsible or non-conforming.

The acceptability of major subcontractors will be considered in determining if a Bidder is responsible. In comparing Bids, the City will give consideration to alternate Bids for items listed in the bid forms. All key staff and subcontractors are subject to the approval by the City.

## Official Documents

The City of Ann Arbor officially distributes bid documents from the Procurement Unit or through the Michigan Intergovernmental Trade Network (MITN). Copies of the bid documents obtained from any other source are not Official copies. Addenda and other bid information will only be posted to these official distribution sites. If you obtained City of Ann Arbor Bid documents from other sources, it is recommended that you register on [www.MITN.info](http://www.MITN.info) and obtain an official Bid. Bidders do not need to be shown on the plan holders list provided by MITN to be considered an official plan holder.

## Bid Security

Each bid must be accompanied by a certified check, or Bid Bond by a surety licensed and authorized to do business within the State of Michigan, in the amount of 5% of the total of the bid price.

## Withdrawal of Bids

After the time of opening, no Bid may be withdrawn for the period of ninety (90) days.

## Contract Time

Time is of the essence in the performance of the work under this Contract. The available time for work under this Contract is indicated on page C-1, Article III of the Contract. If these time requirements can not be met, the Bidder must stipulate on Bid Form Section 3 - Time Alternate its schedule for performance of the work. Consideration will be given to time in evaluating bids.

## Liquidated Damages

A liquidated damages clause, as given on page C-2, Article III of the Contract, provides that the Contractor shall pay the City as liquidated damages, and not as a penalty, a sum certain per day for each and every day that the Contractor may be in default of completion of the specified work, within the time(s) stated in the Contract, or written extensions.

Liquidated damages clauses, as given in the General Conditions, provide further that the City shall be entitled to impose and recover liquidated damages for breach of the obligations under Chapter 112 of the City Code.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended

to preclude recovery of actual damages in addition to the recovery of liquidated damages.

## Human Rights Information

All contractors proposing to do business with the City shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the Section 9:158 of the Ann Arbor City Code. Breach of the obligation not to discriminate as outlined in Section 5, beginning at page GC-2 shall be a material breach of the contract. Contractors are required to post a copy of Ann Arbor's Non-Discrimination Ordinance attached at all work locations where its employees provide services under a contract with the City.

## Wage Requirements

Section 4, beginning at page GC-1, outlines the requirements for payment of prevailing wages and for payment of a "living wage" to employees providing service to the City under this contract. The successful bidder and its subcontractors must comply with all applicable requirements and provide proof of compliance.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

For laborers whose wage level are subject to federal, state and/or local prevailing wage law the appropriate Davis-Bacon wage rate classification is identified based upon the work including within this contract. **The wage determination(s) current on the date 10 days before bids are due shall apply to this contract.** The U.S. Department of Labor (DOL) has provided explanations to assist with classification in the following resource link: [www.wdol.gov](http://www.wdol.gov).

For the purposes of this ITB the Construction Type of Heavy will apply.

## Conflict Of Interest Disclosure

The City of Ann Arbor Purchasing Policy requires that prospective Vendors complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected Vendor unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Vendor Conflict of Interest Disclosure Form is attached.

## Major Subcontractors

The Bidder shall identify on Bid Form Section 4 each major subcontractor it expects to engage for this Contract if the work to be subcontracted is 15% or more of the bid sum or over \$50,000, whichever is less. The Bidder also shall identify the work to be subcontracted to each major subcontractor. The Bidder shall not change or replace a subcontractor without approval by the City.

## Debarment

Submission of a Bid in response to this ITB is certification that the Bidder is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

## Disclosures

After bids are opened, all information in a submitter's bid is subjected to disclosure under the provisions of Michigan Public Act No. 442 of 1976, as amended (MCL 15.231 et seq.) known as the "Freedom of Information Act." The Freedom of Information Act also provides for the complete disclosure of contracts and attachments thereto except where specifically exempted.

## Bid Protest

All Bid protests must be in writing and filed with the Purchasing Agent within five (5) business days of the award action. The bidder must clearly state the reasons for the protest. If a bidder contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the bidder to the Purchasing Agent. The Purchasing Agent will provide the bidder with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee whose decision shall be final.

*Any inquiries or requests regarding this procurement should be only submitted in writing to the Designated City Contacts provided herein. Attempts by any prospective bidder to initiate contact with anyone other than the Designated City Contacts provided herein that the bidder believes can influence the procurement decision, e.g., Elected Officials, City Administrator, Selection Committee Members, Appointed Committee Members, etc., may lead to immediate elimination from further consideration.*

## Cost Liability

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the Bidder prior to the execution of a contract with the City. By submitting a bid, a bidder agrees to bear all costs incurred or related to the preparation, submission and selection process for the bid.

## Reservation of Rights

The City of Ann Arbor reserves the right to accept any bid or alternative bid proposed in whole or in part, to reject any or all bids or alternatives bids in whole or in part and to waive irregularity and/or informalities in any bid and to make the award in any manner deemed in the best interest of the City.

## Idlefree Ordinance

The City of Ann Arbor adopted an idling reduction Ordinance that went into effect July 1, 2017. The full text of the ordinance (including exemptions) can be found at: [www.a2gov.org/idlefree](http://www.a2gov.org/idlefree).

Under the ordinance, No Operator of a Commercial Vehicle shall cause or permit the Commercial Vehicle to Idle:

- (a) For any period of time while the Commercial Vehicle is unoccupied; or
- (b) For more than 5 minutes in any 60-minute period while the Commercial Vehicle is occupied.

In addition, generators and other internal combustion engines are covered

(1) Excluding Motor Vehicle engines, no internal combustion engine shall be operated except when it is providing power or electrical energy to equipment or a tool that is actively in use.

## Environmental Commitment

The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment.

The City encourages potential vendors to bring forward emerging and progressive products and services that are best suited to the City's environmental principles.

## INVITATION TO BID

City of Ann Arbor  
Guy C. Larcom Municipal Building  
Ann Arbor, Michigan 48107

Ladies and Gentlemen:

The undersigned, as Bidder, declares that this Bid is made in good faith, without fraud or collusion with any person or persons bidding on the same Contract; that this Bidder has carefully read and examined the bid documents, including City Nondiscrimination requirements and Declaration of Compliance Form, Living Wage requirements and Declaration of Compliance Form, Prevailing Wage requirements and Declaration of Compliance Form, Vendor Conflict of Interest Form, Notice of Pre-Bid Conference, Instructions to Bidders, Bid, Bid Forms, Contract, Bond Forms, General Conditions, Standard Specifications, Detailed Specifications, all Addenda, and the Plans (if applicable) and understands them. The Bidder declares that it conducted a full investigation at the site and of the work proposed and is fully informed as to the nature of the work and the conditions relating to the work's performance. The Bidder also declares that it has extensive experience in successfully completing projects similar to this one.

The Bidder acknowledges that it has not received or relied upon any representations or warrants of any nature whatsoever from the City of Ann Arbor, its agents or employees, and that this Bid is based solely upon the Bidder's own independent business judgment.

The undersigned proposes to perform all work shown on the plans or described in the bid documents, including any addenda issued, and to furnish all necessary machinery, tools, apparatus, and other means of construction to do all the work, furnish all the materials, and complete the work in strict accordance with all terms of the Contract of which this Bid is one part.

In accordance with these bid documents, and Addenda numbered \_\_\_\_\_, the undersigned, as Bidder, proposes to perform at the sites in and/or around Ann Arbor, Michigan, all the work included herein for the amounts set forth in the Bid Forms.

The Bidder declares that it has become fully familiar with the liquidated damage clauses for completion times and for compliance with City Code Chapter 112, understands and agrees that the liquidated damages are for the non-quantifiable aspects of non-compliance and do not cover actual damages that may be shown and agrees that if awarded the Contract, all liquidated damage clauses form part of the Contract.

The Bidder declares that it has become fully familiar with the provisions of Chapter 14, Section 1:320 (Prevailing wages) and Chapter 23 (Living Wage) of the Code of the City of Ann Arbor and that it understands and agrees to comply, to the extent applicable to employees providing services to the City under this Contract, with the wage and reporting requirements stated in the City Code provisions cited. Bidder certifies that the statements contained in the City Prevailing Wage and Living Wage Declaration of Compliance Forms are true and correct. Bidder further agrees that

the cited provisions of Chapter 14 and Chapter 23 form a part of this Contract.

The Bidder declares that it has become familiar with the City Conflict of Interest Disclosure Form and certifies that the statement contained therein is true and correct.

The Bidder encloses a certified check or Bid Bond in the amount of 5% of the total of the Bid Price. The Bidder agrees both to contract for the work and to furnish the necessary Bonds and insurance documentation within 10 days after being notified of the acceptance of the Bid.

If this Bid is accepted by the City and the Bidder fails to contract and furnish the required Bonds and insurance documentation within 10 days after being notified of the acceptance of this Bid, then the Bidder shall be considered to have abandoned the Contract and the certified check or Bid Bond accompanying this Bid shall become due and payable to the City.

If the Bidder enters into the Contract in accordance with this Bid, or if this Bid is rejected, then the accompanying check or Bid Bond shall be returned to the Bidder.

In submitting this Bid, it is understood that the right is reserved by the City to accept any Bid, to reject any or all Bids, to waive irregularities and/or informalities in any Bid, and to make the award in any manner the City believes to be in its best interest.

SIGNED THIS \_\_\_\_\_ DAY OF \_\_\_\_\_, 201\_.

\_\_\_\_\_  
Bidder's Name

\_\_\_\_\_  
Authorized Signature of Bidder

\_\_\_\_\_  
Official Address

\_\_\_\_\_  
(Print Name of Signer Above)

\_\_\_\_\_  
Telephone Number

\_\_\_\_\_  
Email Address for Award Notice

**LEGAL STATUS OF BIDDER**

(The Bidder shall fill out the appropriate form and strike out the other three.)

Bidder declares that it is:

\* A corporation organized and doing business under the laws of the State of \_\_\_\_\_, for whom \_\_\_\_\_, bearing the office title of \_\_\_\_\_, whose signature is affixed to this Bid, is authorized to execute contracts.

**NOTE: If not incorporated in Michigan, please attach the corporation's Certificate of Authority**

• A limited liability company doing business under the laws of the State of \_\_\_\_\_, whom \_\_\_\_\_ bearing the title of \_\_\_\_\_ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.

\* A partnership, organized under the laws of the state of \_\_\_\_\_ and filed in the county of \_\_\_\_\_, whose members are (list all members and the street and mailing address of each) (attach separate sheet if necessary):

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\* An individual, whose signature with address, is affixed to this Bid: \_\_\_\_\_ (initial here)

**Authorized Official**

\_\_\_\_\_ **Date** \_\_\_\_\_, 201\_

(Print) Name \_\_\_\_\_ Title \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Contact Phone ( ) \_\_\_\_\_ Fax ( ) \_\_\_\_\_

Email \_\_\_\_\_

# BID FORM

## Section 1 – Schedule of Prices

Company: \_\_\_\_\_

Project: **Lift Stations Replacement Project**

### Unit Price Bid –

<u>Item Description</u>	<u>Estimated Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>
1) Astor Lift Station Renovation	1 LS	_____	_____
2) Astor Lift Station Forcemain Replacement	1 LS	_____	_____
3) Astor Wet Well Repair Type 1 Joint Seal and Repair	250 LF	_____	_____
4) Astor Wet Well Repair Type 2 Cracks, Repair and Seal	100 LF	_____	_____
5) Astor Wet Well Repair Type 3 Concrete Surface Repair	200 SF	_____	_____
6) Astor Wet Well Repair Type 4 Surface Prep and Install Protective Concrete Coating	1 LS	_____	_____
7) Astor Lift Station Utilities	CONTINGENCY ALLOWANCE		\$20,000
	Astor Lift Station Subtotal: (Items 1-7)		_____
8) Franklin Lift Station Renovation	1 LS	_____	_____
9) Franklin Wet Well Repair Type 1 Joint Seal and Repair	250 LF	_____	_____
10) Franklin Wet Well Repair Type 2 Cracks, Repair and Seal	100 LF	_____	_____
11) Franklin Wet Well Repair Type 3 Concrete Surface Repair	200 SF	_____	_____

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**12) Franklin Wet Well Repair Type 4  
Surface Prep and Install  
Protective Concrete Coating**

**1 LS**

\_\_\_\_\_

**Franklin Lift Station Subtotal:**

**(Items 8-12)**

\_\_\_\_\_

**ESTIMATED  
TOTAL  
(Items 1-12)**

**\$ \_\_\_\_\_**

## BID FORM

### Section 2 – Material, Equipment and Environmental Alternates

The Base Bid proposal price shall include materials and equipment selected from the designated items and manufacturers listed in the bidding documents. This is done to establish uniformity in bidding and to establish standards of quality for the items named.

If the Contractor wishes to quote alternate items for consideration by the City, it may do so under this Section. A complete description of the item and the proposed price differential must be provided. Unless approved at the time of award, substitutions where items are specifically named will be considered only as a negotiated change in Contract Sum.

If an environmental alternative is bid the City strongly encourages bidders to provide recent examples of product testing and previous successful use for the City to properly evaluate the environmental alternative. Testing data from independent accredited organizations are strongly preferred.

<u>Item Number</u>	<u>Description</u>	<u>Add/Deduct Amount</u>
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If the Bidder does not suggest any material or equipment alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any material or equipment alternate under the Contract.

Signature of Authorized Representative of Bidder \_\_\_\_\_ Date \_\_\_\_\_

# BID FORM

## Section 3 - Time Alternate

If the Bidder takes exception to the time stipulated in Article III of the Contract, Time of Completion, page C-2, it is requested to stipulate below its proposed time for performance of the work. Consideration will be given to time in evaluating bids.

If the Bidder does not suggest any time alternate, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT propose any time alternate under the Contract.

Signature of Authorized Representative of Bidder \_\_\_\_\_ Date \_\_\_\_\_

# BID FORM

## Section 4 - Major Subcontractors

For purposes of this Contract, a Subcontractor is anyone (other than the Contractor) who performs work (other than or in addition to the furnishing of materials, plans or equipment) at or about the construction site, directly or indirectly for or on behalf of the Contractor (and whether or not in privity of Contract with the Contractor), but shall not include any individual who furnishes merely the individual's own personal labor or services.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision to Section 4 of the General Conditions covering subcontractor's employees who perform work on this contract.

For the work outlined in these documents the Bidder expects to engage the following major subcontractors to perform the work identified:

<u>Subcontractor (Name and Address)</u>	<u>Work</u>	<u>Amount</u>
	Mechanical	
	Electrical	
	Excavating	
	Landscaping	
	Directional Drilling	
	Bypass Pumping	

If the Bidder does not expect to engage any major subcontractor, the Bidder **MUST** complete the following statement:

For the work outlined in this request for bid, the bidder does NOT expect to engage any major subcontractor to perform work under the Contract.

Signature of Authorized Representative of Bidder \_\_\_\_\_ Date \_\_\_\_\_



# SAMPLE STANDARD CONTRACT

*If a contract is awarded, the selected contractor will be required to adhere to a set of general contract provisions which will become a part of any formal agreement. These provisions are general principles which apply to all contractors of service to the City of Ann Arbor such as the following:*

## CONTRACT

THIS AGREEMENT is made on the \_\_\_\_\_ day of \_\_\_\_\_, 201\_, between the CITY OF ANN ARBOR, a Michigan Municipal Corporation, 301 East Huron Street, Ann Arbor, Michigan 48104 ("City") and \_\_\_\_\_ ("Contractor")

(An individual/partnership/corporation, include state of incorporation)

(Address)

Based upon the mutual promises below, the Contractor and the City agree as follows:

### ARTICLE I - Scope of Work

The Contractor agrees to furnish all of the materials, equipment and labor necessary; and to abide by all the duties and responsibilities applicable to it for the project titled Lift Station Replacement Bid Number 4606 in accordance with the requirements and provisions of the following documents, including all written modifications incorporated into any of the documents, which are incorporated as part of this Contract:

Non-discrimination and Living Wage  
Declaration of Compliance Forms (if  
applicable)  
Vendor Conflict of Interest Form  
Prevailing Wage Declaration of  
Compliance Form (if applicable)  
Bid Forms  
Contract and Exhibits  
Bonds

General Conditions  
Standard Specifications  
Detailed Specifications  
Plans  
Addenda

### ARTICLE II - Definitions

Administering Service Area/Unit means **Wastewater Treatment Services**

Project means **Lift Stations Replacement Bid Number 4606**

### ARTICLE III - Time of Completion

- (A) The work to be completed under this Contract shall begin immediately on the date specified in the Notice to Proceed issued by the City.
- (B) The entire work for this Contract shall be completed within One Hundred Sixty (160) consecutive calendar days.
- (C) Failure to complete all the work within the time specified above, including any extension granted in writing by the Supervising Professional, shall obligate the Contractor to pay the City, as liquidated damages and not as a penalty, an amount

equal to \$800 for each calendar day of delay in the completion of all the work. If any liquidated damages are unpaid by the Contractor, the City shall be entitled to deduct these unpaid liquidated damages from the monies due the Contractor.

The liquidated damages are for the non-quantifiable aspects of any of the previously identified events and do not cover actual damages that can be shown or quantified nor are they intended to preclude recovery of actual damages in addition to the recovery of liquidated damages.

#### **ARTICLE IV - The Contract Sum**

- (A) The City shall pay to the Contractor for the performance of the Contract, the unit prices as given in the Bid Form for the estimated bid total of:

\_\_\_\_\_ Dollars (\$\_\_\_\_\_)

- (B) The amount paid shall be equitably adjusted to cover changes in the work ordered by the Supervising Professional but not required by the Contract Documents. Increases or decreases shall be determined only by written agreement between the City and Contractor.

#### **ARTICLE V - Assignment**

This Contract may not be assigned or subcontracted any portion of any right or obligation under this contract without the written consent of the City. Notwithstanding any consent by the City to any assignment, Contractor shall at all times remain bound to all warranties, certifications, indemnifications, promises and performances, however described, as are required of it under this contract unless specifically released from the requirement, in writing, by the City.

#### **ARTICLE VI - Choice of Law**

This Contract shall be construed, governed, and enforced in accordance with the laws of the State of Michigan. By executing this agreement, the Contractor and the City agree to venue in a court of appropriate jurisdiction sitting within Washtenaw County for purposes of any action arising under this Contract. The parties stipulate that the venue referenced in this Contract is for convenience and waive any claim of non-convenience.

Whenever possible, each provision of the Contract will be interpreted in a manner as to be effective and valid under applicable law. The prohibition or invalidity, under applicable law, of any provision will not invalidate the remainder of the Contract.

#### **ARTICLE VII - Relationship of the Parties**

The parties of the Contract agree that it is not a Contract of employment but is a Contract to accomplish a specific result. Contractor is an independent Contractor performing services for the City. Nothing contained in this Contract shall be deemed to constitute any other relationship between the City and the Contractor.

Contractor certifies that it has no personal or financial interest in the project other than the compensation it is to receive under the Contract. Contractor certifies that it is not, and shall not become, overdue or in default to the City for any Contract, debt, or any other obligation to the City including real or personal property taxes. City shall have the right to set off any such debt against compensation awarded for services under this agreement.

**ARTICLE VIII - Notice**

All notices given under this Contract shall be in writing, and shall be by personal delivery or by certified mail with return receipt requested to the parties at their respective addresses as specified in the Contract Documents or other address the Contractor may specify in writing. Notice will be deemed given on the date when one of the following first occur: (1) the date of actual receipt; or (2) three days after mailing certified U.S. mail.

**ARTICLE IX - Indemnification**

To the fullest extent permitted by law, Contractor shall indemnify, defend and hold harmless the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result, in whole or in part, from any act or omission, which is in any way connected or associated with this Contract, by the Contractor or anyone acting on the Contractor's behalf under this Contract. Contractor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City's sole negligence. The provisions of this Article shall survive the expiration or earlier termination of this contract for any reason.

**ARTICLE X - Entire Agreement**

This Contract represents the entire understanding between the City and the Contractor and it supersedes all prior representations, negotiations, agreements, or understandings whether written or oral. Neither party has relied on any prior representations in entering into this Contract. No terms or conditions of either party's invoice, purchase order or other administrative document shall modify the terms and conditions of this Contract, regardless of the other party's failure to object to such form. This Contract shall be binding on and shall inure to the benefit of the parties to this Contract and their permitted successors and permitted assigns and nothing in this Contract, express or implied, is intended to or shall confer on any other person or entity any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Contract. This Contract may be altered, amended or modified only by written amendment signed by the City and the Contractor.

**FOR CONTRACTOR**

By \_\_\_\_\_

Its: \_\_\_\_\_

**FOR THE CITY OF ANN ARBOR**

By \_\_\_\_\_

Christopher Taylor, Mayor

By \_\_\_\_\_

Jacqueline Beaudry, City Clerk

[Signatures continued on next page]

**Approved as to substance**

By \_\_\_\_\_

Howard S. Lazarus, City Administrator

By \_\_\_\_\_

Craig Hupy, P.E., Public Services Area  
Administrator

**Approved as to form and content**

\_\_\_\_\_  
Stephen K. Postema, City Attorney

**PERFORMANCE BOND**

(1) \_\_\_\_\_ of \_\_\_\_\_ (referred to as "Principal"), and \_\_\_\_\_, a corporation duly authorized to do business in the State of Michigan (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for

\$ \_\_\_\_\_, the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.

(2) The Principal has entered a written Contract with the City dated \_\_\_\_\_, 201\_, for: \_\_\_\_\_ and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq.

(3) Whenever the Principal is declared by the City to be in default under the Contract, the Surety may promptly remedy the default or shall promptly:

(a) complete the Contract in accordance with its terms and conditions; or

(b) obtain a bid or bids for submission to the City for completing the Contract in accordance with its terms and conditions, and upon determination by Surety of the lowest responsible bidder, arrange for a Contract between such bidder and the City, and make available, as work progresses, sufficient funds to pay the cost of completion less the balance of the Contract price; but not exceeding, including other costs and damages for which Surety may be liable hereunder, the amount set forth in paragraph 1.

(4) Surety shall have no obligation to the City if the Principal fully and promptly performs under the Contract.

(5) Surety agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder, or the specifications accompanying it shall in any way affect its obligations on this bond, and waives notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the work, or to the specifications.

**SIGNED AND SEALED** this \_\_\_\_\_ day of \_\_\_\_\_, 201\_.

\_\_\_\_\_  
(Name of Surety Company)

By \_\_\_\_\_  
(Signature)

Its \_\_\_\_\_  
(Title of Office)

Approved as to form:

\_\_\_\_\_  
Stephen K. Postema, City Attorney

\_\_\_\_\_  
(Name of Principal)

By \_\_\_\_\_  
(Signature)

Its \_\_\_\_\_  
(Title of Office)

Name and address of agent:

\_\_\_\_\_



## LABOR AND MATERIAL BOND

- (1) \_\_\_\_\_  
of \_\_\_\_\_ (referred to as "Principal"), and \_\_\_\_\_, a corporation duly authorized to do business in the State of Michigan, (referred to as "Surety"), are bound to the City of Ann Arbor, Michigan (referred to as "City"), for the use and benefit of claimants as defined in Act 213 of Michigan Public Acts of 1963, as amended, being MCL 129.201 et seq., in the amount of \$ \_\_\_\_\_, for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, by this bond.
- (2) The Principal has entered a written Contract with the City, dated \_\_\_\_\_, 201\_, for \_\_\_\_\_; and this bond is given for that Contract in compliance with Act No. 213 of the Michigan Public Acts of 1963 as amended;
- (3) If the Principal fails to promptly and fully repay claimants for labor and material reasonably required under the Contract, the Surety shall pay those claimants.
- (4) Surety's obligations shall not exceed the amount stated in paragraph 1, and Surety shall have no obligation if the Principal promptly and fully pays the claimants.

**SIGNED AND SEALED** this \_\_\_\_\_ day of \_\_\_\_\_, 201\_

\_\_\_\_\_  
(Name of Surety Company)

By \_\_\_\_\_  
(Signature)

Its \_\_\_\_\_  
(Title of Office)

Approved as to form:

\_\_\_\_\_  
Stephen K. Postema, City Attorney

\_\_\_\_\_  
(Name of Principal)

By \_\_\_\_\_  
(Signature)

Its \_\_\_\_\_  
(Title of Office)

Name and address of agent:

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

## **GENERAL CONDITIONS**

### **Section 1 - Execution, Correlation and Intent of Documents**

The contract documents shall be signed in 2 copies by the City and the Contractor.

The contract documents are complementary and what is called for by any one shall be binding. The intention of the documents is to include all labor and materials, equipment and transportation necessary for the proper execution of the work. Materials or work described in words which so applied have a well-known technical or trade meaning have the meaning of those recognized standards.

In case of a conflict among the contract documents listed below in any requirement(s), the requirement(s) of the document listed first shall prevail over any conflicting requirement(s) of a document listed later.

(1) Addenda in reverse chronological order; (2) Detailed Specifications; (3) Standard Specifications; (4) Plans; (5) General Conditions; (6) Contract; (7) Bid Forms; (8) Bond Forms; (9) Bid.

### **Section 2 - Order of Completion**

The Contractor shall submit with each invoice, and at other times reasonably requested by the Supervising Professional, schedules showing the order in which the Contractor proposes to carry on the work. They shall include the dates at which the Contractor will start the several parts of the work, the estimated dates of completion of the several parts, and important milestones within the several parts.

### **Section 3 - Familiarity with Work**

The Bidder or its representative shall make personal investigations of the site of the work and of existing structures and shall determine to its own satisfaction the conditions to be encountered, the nature of the ground, the difficulties involved, and all other factors affecting the work proposed under this Contract. The Bidder to whom this Contract is awarded will not be entitled to any additional compensation unless conditions are clearly different from those which could reasonably have been anticipated by a person making diligent and thorough investigation of the site.

The Bidder shall immediately notify the City upon discovery, and in every case prior to submitting its Bid, of every error or omission in the bidding documents that would be identified by a reasonably competent, diligent Bidder. In no case will a Bidder be allowed the benefit of extra compensation or time to complete the work under this Contract for extra expenses or time spent as a result of the error or omission.

### **Section 4 - Wage Requirements**

Under this Contract, the Contractor shall conform to Chapter 14 of Title I of the Code of the City of Ann Arbor as amended; which in part states "...that all craftsmen, mechanics and laborers employed directly on the site in connection with said improvements, including said employees of

subcontractors, shall receive the prevailing wage for the corresponding classes of craftsmen, mechanics and laborers, as determined by statistics for the Ann Arbor area compiled by the United States Department of Labor. At the request of the City, any contractor or subcontractor shall provide satisfactory proof of compliance with the contract provisions required by the Section.

Pursuant to Resolution R-16-469 all public improvement contractors are subject to prevailing wage and will be required to provide to the City payroll records sufficient to demonstrate compliance with the prevailing wage requirements. A sample Prevailing Wage Form is provided in the Appendix herein for reference as to what will be expected from contractors. Use of the Prevailing Wage Form provided in the Appendix section or a City-approved equivalent will be required along with wage rate interviews.

Where the Contract and the Ann Arbor City Ordinance are silent as to definitions of terms required in determining contract compliance with regard to prevailing wages, the definitions provided in the Davis-Bacon Act as amended (40 U.S.C. 278-a to 276-a-7) for the terms shall be used.

If the Contractor is a "covered employer" as defined in Chapter 23 of the Ann Arbor City Code, the Contractor agrees to comply with the living wage provisions of Chapter 23 of the Ann Arbor City Code. The Contractor agrees to pay those employees providing Services to the City under this Agreement a "living wage," as defined in Section 1:815 of the Ann Arbor City Code, as adjusted in accordance with Section 1:815(3); to post a notice approved by the City of the applicability of Chapter 23 in every location in which regular or contract employees providing services under this Agreement are working; to maintain records of compliance; if requested by the City, to provide documentation to verify compliance; to take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee or person contracted for employment in order to pay the living wage required by Section 1:815; and otherwise to comply with the requirements of Chapter 23.

Contractor agrees that all subcontracts entered into by the Contractor shall contain similar wage provision covering subcontractor's employees who perform work on this contract.

## **Section 5 - Non-Discrimination**

The Contractor agrees to comply, and to require its subcontractor(s) to comply, with the nondiscrimination provisions of MCL 37.2209. The Contractor further agrees to comply with the provisions of Section 9:158 of Chapter 112 of Title IX of the Ann Arbor City Code, and to assure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity.

## **Section 6 - Materials, Appliances, Employees**

Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, water, tools, equipment, light, power, transportation, and other facilities necessary or used for the execution and completion of the work. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and materials shall be of the highest quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

The Contractor shall at all times enforce strict discipline and good order among its employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work assigned.

Adequate sanitary facilities shall be provided by the Contractor.

## **Section 7 - Qualifications for Employment**

The Contractor shall employ competent laborers and mechanics for the work under this Contract. For work performed under this Contract, employment preference shall be given to qualified local residents.

## **Section 8 - Royalties and Patents**

The Contractor shall pay all royalties and license fees. It shall defend all suits or claims for infringements of any patent rights and shall hold the City harmless from loss on account of infringement except that the City shall be responsible for all infringement loss when a particular process or the product of a particular manufacturer or manufacturers is specified, unless the City has notified the Contractor prior to the signing of the Contract that the particular process or product is patented or is believed to be patented.

## **Section 9 - Permits and Regulations**

The Contractor must secure and pay for all permits, permit or plan review fees and licenses necessary for the prosecution of the work. These include but are not limited to City building permits, right-of-way permits, lane closure permits, right-of-way occupancy permits, and the like. The City shall secure and pay for easements shown on the plans unless otherwise specified.

The Contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the contract documents are at variance with those requirements, it shall promptly notify the Supervising Professional in writing, and any necessary changes shall be adjusted as provided in the Contract for changes in the work.

## **Section 10 - Protection of the Public and of Work and Property**

The Contractor is responsible for the means, methods, sequences, techniques and procedures of construction and safety programs associated with the work contemplated by this contract. The Contractor, its agents or sub-contractors, shall comply with the "General Rules and Regulations for the Construction Industry" as published by the Construction Safety Commission of the State of Michigan and to all other local, State and National laws, ordinances, rules and regulations pertaining to safety of persons and property.

The Contractor shall take all necessary and reasonable precautions to protect the safety of the public. It shall continuously maintain adequate protection of all work from damage, and shall take all necessary and reasonable precautions to adequately protect all public and private property from injury or loss arising in connection with this Contract. It shall make good any damage, injury or loss to its work and to public and private property resulting from lack of reasonable protective precautions, except as may be due to errors in the contract documents, or caused by agents or employees of the City. The Contractor shall obtain and maintain sufficient insurance to cover damage to any City property at the site by any cause.

In an emergency affecting the safety of life, or the work, or of adjoining property, the Contractor is, without special instructions or authorization from the Supervising Professional, permitted to act

at its discretion to prevent the threatened loss or injury. It shall also so act, without appeal, if authorized or instructed by the Supervising Professional.

Any compensation claimed by the Contractor for emergency work shall be determined by agreement or in accordance with the terms of Claims for Extra Cost - Section 15.

## **Section 11 - Inspection of Work**

The City shall provide sufficient competent personnel for the inspection of the work.

The Supervising Professional shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for access and for inspection.

If the specifications, the Supervising Professional's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Supervising Professional timely notice of its readiness for inspection, and if the inspection is by an authority other than the Supervising Professional, of the date fixed for the inspection. Inspections by the Supervising Professional shall be made promptly, and where practicable at the source of supply. If any work should be covered up without approval or consent of the Supervising Professional, it must, if required by the Supervising Professional, be uncovered for examination and properly restored at the Contractor's expense.

Re-examination of any work may be ordered by the Supervising Professional, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to be in accordance with the contract documents, the City shall pay the cost of re-examination and replacement. If the work is not in accordance with the contract documents, the Contractor shall pay the cost.

## **Section 12 - Superintendence**

The Contractor shall keep on the work site, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Supervising Professional. The superintendent will be responsible to perform all on-site project management for the Contractor. The superintendent shall be experienced in the work required for this Contract. The superintendent shall represent the Contractor and all direction given to the superintendent shall be binding as if given to the Contractor. Important directions shall immediately be confirmed in writing to the Contractor. Other directions will be confirmed on written request. The Contractor shall give efficient superintendence to the work, using its best skill and attention.

## **Section 13 - Changes in the Work**

The City may make changes to the quantities of work within the general scope of the Contract at any time by a written order and without notice to the sureties. If the changes add to or deduct from the extent of the work, the Contract Sum shall be adjusted accordingly. All the changes shall be executed under the conditions of the original Contract except that any claim for extension of time caused by the change shall be adjusted at the time of ordering the change.

In giving instructions, the Supervising Professional shall have authority to make minor changes in the work not involving extra cost and not inconsistent with the purposes of the work, but otherwise, except in an emergency endangering life or property, no extra work or change shall be made

unless in pursuance of a written order by the Supervising Professional, and no claim for an addition to the Contract Sum shall be valid unless the additional work was ordered in writing.

The Contractor shall proceed with the work as changed and the value of the work shall be determined as provided in Claims for Extra Cost - Section 15.

## **Section 14 - Extension of Time**

Extension of time stipulated in the Contract for completion of the work will be made if and as the Supervising Professional may deem proper under any of the following circumstances:

- (1) When work under an extra work order is added to the work under this Contract;
- (2) When the work is suspended as provided in Section 20;
- (3) When the work of the Contractor is delayed on account of conditions which could not have been foreseen, or which were beyond the control of the Contractor, and which were not the result of its fault or negligence;
- (4) Delays in the progress of the work caused by any act or neglect of the City or of its employees or by other Contractors employed by the City;
- (5) Delay due to an act of Government;
- (6) Delay by the Supervising Professional in the furnishing of plans and necessary information;
- (7) Other cause which in the opinion of the Supervising Professional entitles the Contractor to an extension of time.

The Contractor shall notify the Supervising Professional within 7 days of an occurrence or conditions which, in the Contractor's opinion, entitle it to an extension of time. The notice shall be in writing and submitted in ample time to permit full investigation and evaluation of the Contractor's claim. The Supervising Professional shall acknowledge receipt of the Contractor's notice within 7 days of its receipt. Failure to timely provide the written notice shall constitute a waiver by the Contractor of any claim.

In situations where an extension of time in contract completion is appropriate under this or any other section of the contract, the Contractor understands and agrees that the only available adjustment for events that cause any delays in contract completion shall be extension of the required time for contract completion and that there shall be no adjustments in the money due the Contractor on account of the delay.

## **Section 15 - Claims for Extra Cost**

If the Contractor claims that any instructions by drawings or other media issued after the date of the Contract involved extra cost under this Contract, it shall give the Supervising Professional written notice within 7 days after the receipt of the instructions, and in any event before proceeding to execute the work, except in emergency endangering life or property. The procedure shall then be as provided for Changes in the Work-Section 13. No claim shall be valid unless so made.

If the Supervising Professional orders, in writing, the performance of any work not covered by the contract documents, and for which no item of work is provided in the Contract, and for which no unit price or lump sum basis can be agreed upon, then the extra work shall be done on a Cost-Plus-Percentage basis of payment as follows:

- (1) The Contractor shall be reimbursed for all reasonable costs incurred in doing the work, and shall receive an additional payment of 15% of all the reasonable costs to cover both its indirect overhead costs and profit;
- (2) The term "Cost" shall cover all payroll charges for employees and supervision required under the specific order, together with all worker's compensation, Social Security, pension and retirement allowances and social insurance, or other regular payroll charges on same; the cost of all material and supplies required of either temporary or permanent character; rental of all power-driven equipment at agreed upon rates, together with cost of fuel and supply charges for the equipment; and any costs incurred by the Contractor as a direct result of executing the order, if approved by the Supervising Professional;
- (3) If the extra is performed under subcontract, the subcontractor shall be allowed to compute its charges as described above. The Contractor shall be permitted to add an additional charge of 5% percent to that of the subcontractor for the Contractor's supervision and contractual responsibility;
- (4) The quantities and items of work done each day shall be submitted to the Supervising Professional in a satisfactory form on the succeeding day, and shall be approved by the Supervising Professional and the Contractor or adjusted at once;
- (5) Payments of all charges for work under this Section in any one month shall be made along with normal progress payments. Retainage shall be in accordance with Progress Payments-Section 16.

No additional compensation will be provided for additional equipment, materials, personnel, overtime or special charges required to perform the work within the time requirements of the Contract.

When extra work is required and no suitable price for machinery and equipment can be determined in accordance with this Section, the hourly rate paid shall be 1/40 of the basic weekly rate listed in the Rental Rate Blue Book published by Dataquest Incorporated and applicable to the time period the equipment was first used for the extra work. The hourly rate will be deemed to include all costs of operation such as bucket or blade, fuel, maintenance, "regional factors", insurance, taxes, and the like, but not the costs of the operator.

## **Section 16 - Progress Payments**

The Contractor shall submit each month, or at longer intervals, if it so desires, an invoice covering work performed for which it believes payment, under the Contract terms, is due. The submission shall be to the City's Finance Department - Accounting Division. The Supervising Professional will, within 10 days following submission of the invoice, prepare a certificate for payment for the work in an amount to be determined by the Supervising Professional as fairly representing the acceptable work performed during the period covered by the Contractor's invoice. To insure the proper performance of this Contract, the City will retain a percentage of the estimate in accordance with Act 524, Public Acts of 1980. The City will then, following the receipt of the Supervising Professional's Certificate, make payment to the Contractor as soon as feasible, which is anticipated will be within 15 days.

An allowance may be made in progress payments if substantial quantities of permanent material have been delivered to the site but not incorporated in the completed work if the Contractor, in the opinion of the Supervising Professional, is diligently pursuing the work under this Contract. Such materials shall be properly stored and adequately protected. Allowance in the estimate shall be at the invoice price value of the items. Notwithstanding any payment of any allowance, all risk of loss due to vandalism or any damages to the stored materials remains with the Contractor.

In the case of Contracts which include only the Furnishing and Delivering of Equipment, the payments shall be; 60% of the Contract Sum upon the delivery of all equipment to be furnished, or in the case of delivery of a usable portion of the equipment in advance of the total equipment delivery, 60% of the estimated value of the portion of the equipment may be paid upon its delivery in advance of the time of the remainder of the equipment to be furnished; 30% of the Contract Sum upon completion of erection of all equipment furnished, but not later than 60 days after the date of delivery of all of the equipment to be furnished; and payment of the final 10% on final completion of erection, testing and acceptance of all the equipment to be furnished; but not later than 180 days after the date of delivery of all of the equipment to be furnished, unless testing has been completed and shows the equipment to be unacceptable.

With each invoice for periodic payment, the Contractor shall enclose a Contractor's Declaration - Section 43, and an updated project schedule per Order of Completion - Section 2.

## **Section 17 - Deductions for Uncorrected Work**

If the Supervising Professional decides it is inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made.

## **Section 18 - Correction of Work Before Final Payment**

The Contractor shall promptly remove from the premises all materials condemned by the Supervising Professional as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute the work in accordance with the Contract and without expense to the City and shall bear the expense of making good all work of other contractors destroyed or damaged by the removal or replacement.

If the Contractor does not remove the condemned work and materials within 10 days after written notice, the City may remove them and, if the removed material has value, may store the material

at the expense of the Contractor. If the Contractor does not pay the expense of the removal within 10 days thereafter, the City may, upon 10 days written notice, sell the removed materials at auction or private sale and shall pay to the Contractor the net proceeds, after deducting all costs and expenses that should have been borne by the Contractor. If the removed material has no value, the Contractor must pay the City the expenses for disposal within 10 days of invoice for the disposal costs.

The inspection or lack of inspection of any material or work pertaining to this Contract shall not relieve the Contractor of its obligation to fulfill this Contract and defective work shall be made good. Unsuitable materials may be rejected by the Supervising Professional notwithstanding that the work and materials have been previously overlooked by the Supervising Professional and accepted or estimated for payment or paid for. If the work or any part shall be found defective at any time before the final acceptance of the whole work, the Contractor shall forthwith make good the defect in a manner satisfactory to the Supervising Professional. The judgment and the decision of the Supervising Professional as to whether the materials supplied and the work done under this Contract comply with the requirements of the Contract shall be conclusive and final.

## **Section 19 - Acceptance and Final Payment**

Upon receipt of written notice that the work is ready for final inspection and acceptance, the Supervising Professional will promptly make the inspection. When the Supervising Professional finds the work acceptable under the Contract and the Contract fully performed, the Supervising Professional will promptly sign and issue a final certificate stating that the work required by this Contract has been completed and is accepted by the City under the terms and conditions of the Contract. The entire balance found to be due the Contractor, including the retained percentage, shall be paid to the Contractor by the City within 30 days after the date of the final certificate.

Before issuance of final certificates, the Contractor shall file with the City:

- (1) The consent of the surety to payment of the final estimate;
- (2) The Contractor's Affidavit in the form required by Section 44.

In case the Affidavit or consent is not furnished, the City may retain out of any amount due the Contractor, sums sufficient to cover all lienable claims.

The making and acceptance of the final payment shall constitute a waiver of all claims by the City except those arising from:

- (1) unsettled liens;
- (2) faulty work appearing within 12 months after final payment;
- (3) hidden defects in meeting the requirements of the plans and specifications;
- (4) manufacturer's guarantees.

It shall also constitute a waiver of all claims by the Contractor, except those previously made and still unsettled.

## **Section 20 - Suspension of Work**

The City may at any time suspend the work, or any part by giving 5 days notice to the Contractor in writing. The work shall be resumed by the Contractor within 10 days after the date fixed in the written notice from the City to the Contractor to do so. The City shall reimburse the Contractor for

expense incurred by the Contractor in connection with the work under this Contract as a result of the suspension.

If the work, or any part, shall be stopped by the notice in writing, and if the City does not give notice in writing to the Contractor to resume work at a date within 90 days of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work suspended and will be entitled to the estimates and payments for all work done on the portions abandoned, if any, plus 10% of the value of the work abandoned, to compensate for loss of overhead, plant expense, and anticipated profit.

## **Section 21 - Delays and the City's Right to Terminate Contract**

If the Contractor refuses or fails to prosecute the work, or any separate part of it, with the diligence required to insure completion, ready for operation, within the allowable number of consecutive calendar days specified plus extensions, or fails to complete the work within the required time, the City may, by written notice to the Contractor, terminate its right to proceed with the work or any part of the work as to which there has been delay. After providing the notice the City may take over the work and prosecute it to completion, by contract or otherwise, and the Contractor and its sureties shall be liable to the City for any excess cost to the City. If the Contractor's right to proceed is terminated, the City may take possession of and utilize in completing the work, any materials, appliances and plant as may be on the site of the work and useful for completing the work. The right of the Contractor to proceed shall not be terminated or the Contractor charged with liquidated damages where an extension of time is granted under Extension of Time - Section 14.

If the Contractor is adjudged a bankrupt, or if it makes a general assignment for the benefit of creditors, or if a receiver is appointed on account of its insolvency, or if it persistently or repeatedly refuses or fails except in cases for which extension of time is provided, to supply enough properly skilled workers or proper materials, or if it fails to make prompt payments to subcontractors or for material or labor, or persistently disregards laws, ordinances or the instructions of the Supervising Professional, or otherwise is guilty of a substantial violation of any provision of the Contract, then the City, upon the certificate of the Supervising Professional that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor 3 days written notice, terminate this Contract. The City may then take possession of the premises and of all materials, tools and appliances thereon and without prejudice to any other remedy it may have, make good the deficiencies or finish the work by whatever method it may deem expedient, and deduct the cost from the payment due the Contractor. The Contractor shall not be entitled to receive any further payment until the work is finished. If the expense of finishing the work, including compensation for additional managerial and administrative services exceeds the unpaid balance of the Contract Sum, the Contractor and its surety are liable to the City for any excess cost incurred. The expense incurred by the City, and the damage incurred through the Contractor's default, shall be certified by the Supervising Professional.

## **Section 22 - Contractor's Right to Terminate Contract**

If the work should be stopped under an order of any court, or other public authority, for a period of 3 months, through no act or fault of the Contractor or of anyone employed by it, then the Contractor may, upon 7 days written notice to the City, terminate this Contract and recover from the City payment for all acceptable work executed plus reasonable profit.

## **Section 23 - City's Right To Do Work**

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the City, 3 days after giving written notice to the Contractor and its surety may, without prejudice to any other remedy the City may have, make good the deficiencies and may deduct the cost from the payment due to the Contractor.

## **Section 24 - Removal of Equipment and Supplies**

In case of termination of this Contract before completion, from any or no cause, the Contractor, if notified to do so by the City, shall promptly remove any part or all of its equipment and supplies from the property of the City, failing which the City shall have the right to remove the equipment and supplies at the expense of the Contractor.

The removed equipment and supplies may be stored by the City and, if all costs of removal and storage are not paid by the Contractor within 10 days of invoicing, the City upon 10 days written notice may sell the equipment and supplies at auction or private sale, and shall pay the Contractor the net proceeds after deducting all costs and expenses that should have been borne by the Contractor and after deducting all amounts claimed due by any lien holder of the equipment or supplies.

## **Section 25 - Responsibility for Work and Warranties**

The Contractor assumes full responsibility for any and all materials and equipment used in the construction of the work and may not make claims against the City for damages to materials and equipment from any cause except negligence or willful act of the City. Until its final acceptance, the Contractor shall be responsible for damage to or destruction of the project (except for any part covered by Partial Completion and Acceptance - Section 26). The Contractor shall make good all work damaged or destroyed before acceptance. All risk of loss remains with the Contractor until final acceptance of the work (Section 19) or partial acceptance (Section 26). The Contractor is advised to investigate obtaining its own builders risk insurance.

The Contractor shall guarantee the quality of the work for a period of one year. The Contractor shall also unconditionally guarantee the quality of all equipment and materials that are furnished and installed under the contract for a period of one year. At the end of one year after the Contractor's receipt of final payment, the complete work, including equipment and materials furnished and installed under the contract, shall be inspected by the Contractor and the Supervising Professional. Any defects shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. Any defects that are identified prior to the end of one year shall also be inspected by the Contractor and the Supervising Professional and shall be corrected by the Contractor at its expense as soon as practicable but in all cases within 60 days. The Contractor shall assign all manufacturer or material supplier warranties to the City prior to final payment. The assignment shall not relieve the Contractor of its obligations under this paragraph to correct defects.

## **Section 26 - Partial Completion and Acceptance**

If at any time prior to the issuance of the final certificate referred to in Acceptance and Final Payment - Section 19, any portion of the permanent construction has been satisfactorily completed, and if the Supervising Professional determines that portion of the permanent construction is not required for the operations of the Contractor but is needed by the City, the Supervising Professional shall issue to the Contractor a certificate of partial completion, and immediately the City may take over and use the portion of the permanent construction described in the certificate, and exclude the Contractor from that portion.

The issuance of a certificate of partial completion shall not constitute an extension of the Contractor's time to complete the portion of the permanent construction to which it relates if the Contractor has failed to complete it in accordance with the terms of this Contract. The issuance of the certificate shall not release the Contractor or its sureties from any obligations under this Contract including bonds.

If prior use increases the cost of, or delays the work, the Contractor shall be entitled to extra compensation, or extension of time, or both, as the Supervising Professional may determine.

## **Section 27 - Payments Withheld Prior to Final Acceptance of Work**

The City may withhold or, on account of subsequently discovered evidence, nullify the whole or part of any certificate to the extent reasonably appropriate to protect the City from loss on account of:

- (1) Defective work not remedied;
- (2) Claims filed or reasonable evidence indicating probable filing of claims by other parties against the Contractor;
- (3) Failure of the Contractor to make payments properly to subcontractors or for material or labor;
- (4) Damage to another Contractor.

When the above grounds are removed or the Contractor provides a Surety Bond satisfactory to the City which will protect the City in the amount withheld, payment shall be made for amounts withheld under this section.

## **Section 28 - Contractor's Insurance**

- (1) The Contractor shall procure and maintain during the life of this Contract, including the guarantee period and during any warranty work, such insurance policies, including those set forth below, as will protect itself and the City from all claims for bodily injuries, death or property damage which may arise under this Contract; whether the act(s) or omission(s) giving rise to the claim were made by the Contractor or by any subcontractor or anyone employed by them directly or indirectly. In the case of all contracts involving on-site work, the Contractor shall provide to the City, before the commencement of any work under this contract, certificates of insurance and other documentation satisfactory to the City demonstrating it has obtained the policies and endorsements required on behalf of itself,

and when requested, any subcontractor(s). The certificates of insurance endorsements and/or copies of policy language shall document that the Contractor satisfies the following minimum requirements.

- (a) Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:

Bodily Injury by Accident - \$500,000 each accident  
Bodily Injury by Disease - \$500,000 each employee  
Bodily Injury by Disease - \$500,000 each policy limit

- (b) Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 07 98 or current equivalent. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements specifically for the following coverages: Products and Completed Operations, Explosion, Collapse and Underground coverage or Pollution. Further there shall be no added exclusions or limiting endorsements which diminish the City's protections as an additional insured under the policy. The following minimum limits of liability are required:

\$1,000,000	Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined.
\$2,000,000	Per Job General Aggregate
\$1,000,000	Personal and Advertising Injury
\$2,000,000	Products and Completed Operations Aggregate

- (c) Motor Vehicle Liability Insurance, including Michigan No-Fault Coverages, equivalent to, as a minimum, Insurance Services Office form CA 00 01 07 97 or current equivalent. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. The City of Ann Arbor shall be named as an additional insured. There shall be no added exclusions or limiting endorsements which diminish the City's protections as an additional insured under the policy. Further, the limits of liability shall be \$1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.

- (d) Umbrella/Excess Liability Insurance shall be provided to apply excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of \$1,000,000.

- (2) Insurance required under subsection (1)(b) and (1)(c) above shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City.
- (3) Insurance companies and policy forms are subject to approval of the City Attorney, which approval shall not be unreasonably withheld. Documentation must provide and demonstrate an unconditional 30 day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy

number; name of insurance company; name and address of the agent or authorized representative; name and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions which shall be approved by the City, in its sole discretion; (c) that the policy conforms to the requirements specified Contractor shall furnish the City with satisfactory certificates of insurance and endorsements prior to commencement of any work. Upon request, the Contractor shall provide within 30 days a copy of the policy(ies) to the City. If any of the above coverages expire by their terms during the term of this Contract, the Contractor shall deliver proof of renewal and/or new policies and endorsements to the Administering Service Area/Unit at least ten days prior to the expiration date.

- (4) Any Insurance provider of Contractor shall be admitted and authorized to do business in the State of Michigan and shall carry and maintain a minimum rating assigned by A.M. Best & Company's Key Rating Guide of "A-" Overall and a minimum Financial Size Category of "V". Insurance policies and certificates issued by non-admitted insurance companies are not acceptable unless approved in writing by the City.
- (5) City reserves the right to require additional coverage and/or coverage amounts as may be included from time to time in the Detailed Specifications for the Project.
- (6) The provisions of General Condition 28 shall survive the expiration or earlier termination of this contract for any reason.

## **Section 29 - Surety Bonds**

Bonds will be required from the successful bidder as follows:

- (1) A Performance Bond to the City of Ann Arbor for the amount of the bid(s) accepted;
- (2) A Labor and Material Bond to the City of Ann Arbor for the amount of the bid(s) accepted.

Bonds shall be executed on forms supplied by the City in a manner and by a Surety Company authorized to transact business in Michigan and satisfactory to the City Attorney.

## **Section 30 - Damage Claims**

The Contractor shall be held responsible for all damages to property of the City or others, caused by or resulting from the negligence of the Contractor, its employees, or agents during the progress of or connected with the prosecution of the work, whether within the limits of the work or elsewhere. The Contractor must restore all property injured including sidewalks, curbing, sodding, pipes, conduit, sewers or other public or private property to not less than its original condition with new work.

## **Section 31 - Refusal to Obey Instructions**

If the Contractor refuses to obey the instructions of the Supervising Professional, the Supervising Professional shall withdraw inspection from the work, and no payments will be made for work performed thereafter nor may work be performed thereafter until the Supervising Professional shall have again authorized the work to proceed.

## **Section 32 - Assignment**

Neither party to the Contract shall assign the Contract without the written consent of the other. The Contractor may assign any monies due to it to a third party acceptable to the City.

## **Section 33 - Rights of Various Interests**

Whenever work being done by the City's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Supervising Professional, to secure the completion of the various portions of the work in general harmony.

The Contractor is responsible to coordinate all aspects of the work, including coordination of, and with, utility companies and other contractors whose work impacts this project.

## **Section 34 - Subcontracts**

The Contractor shall not award any work to any subcontractor without prior written approval of the City. The approval will not be given until the Contractor submits to the City a written statement concerning the proposed award to the subcontractor. The statement shall contain all information the City may require.

The Contractor shall be as fully responsible to the City for the acts and omissions of its subcontractors, and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the Contractor by the terms of the General Conditions and all other contract documents applicable to the work of the subcontractors and to give the Contractor the same power to terminate any subcontract that the City may exercise over the Contractor under any provision of the contract documents.

Nothing contained in the contract documents shall create any contractual relation between any subcontractor and the City.

## **Section 35 - Supervising Professional's Status**

The Supervising Professional has the right to inspect any or all work. The Supervising Professional has authority to stop the work whenever stoppage may be appropriate to insure the proper execution of the Contract. The Supervising Professional has the authority to reject all work and materials which do not conform to the Contract and to decide questions which arise in the execution of the work.

The Supervising Professional shall make all measurements and determinations of quantities. Those measurements and determinations are final and conclusive between the parties.

## **Section 36 - Supervising Professional's Decisions**

The Supervising Professional shall, within a reasonable time after their presentation to the Supervising Professional, make decisions in writing on all claims of the City or the Contractor and on all other matters relating to the execution and progress of the work or the interpretation of the contract documents.

## **Section 37 - Storing Materials and Supplies**

Materials and supplies may be stored at the site of the work at locations agreeable to the City unless specific exception is listed elsewhere in these documents. Ample way for foot traffic and drainage must be provided, and gutters must, at all times, be kept free from obstruction. Traffic on streets shall be interfered with as little as possible. The Contractor may not enter or occupy with agents, employees, tools, or material any private property without first obtaining written permission from its owner. A copy of the permission shall be furnished to the Supervising Professional.

## **Section 38 - Lands for Work**

The Contractor shall provide, at its own expense and without liability to the City, any additional land and access that may be required for temporary construction facilities or for storage of materials.

## **Section 39 - Cleaning Up**

The Contractor shall, as directed by the Supervising Professional, remove at its own expense from the City's property and from all public and private property all temporary structures, rubbish and waste materials resulting from its operations unless otherwise specifically approved, in writing, by the Supervising Professional.

## **Section 40 - Salvage**

The Supervising Professional may designate for salvage any materials from existing structures or underground services. Materials so designated remain City property and shall be transported or stored at a location as the Supervising Professional may direct.

## **Section 41 - Night, Saturday or Sunday Work**

No night or Sunday work (without prior written City approval) will be permitted except in the case of an emergency and then only to the extent absolutely necessary. The City may allow night work which, in the opinion of the Supervising Professional, can be satisfactorily performed at night. Night work is any work between 8:00 p.m. and 7:00 a.m. No Saturday work will be permitted unless the Contractor gives the Supervising Professional at least 48 hours but not more than 5 days notice of the Contractor's intention to work the upcoming Saturday.

## **Section 42 - Sales Taxes**

Under State law the City is exempt from the assessment of State Sales Tax on its direct purchases. Contractors who acquire materials, equipment, supplies, etc. for incorporation in City projects are not likewise exempt. State Law shall prevail. The Bidder shall familiarize itself with the State Law and prepare its Bid accordingly. No extra payment will be allowed under this Contract for failure of the Contractor to make proper allowance in this bid for taxes it must pay.



## Section 44

### CONTRACTOR'S AFFIDAVIT

The undersigned Contractor, \_\_\_\_\_, represents that on \_\_\_\_\_, 20\_\_\_\_, it was awarded a contract by the City of Ann Arbor, Michigan to \_\_\_\_\_ under the terms and conditions of a Contract titled \_\_\_\_\_. The Contractor represents that all work has now been accomplished and the Contract is complete.

The Contractor warrants and certifies that all of its indebtedness arising by reason of the Contract has been fully paid or satisfactorily secured; and that all claims from subcontractors and others for labor and material used in accomplishing the project, as well as all other claims arising from the performance of the Contract, have been fully paid or satisfactorily settled. The Contractor agrees that, if any claim should hereafter arise, it shall assume responsibility for it immediately upon request to do so by the City of Ann Arbor.

The Contractor, for valuable consideration received, does further waive, release and relinquish any and all claims or right of lien which the Contractor now has or may acquire upon the subject premises for labor and material used in the project owned by the City of Ann Arbor.

This affidavit is freely and voluntarily given with full knowledge of the facts.

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Date

By \_\_\_\_\_  
(Signature)

Its \_\_\_\_\_  
(Title of Office)

Subscribed and sworn to before me, on this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_  
\_\_\_\_\_, \_\_\_\_\_ County, Michigan

Notary Public

\_\_\_\_\_ County, MI

My commission expires on:

## **STANDARD SPECIFICATIONS**

All work under this contract shall be performed in accordance with the Public Services Department Standard Specifications in effect at the date of availability of the contract documents stipulated in the Bid. All work under this Contract which is not included in these Standard Specifications, or which is performed using modifications to these Standard Specifications, shall be performed in accordance with the Detailed Specifications included in these contract documents.

Standard Specifications are available online:

<http://www.a2gov.org/departments/engineering/Pages/Engineering-and-Contractor-Resources.aspx>

**DETAILED SPECIFICATIONS**

SECTION 01005

ADMINISTRATIVE PROVISIONS

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- 1.2 Related Sections
- 1.3 Summary of work.
- 1.4 Work sequence.
- 1.5 Alternatives.
- 1.6 Coordination
- 1.7 Cleanliness of the work and streets.
- 1.8 Fire protection.
- 1.9 Historical specimens.
- 1.10 Abbreviations.
- 1.11 References.

1.2 RELATED REQUIREMENTS

- A. Instructions to Bidders.
- B. Contract.
- C. General Conditions.
- D. Standard Specifications
- E. Section 01310 - Progress Schedules.
- F. Section 01700 - Contract Closeout.
- G. Section 01950 - Sequence of Construction and Special Project Requirements.

1.3 SUMMARY OF WORK

- A. The work consists of the improvements to renovate two existing sanitary lift stations, including demolition of existing structures, modification to existing wet well structures,

installation of new pumps and valves, new forcemain construction on one station, bypass pumping, site improvements and related electrical and controls work.

#### 1.4 WORK SEQUENCE

- A. The Contractor shall arrange his work so that at no time will it cause unnecessary interruption to the operation of existing facilities. To this end, the Contractor shall prepare and submit to the Engineer for approval a complete detailed working schedule setting forth the sequencing of operations he proposes to follow.

#### 1.5 ALTERNATIVES

- A. Contract Drawings indicate the extent and general arrangement of the work. If any departures from the Contract Drawings are deemed necessary by the Contractor to accommodate the material and equipment he proposes to furnish, details of such departures and reasons thereof shall be submitted as soon as practicable to the Engineer for approval.
- B. The Contractor shall refer to Section 01300, SUBMITTALS, for complete requirements regarding Alternates, Substitutions.

#### 1.6 COORDINATION

- A. Contract Documents:
  - 1. It is not the intent nor shall it be so construed that work included in any one Section of the Specifications must be performed by a particular trade or by subcontract. The work to be performed by a particular trade is not necessarily restricted to that of any one Section.
  - 2. Any item mentioned under any heading must be supplied even though it is not called for again under the heading for the respective work.
- B. Existing Facilities:
  - 1. All existing facilities and operations shall be uninterrupted by the Contractor's performances unless otherwise allowed in the Contract Documents.
  - 2. All proposed interruptions or tie-ins to existing facilities or utilities or other activities affecting the operations shall be scheduled.
  - 3. The Engineer shall approve the scheduling of all such activities.

#### 1.7 CLEANLINESS OF THE WORK AND STREETS

- A. The work itself, and all public and private property used therewith, shall be kept in a neat orderly condition at all times. Excess excavation, waste and rejected materials, rubbish, and debris shall not be allowed to accumulate. The newly constructed work shall be cleared of all temporary construction of facilities when such are entirely free of all debris and the premises left in a condition that will not be susceptible to soil erosion and that will not create a situation problem.
- B. Trucks hauling loose materials to or from the site shall be tightly covered and their loads shall be trimmed to prevent spillage on the public streets or roads. This requirement likewise applies to suppliers making deliveries to the site. The Contractor shall promptly clean streets or roads dirtied by any cause arising from his operations or that of his Subcontractors or his

suppliers. Should the Contractor fail to maintain proper street or road cleanliness, the Owner will take necessary steps to perform such cleaning and will charge the Contractor for all cost thereof.

- C. The Contractor shall control dust from his operations to meet the requirements of the jurisdictional authorities. Control measures shall include but are not limited to sprinkling, applying calcium chloride, wheel washing, street sweeping, street washing, load covering, and the like.

#### 1.8 FIRE PROTECTION

- A. The Contractor shall take all necessary precautions to prevent fires and shall provide adequate equipment for extinguishing fires. No burning of trash or debris will be permitted.
- B. When fire or explosion hazards are created in the vicinity of the work as a result of the locations of fuel tanks or similar hazardous utilities or devices, the Contractor shall immediately alert the local Fire Marshal, the Engineer, and the Owner. The Contractor shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the Owner of the tank or device to prevent the occurrence of fire or explosion.

#### 1.9 HISTORICAL SPECIMENS

- A. Any and all specimens of historical or scientific value or interest encountered in the Work shall be preserved and delivered to the Engineer.

#### 1.10 REFERENCES

- A. Specifications by Reference:
  - 1. Where reference is made in the specifications to specifications or standards of any technical society, association, governmental agency, etc., it is understood and agreed that such specifications or standards are as much a part of the specifications as though fully repeated therein.
- B. Materials by Reference:
  - 1. A material included in more than one section of the specifications will be specified in detail in only one of the Sections.
  - 2. In other sections, the material is specified by reference to the section containing the specifications for the same material, and such specifications shall be considered as much a part of the other sections as if they were therein repeated in full.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01039

COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Related Sections
- B. Coordination.
- C. Pre-Bid Meeting.
- D. Preconstruction Meeting.
- E. Progress Meetings.
- F. Preinstallation Meetings.

1.2 RELATED SECTIONS

- A. Instructions for Bidders.
- B. General Conditions.
- C. Supplemental General Conditions.
- D. Section 01005 - Administration Provisions.
- E. Section 01300 - Submittals.
- F. Section 01310 - Progress Schedules.

1.3 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

- D. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- E. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

#### 1.4 PRE-BID MEETING

- A. Engineer will schedule a meeting as noted in the Information for Bidders.
- B. Attendance Required: Owner, Engineer, and Bidders.
- C. Attendance Requested: Regulatory Agencies, Utility Representatives.
- D. Agenda:
  - 1. Review of Permits Required.
  - 2. Review of Special Project Requirements.
  - 3. Regulatory requirements affecting the project.
  - 4. Review of Contract Documents.
  - 5. Critical work sequencing.
  - 6. Use of premises by Owner and Contractors
  - 7. Construction facilities and controls provided by Owner.
  - 8. Temporary utilities provided by Contractor and by Owner.
  - 9. Survey and layout.
  - 10. Security and housekeeping procedures.
  - 11. Responsibility for testing.
- E. Record minutes and distribute copies within two days after meeting to participants, with one copy to all participants, and those affected by decisions made.

#### 1.5 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting prior to issuing Notice of Award.
- B. Attendance Required: Owner, Engineer, major subcontractors and Contractor.
- C. Agenda:
  - 1. Review of Execution of Owner-Contractor Agreement.
  - 2. Review of Regulatory requirements affecting the project.
  - 3. Distribution of Control Documents.
  - 4. Submission of progress construction schedule.
  - 5. Designation of personnel representing the parties in Contract, and the Engineer.
  - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 7. Critical work sequencing.
  - 8. Use of premises by Owner and Contractor
  - 9. Construction facilities and controls provided by Owner.
  - 10. Mobilization
  - 11. Project Coordination

12. Temporary utilities provided by Contractor and Owner.
  13. Survey and layout.
  14. Security and housekeeping procedures.
  15. Procedures for testing.
  16. Procedures for maintaining record documents.
- D. Record minutes and distribute copies within two days after meeting to participants, with one copy to all participants, and those affected by decisions made.

#### 1.6 PROGRESS MEETINGS

- A. The Engineer will schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and Suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
1. Review minutes of previous meetings.
  2. Review of Work progress.
  3. Field observations, problems, and decisions.
  4. Identification of problems which impede planned progress.
  5. Review of submittals schedule and status of submittals.
  6. Review of on site and off-site fabrication and delivery schedules.
  7. Maintenance of progress schedule.
  8. Corrective measures to regain projected schedules.
  9. Planned progress during succeeding work period.
  10. Coordination of projected progress.
  11. Maintenance of quality and work standards.
  12. Effect of proposed changes on progress schedule and coordination.

#### 1.7 PREINSTALLATION MEETING

- A. When required in individual specification sections, convene a preinstallation meeting at work site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Engineer four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
  2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with copies to Engineer, Owner, participants, and those affected by decisions made.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SCHEDULE FOR SUBMISSION

- A. Submittal procedures
- B. Submittal Review
- C. Proposed Products list
- D. Shop Drawings, Product Data, and Samples
- E. Manufacture's installation instructions
- F. Manufacture's certificates

1.2 RELATED SECTIONS

- A. General Conditions
- B. Standard Specifications
- C. Section 01310 Construction Schedule
- D. Section 01400 - Quality Control
- E. Section 01700 - Contract Closeout
- F. Section 01730 Operation and Maintenance Data

1.3 SCHEDULE FOR SUBMISSION

- A. Prior to submitting any shop drawings, product data, portfolios, samples, etc. the Contractor shall prepare a Schedule of Submittals, listing all items in the project which he will submit for review by the Engineer. Identify all critical path submittals.
- B. The summary shall be submitted within twenty (20) calendar days after receipt of Notice to Proceed and shall be updated once per month thereafter.
- C. The summary shall include the proposed dates for submittal for each item for control purposes. The summary shall be prepared in coordination with the Project Schedule for Construction and adequate time shall be allowed therein for review and possible resubmittal.
- D. The summary and schedule for submittals shall not relieve the Contractor of his obligation to comply with specification requirements for items not listed on the schedule.

- E. Nothing herein shall be construed as allowing additional time for completion of the project in the event resubmittal is required for shop drawings or the other items to be submitted.

#### 1.4 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer approved transmittal form.
- B. Sequentially number the transmittal form. Re-submittals shall have original specification number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor and supplier; pertinent drawing and detail number, and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite the Project, and deliver to the Engineer in a manner to allow sufficient time for review and processing by the Engineer so as to not cause delays in the Work. Coordinate submission of related items.
- F. All drawings, information and documentation shall be prepared and submitted with all words in the English language and dimensions in American units. No foreign language or metric units will be permitted.
- G. Identify variations from Contract Documents and Products and system limitations which may be detrimental to successful performance of the completed work.
- H. Provide space for Contractor and Engineer review stamps.
- I. Revise and resubmit submittals as required and identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals to all concerned and related parties. Instruct parties to promptly report any inability to comply with provisions.
- K. The Engineer reserves the right to refuse to check or review any submittal of a subcontractor or manufacturer which is not presented in compliance with the foregoing requirements.
- L. Electronic Submittals:
  - 1. All electronic submittals shall follow the procedures outlined above.
  - 2. Electronic submittal procedures are only applicable to Shop Drawings and product data submittals.
  - 3. Electronic submittals shall be made in .PDF format
  - 4. Reviewed submittals shall be returned in PDF electronic format for the Contractor's printing and distribution.

## 1.5 SUBMITTAL REVIEW

- A. All subcontractors and manufacturers' drawings shall first be sent directly to the Contractor, who shall keep a record of the drawing numbers and the dates of receipt. The Contractor shall check thoroughly all such drawings, as regards measurements, sizes of members, materials, and all other details to assure himself that they conform to the intent of the drawings and the specification, and shall promptly return to the subcontractors and/or manufacturers for correction such drawings as are found inaccurate or otherwise in error.
- B. The Engineer will review the Contractor's, subcontractors' and manufacturers' drawings within a reasonable time after receipt thereof and will return one copy endeavoring to indicate, by notation thereon or written instructions, any correction which may be necessary to meet the Contract requirements. The Contractor shall then review such notations and/or instructions and if he concurs therein, shall make or have made such required corrections, and shall, when so noted on the drawings or requested by the Engineer, resubmit corrected drawings to the Engineer as soon as possible, for final review. Such further review by the Engineer will be limited to the corrections only, and the Contractor, by such re-submission shall be held to have represented that such drawings contain no other alterations, additions or deletions, unless the Contractor (in writing) directs the Engineer's specific attention to same. Should the Contractor question, or dissent from, such notations and/or instructions, he shall so inform the Engineer and request further clarification before resubmitting the drawings.
- C. The review of Contractor's, subcontractors', and manufacturers' drawings by the Engineer is for coordination and assistance, and the Engineer does not thereby assume responsibility for errors or omissions. Such errors or omissions must be made good by the Contractor, irrespective of the receipt, review of the drawings by the Engineer, and even though the work is done in accordance with such drawings.

## 1.6 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Owner-Contractor Agreement submit list of all major products proposed for use, including those previously called for to be submitted in the Proposal, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

## 1.7 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. While the contract drawings and specifications propose to be complete in all respects as to layout, type of equipment and materials, they are not intended to serve as detailed installation drawings and the preparation of such drawings required or necessary for this purpose, or to set equipment accurately, shall be the responsibility of the Contractor.
- B. These Contract Documents shall be supplemented by other drawings, product data, samples and portfolios of all equipment, components, apparatus, materials, anchors/fasteners, etc. furnished by the Contractor and reviewed by the Engineer. All such supplementary drawings or instructions are intended to be consistent with the Contract Documents, true developments thereof and reasonably inferable therefrom. Therefore, no extra charge will be allowed on a claim that particular supplemental drawings or instructions differed from the Contract

documents, incurring extra work, unless the Contractor has first brought the matter, in writing, to the Engineer's attention for proper adjustment before starting on the work covered by such and has received from the Engineer an order in writing to so proceed.

- C. These original and supplementary drawings constitute the drawings according to which the work is to be done. The Contractor shall keep at the site of the work, copies of all drawings and specifications and shall at all times give the Engineer or Owner access thereto.
- D. Shop Drawings are drawings, diagrams, schedules other data specifically prepared for the Work by the Contractor or a subcontractor, Subcontractor manufacturer, supplier or distributor to illustrate some portion of the Work.
- E. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of these submittals is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.
- F. Product Data are illustrations, standard schedules, performance charts, instructions, catalog cuts, brochures, diagrams, materials lists and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
- G. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
- H. The Contractor shall review, approve, and submit to the Engineer, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents requested by the Engineer or Owner or otherwise necessary for the proper execution of the work, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals made by the Contractor which are not required by the Contract Documents may be returned without action.
- I. The Contractor shall perform no portion of the Work requiring submittal, resubmittal, and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by the Engineer. Such Work shall be in accordance with reviewed submittals.
- J. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or contained within such submittals with the requirements of the Work and of the Contract Documents.
- K. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's review of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation at the time of submittal and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or similar submittals by the Engineer's review thereof, as the Engineer's review is intended to cover compliance with the Contract Document and not to enter into every detail of the shop work.

- L. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those required by the Engineer on previous submittals.
- M. When professional certification of performance criteria of materials systems or equipment is required by the Contract Documents, the Engineer shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.
- N. Shop Drawings
  - 1. Submit in the form of legible PDFs
- O. Product Data
  - 1. Submit in the form of legible PDFs
  - 2. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
  - 3. Product data shall include an index sheet containing a space at least 5" x 8" for review stamps and notes.
  - 4. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 - CONTRACT CLOSEOUT.
- P. Samples
  - 1. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
  - 2. Submit samples of sufficient size and representative of finishes indicating textures, and patterns for Owner selection.
  - 3. Include identification on each sample, with full Project information.
  - 4. Submit the number of samples specified in individual specification sections; two of which will be retained by the Engineer.
  - 5. Reviewed samples which may be used in the work are indicated in individual specification sections.

#### 1.8 MANUFACTURER INSTALLATION INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, operating, maintaining and finishing to the Engineer in quantities specified for Product Data.
- B. Identify conflicts between manufacturer's instructions and contract documents.

#### 1.9 MANUFACTURER CERTIFICATES

- A. When specified in individual sections, submit certification by manufacturer to Engineer, in quantities specified for Product Data.
- B. Indicate material or Product meets or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01310  
PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format.
- B. Content.
- C. Revisions to schedules.
- D. Submittals.

1.2 RELATED SECTIONS

- A. General Conditions
- B. Standard Specifications
- C. Section 01005 – Administrative Provisions
- D. Section 01300 - Submittals: Shop drawings, product data, and samples

1.3 FORMAT

- A. Prepare schedules using a recognized scheduling software package for construction projects, Primavera, MS Project or Equal. Provide precedence network schedule which identifies a single critical path and associated activities for the duration of the project.
- B. Sequence of Listings: The chronological order of the start of each item of Work.
- C. Scale and Spacing: To provide space for notations and revisions.
- D. Sheet Size: Multiples of 11 x 17 inches

1.4 CONTENT

- A. Show contractual dates, including Notice to Proceed, Substantial Completion(s) and Final Completion
- B. Show Critical Path Submittals, including review time and re-submittal
- C. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- D. Show Critical Path in Red

- E. Identify each item by specification section number.
- F. Identify work of separate stages and other logically grouped activities.
- G. Provide sub-schedules to define critical portions of the entire schedule.
- H. Show float from each contractual date
- I. Provide separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.

#### 1.5 REVISIONS TO SCHEDULES

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- C. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect, on schedules of separate contractors.
- D. Revise Schedule once a month and provide 4-week look-ahead schedule with each revision.

#### 1.6 SUBMITTALS

- A. Submit initial schedules within 30 days after date established in Notice to Proceed. After review, resubmit required revised data within ten days.
- B. Submit the number of opaque reproductions which Contractor requires, plus four copies which will be retained by Engineer or, submit one opaque reproduction and one reproducible transparency.

#### 1.7 DISTRIBUTION

- A. Distribute .PDF files of reviewed schedules to Engineer provided Project site file, Subcontractors, suppliers, and other concerned parties.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION



SECTION 01400  
QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance - control of installation.
- B. Tolerances
- C. References.
- D. Mockup.
- E. Inspecting and testing laboratory services.
- F. Manufacturers' field services and reports.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.
- B. Section 01600 - Material and Equipment: Requirements for material and product quality.

1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.4 TOLERANCES

- A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.

- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

#### 1.5 REFERENCES

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date specified in the individual specification sections, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Architect/Engineer shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

#### 1.6 MOCK-UP

- A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups are representative of the quality required for the Work.
- D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

#### 1.7 INSPECTING AND TESTING LABORATORY SERVICES

- A. The Contractor shall hire an approvable Material Testing firm to perform compaction and concrete tests
- B. Owner may appoint, employ, and pay for specified services of an independent firm to perform inspecting and testing, as required in addition to the material testing identified above..
- C. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Engineer or the Owner.
- D. Inspecting, testing, and source quality control may occur on or off the project site. Perform off-site inspecting or testing as required by the Engineer or the Owner.
- E. Reports will be submitted by the independent firm to the Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
  - 1. Notify Engineer and independent firm 48 hours prior to expected time for operations requiring services.
  - 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- G. Testing or inspecting does not relieve Contractor of performing Work to contract requirements.
- H. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspecting or testing charges from the Contract Sum.

#### 1.8 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Submit report in duplicate within 30 days of observation to Engineer for information.

#### PART 2 PRODUCTS

Not Used.

#### PART 3 EXECUTION

Not Used.

END OF SECTION



SECTION 01600

MATERIALS, PRODUCTS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General Provisions.
- B. Transportation and handling.
- C. Storage and protection.
- D. "Or Equal" Clause
- E. Product options.
- F. Substitutions.
- G. Installation of Equipment.
- H. Damage during tests and instruction period.
- I. Services of manufacturer's engineers.
- J. Equipment manufacturer certification.

1.2 RELATED SECTIONS

- A. Bid Form, Section 2 - Material, Equipment and Environmental Alternatives
- B. Section 00120 - Instructions to Bidders: Product options and substitution procedures.
- C. Section 01400 - Quality Control: Product quality monitoring.

1.3 GENERAL PROVISIONS

- A. Products (including all materials, machinery, equipment, and systems) shall be carefully designed and installed to insure that all required functions are adequately performed within specified degrees of precision and that each unit shall operate with every other part, furnished or existing, to provide a complete integrated system which shall operate to the satisfaction of the Engineer. Any changes or revisions of existing work made necessary by the type and dimensions of furnished products shall be made at the expense of the Contractor, and he shall furnish detail drawings showing such changes or revisions for the approval of the Engineer.
- B. Submit to the Engineer ample proof that each and every part of the products to be furnished is of a reliable make and of a type which has been in successful operation within the continental

United States. Installation of any experimental or untried type of apparatus, material, or machinery will not be allowed.

- C. Each major item of equipment shall have the manufacturer's nameplate securely affixed in a conspicuous place. The nameplate shall show the manufacturer's name, address, model number, rating, and any other pertinent data such as speed, horsepower, etc.
- D. All materials, equipment, and accessories shall be new and unused and shall be essentially the products of a manufacturer regularly engaged in the production of such material or equipment and shall essentially duplicate material or equipment that has been in satisfactory operation at least 5 years.
- E. The owner reserves the right to reject any material or equipment manufacturer who, although he meets the above requirements, does not provide satisfactory evidence indicating adequate and prompt post-installation repair and maintenance service as required to suit the operational requirements of Owner. Items of any one type of materials or equipment shall be the product of a single manufacturer.
- F. All piping and equipment furnished under this contract shall be fabricated of such materials that under normal operating conditions harmful substances are not imparted to the water supply system.
- G. Except as otherwise specified or required, equipment shall be primed and finish painted at the factory in accordance with the recommendations or the approved manufacturer. All equipment supplied under this contract shall include at least one quart of finish paint used for touch-up at the completion of construction.
- H. Necessary field painting shall be in accordance with the requirements of Section 09900 - Painting. Any damage to shop coating shall be corrected to the satisfaction of the Engineer.
- I. Certification shall be provided that all materials which may come into contact with potable water meets the National Sanitation Foundation Standard 61 and all MDPH regulations in force at the time of submittals.

#### 1.4 TRANSPORTATION AND HANDLING

- A. All parts of the equipment shall be carefully crated to facilitate shipping and handling. The crates shall be constructed to completely protect the equipment and shall be sufficiently strong to permit lifting and skidding without requiring additional bracing or reinforcement.
  - 1. Packages or materials showing evidence of damage or contamination, regardless of cause, will be rejected.
- B. Transport and handle Products in accordance with manufacturer's instructions.
- C. Transport and handle all materials in such a manner to avoid breakage, inclusion of foreign materials, and/or damage by water or other causes.
- D. Deliver packaged materials in original unopened containers. Packages or materials showing evidence of damage or contamination regardless of cause will be rejected.

- E. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- F. Repair or replace all items damaged or broken as a result of the Contractor's operation at no cost to the Owner.
- G. When specified in the individual Section, equipment shall be made available for conditional acceptance by the Engineer at the factory prior to shipment.
- H. Equipment shall not be delivered unless it can be immediately incorporated into the work or proper storage facilities are available.
- I. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.
- J. Notify the Engineer at least two days in advance of the delivery of equipment.

#### 1.5 STORAGE AND PROTECTION

- A. All materials and equipment shall be handled in a manner to avoid damage, breakage, soiling, disfigurement, shock, denting, marring of surfaces or delay in the completion of the work.
  - 1. The Contractor shall coordinate delivery of equipment with his construction program so that an undue amount of storage space is not required. Space for contractor's use will be designated by the Owner.
  - 2. The Contractor shall exercise care in the protection of materials and equipment furnished and/or installed under this contract while they are in storage at the site and during and after installation prior to final acceptance.
  - 3. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Owner, all items damaged or broken as a result of his operation.
  - 4. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
  - 5. All materials which have been stored shall be subject to retest and shall meet the requirements of these Specifications at the time they are used in the work and at the time of final acceptance of the work.
  - 6. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.
- B. Store and protect Products in accordance with manufacturers' instructions, with seals and labels intact and legible.
  - 1. Store sensitive Products in weather tight, climate controlled enclosures.
  - 2. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of Product.
  - 3. All machined surfaces of the equipment subject to corrosion shall be protected by coating with grease immediately after finishing.
  - 4. All flanges shall be protected prior to installation by means of wooden flanges bolted in place.
  - 5. Pump casings shall be thoroughly drained of all water.
  - 6. All unpainted steel surfaces shall be prevented from rusting by an Owner approved method.

7. Plate and sheet metal work shall be handled and stored with care to prevent permanent deformations or crimps in the material.
  8. Whenever the shop coat of protective paint is damaged, spot coating shall be made immediately to prevent rusting.
  9. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
  10. Equipment and materials stored outdoors shall be placed on sloped supports, up at least six inches above the ground.
- C. Openings in tanks, valves and pipe shall be kept covered to prevent dirt, rubbish or water from entering, with machined surfaces such as flange faces, pipe threads, machined weld ends of pipe, and fittings protected from corrosion by proper Owner approved compounds.

#### 1.6 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with the provision "No Substitutions": Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for "or Equal" or Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article and Section 01300.

#### 1.7 "OR EQUAL" CLAUSE

- A. Specifying an article, material, or piece of equipment by reference to a proprietary product or by using the name of a manufacturer or vendor followed by the clause "or equal" shall be understood to indicate the type, function, minimum standard of design, efficiency, and quality desired and shall not be construed in such a manner as to exclude products of comparable quality, design, and efficiency.
- B. Comparable products shall be capable of performing equal function and shall be compatible with other equipment, materials, or systems to which they connect or will become an integral part of.
- C. The clause "or approved equal" which may appear elsewhere in the documents shall mean the same as "or equal".
- D. Wherever in the documents an article, material, or piece of equipment is defined by specifying a proprietary product or using the name of a manufacturer or vendor the term "or equal" if not included shall be implied.
- E. Substitutions of "or equal" products are subject to approval of the Engineer.

#### 1.8 SUBSTITUTIONS OR ALTERNATIVES

- A. For the purposes of this Specification, Alternatives and Substitutions are the same.

- B. Alternatives are required to be submitted in the Bid Form, Section 2 – Material, Equipment and Environmental Alternatives. Alternatives submitted on that form must follow the provisions herein, and will be evaluated following the Bid opening. (They will not be considered during the Bid process.) Alternatives proposed following the bid will not be considered.
- C. Refer also to Section 01300.
- D. Document each alternative identified on the Bid Form with complete data substantiating compliance of proposed Substitution with Contract Documents.
- E. Each request shall include the credit amount for the alternative. This amount must include all cost adjustments to any other trade as a result of this alternative.
- F. A request constitutes a representation that the Contractor:
  - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - 2. Will provide the same warranty for the Substitution as for the specified Product.
  - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- G. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- H. Substitution Submittal Procedure:
  - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
  - 2. Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Also provide information required by Section 01300 for substitutions. Burden of proof is on proposer.
  - 3. The Engineer will notify Contractor in writing of decision to accept or reject request.

## 1.9 INSTALLATION OF EQUIPMENT

- A. General
  - 1. Contractor shall have on hand sufficient personnel, proper equipment, and machinery of ample capacity to facilitate the work.
  - 2. Contractor shall be responsible for locating, aligning, and leveling all equipment.
  - 3. Complete manufacturer's installation instructions including permissible tolerances shall be furnished with each unit of equipment.
  - 4. All equipment shall be installed in accordance with the approved manufacturer's specifications, drawings, and tolerances under the direct supervision of the required manufacturer's engineer.
  - 5. Equipment shall be erected in a neat and workman-like manner on the foundations at the locations and elevations shown on the drawings unless directed otherwise by the Engineer during installation.

B. Installation

1. Special care shall be used in locating, aligning and, leveling all equipment and parts thereof to insure that each item is in the proper position relative to other equipment and that all parts are aligned within allowable tolerances. The Contractor shall be responsible for this accuracy and shall notify the Engineer of any conditions in prior work which would prevent this alignment before proceeding with the work. The Contractor shall employ a competent surveyor to set all lines and levels of equipment to the accuracy required.
2. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the Contractor. All temporary supports shall be removed except steel wedges and bronze shims which may be left in place with the approval of the Engineer.
3. Each piece of equipment or supporting base bearing on concrete foundations shall be bedded in grout. The Contractor shall provide a minimum of 1-1/2" thick grouting or as indicated on Contract Drawings.

1.10 DAMAGE DURING TESTS AND INSTRUCTION PERIODS

- A. Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and he shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

1.11 SERVICES OF MANUFACTURER'S ENGINEERS

- A. The contract price shall include the cost of furnishing competent engineers or superintendents from each company manufacturing equipment for the Project to:
1. Assist the Contractor to install, adjust, and test the equipment in conformity with the Contract Documents.
  2. Supervise start-up operations and adequately instruct designated employees of the Owner in the proper operation and maintenance procedures when requested by the Owner throughout the guarantee period of the equipment. A report on each visit shall be filed by the manufacturer's representative with the Engineer.

1.12 EQUIPMENT MANUFACTURER CERTIFICATION

- A. The Contractor will provide Engineer with written certification obtained from each company manufacturing equipment for the Project that the equipment is installed and does operate in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION



SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Spare parts and special tools.
- F. Equipment startup services.
- G. Substantial completion.
- H. Warranties.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals.
- B. Section 01500 - Construction Facilities.
- C. Section 01730 - Operation and Maintenance Data.

1.3 SUBMITTALS

- A. As-Built Drawings
- B. Final Change Order
- C. Final Application for Payment, including
  - 1. Waiver of Liens
  - 2. Contractor's Affidavit
  - 3. Contractors Declaration
  - 4. Release of Surety
- D. Manufacturers extended warranties, with the date of Substantial Completion and warranty end date identified
- E. Occupancy Permit (when required)

- F. Confirmation that all submittals were approved, and that no outstanding re-submittals are required
- G. Satisfactory evidence that all claims have been resolved

#### 1.4 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Submit As-Built drawings to Engineer for scanning. Engineer to provide project AutoCAD Record Drawings

#### 1.5 FINAL CLEANING

- A. Complete final cleaning and restoration prior to final project inspection.
- B. Remove all temporary labels, stains and foreign substances. Wash or clean by approved methods all surfaces on which dust and dirt has collected.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Clean debris from drainage systems.
- E. Clean site; sweep paved areas, rake clean landscaped surfaces.
- F. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- G. Restore disturbed area. Lawn area may be seeded unless otherwise noted. Paved area shall be restored to their original condition, compatible with the surrounding area, using like materials and workmanship.
- H. Touchup painted surface. Clean and repaint with matching color all scratched, marred or otherwise damaged painted surfaces of all equipment and enclosures.

#### 1.6 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

#### 1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents:
  - 1. Drawings.
  - 2. Specifications.

3. Addenda.
  4. Change Orders and other modifications to the Contract.
  5. Reviewed Shop Drawings, Product Data, and Samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. As the work progresses, keep a complete and accurate record of all changes in the Contract Documents (including Drawings, Shop Drawings, Product Data, and Specifications) indicating the work as actually installed. All changes shall be neatly shown on blue-line prints of the drawings effected or in the specifications which shall be kept at the job site for inspection by the Owner and the Engineer.
- C. Ensure entries are complete and accurate, enabling future reference by Owner.
- D. Store record documents separate from documents used for construction.
- E. Record information concurrent with construction progress.
- F. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by Addenda, Field Modifications and Change Orders.
- G. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations, slabs, platforms in relation to finish main floor datum.
  2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  3. Measured locations of internal utilities, conduits and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract drawings.
- H. On completion of the work, prior to the Contractor's application for final payment and as a condition to its approval by the Engineer and Owner, the Contractor shall arrange such site records in order in accordance with the various sections of the specifications bind them together and index them and deliver them to the Engineer. In addition the Contractor shall request a complete set of reproducible contract Drawings, and transfer all as-built revisions and changes to them and deliver them to the Engineer. These drawings shall be dated and marked "As-Built".
- I. All reproducible tracings made by the Contractor, equipment manufacturers, and/or material suppliers shall be corrected to show the work as actually completed or installed and a reproducible copy of these drawings shall then be turned over to the Engineer.
- J. Written approval or other evidence satisfactory to the Engineer of the final conditions of the work shall be obtained from:
1. Detroit Edison Company
  2. All public authorities or agencies having jurisdiction over any portion of the work

3. Any others as requested by the Engineer in writing.

K. All public authorities or agencies having jurisdiction over any part of the work shall be determined, and all the requirements of these authorities or agencies with respect to but not limited to inspection, permits, fees, approval, and the like regardless of whether they are listed above or not shall be met.

L. Submit all documents to Engineer for approval prior to submittal of final Application for Payment.

#### 1.8 SPARE PARTS AND SPECIAL TOOLS

##### A. Spare Parts

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and source of supply.
2. Contractor shall also furnish a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished a part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of 1 year at the particular installation.
3. The foregoing shall not relieve the Contractor of any responsibilities under the guarantee provisions of these Specifications.
4. The Contractor shall deliver all spare parts required by this contract to the Engineer or as directed by the Engineer.

#### 1.9 EQUIPMENT START-UP SERVICES

A. Equipment start-up period for the training of plant personnel shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for that part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.

B. During the equipment start-up period, the Contractor shall furnish at no additional cost to the Owner the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:

1. Assist in the start-up and operations of the equipment.
2. Assist in the training of facility personnel, designated by the Owner, in the proper operation and maintenance of the equipment.

C. The Owner shall:

1. Provide the necessary personnel to be instructed in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment.
2. Pay for all fuel, power and chemicals consumed beyond quantities specified or in the Contract Documents or required due to Contractors fault. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.

- D. Contractor shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total facility operation.
- E. In the event a system, equipment, or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the one year guarantee period for the item shall start after satisfactory replacement and testing of the item.

#### 1.10 SUBSTANTIAL COMPLETION

- A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy and utilize the facilities for its intended use.
- B. When the Contractor considers that the Work, or portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Engineer a comprehensive list of items to be completed or corrected. The Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor's list, the Engineer will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Engineer's inspection discloses any item, whether or not included on the Contractor's list, which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Engineer. The Contractor shall then submit a request for another inspection by the Engineer to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Engineer will prepare a Certificate of Substantial Completion which shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

#### 1.11 WARRANTIES

- A. Provide duplicate copies of all extended warranties.
- B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers with a Table of Contents in three D side ring binder with durable plastic cover.
- C. Submit warranty documents prior to final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.
- E. All parts of the work or equipment which is in the opinion of the Engineer prove defective in material, workmanship, or operation within the warranty period shall be removed and replaced or repaired in a manner satisfactory to the Engineer and at no cost to the Owner.

- F. Any service material or equipment required because of the defect shall be supplied without charge.
- G. All work specified to be designed by the Contractor shall be guaranteed to perform as specified.
- H. The Warranty period shall be one year from the date of Substantial Completion unless:
  - 1. A greater period is specified elsewhere.
  - 2. Owner chooses to take over and use a portion of the Work as provided for in the Specifications; in which case the warranty shall be one year from said takeover and use.
- I. Equipment or work replaced and/or repaired during the warranty period shall be guaranteed for one year from the date of acceptance of the repair or replacement or until expiration of the original warranty period whichever comes later.

#### PART 2 PRODUCTS

Not Used.

#### PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Format and content of manuals.
- B. Instruction of Owner's personnel.
- C. Submittals.

1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01400 - Quality Control
- C. Section 01600 - Material and Equipment
- D. Section 01700 - Contract Closeout
- E. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. The Manual must be annotated for this project. Standard manuals are not acceptable. The manufacturer must remove or delete superfluous information, and identify the specific equipment, components, features, arrangements, wiring diagrams etc. supplied for this project.
- C. Complete the O&M Manual Checklist and CMMS data entry sheet with each manual.

1.4 FORMAT

- A. Prepare data in the form of an instructional manual.
- A. Binders: Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers. When multiple binders are used, correlate data into related consistent groupings. Fill binders to no more than 75% capacity.
- B. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; Volume number, General Contractor name and address and Engineer name and address.

- C. Provide tabbed indexes for each separate product and system, with typed description of product and system.
- D. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Arrange content by process flow under section numbers and sequence of Table of Contents of this Project Manual.

#### 1.5 CONTENTS, GENERAL FOR EACH VOLUME

- A. Table of Contents: Provide title of Projects and the names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor in the heading. Next, provide a schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties and Bonds: Bind in copy of each.

#### 1.6 MANUFACTURERS MANUALS FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts with diagrams, charts, capabilities, etc. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, complete nomenclature and model number of replaceable parts, and catalog data or literature with correct model number of equipment noted where literature covers more than one model.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications, either typed or by label machine.
- C. Include color coded wiring diagrams as installed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

- E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions and drawings; and alignment, adjusting, balancing, calibration and checking instructions.
- F. Provide preventive maintenance recommendations servicing and lubrication schedule, and list of lubricants required. Include manufacturer's printed storage and installation instructions with alignment instructions and tolerances.
- G. Include manufacturer's printed operation and maintenance instructions. Provide trouble shooting guide for equipment and system components.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's detailed parts list and parts drawing, illustrations, assembly/disassembly drawings and instructions, and diagrams required for maintenance. Provide a cross reference to all individual component manuals for all parts lists and illustrations provide correct parts numbers. All bearing numbers shall be listed.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed for equipment systems.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams for each equipment system.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage and how to obtain them.
- N. Additional Requirements: As specified in individual Product specification sections.
- O. Provide a listing in Table of Contents for design data, with tabbed indexed and space for insertion of data.

#### 1.7 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. For equipment requiring seasonal operation, perform instructions for other seasons.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
- E. Refer to individual equipment specification section for instruction and training requirements.

1.8 SUBMITTALS

- A. Submit draft manual prior to equipment shipment, principally for off-loading and storage directions
- B. Submit revised manual prior to start-up and training
- C. Revise the manual following training when required
- D. Submit .PDF file for versions. Submit 4 binder copies of the final approved manual

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01800

TRAINING

PART 1 GENERAL

1.1 REQUIREMENTS INCLUDED

- A. Instruct and train Owner's personnel in maintenance and operation of equipment for systems supplied and/or installed under this Contract, including the following items:
  - 1. Pumps.
  - 2. Packaged Control Panel System.
  - 3. System instrumentation.
  - 4. Primary switchgear.
  - 5. Motor control centers.
- B. Incorporate the following maintenance and operation data and training services into the training program:
  - 1. Shop Drawings.
  - 2. Equipment Operation and Maintenance Manuals.
- C. Prepare instruction training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training.

1.2 RELATED REQUIREMENTS

- A. Division 1 - General Requirements including:
  - 1. Section 01300 - Submittals.
  - 2. Section 01310 - Project Schedules.
  - 3. Section 01600 - Material and Equipment.
  - 4. Section 01700 - Contract Close Out.
  - 5. Section 01730 - Operation and Maintenance Data.
- B. Division 11 – Equipment
- C. Division 15 - Mechanical:
- D. Division 16 - Electrical:

1.3 QUALITY ASSURANCE

- A. Preparations of training materials and instruction to be provided shall be performed by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

#### 1.4 SCHEDULE OF CONDUCTING TRAINING

- A. Classroom and field training programs shall be conducted after performance testing begins but prior to substantial completion.
- B. Training programs shall be planned and conducted for:
  - 1. Operations Personnel.
  - 2. Maintenance Personnel.
- C. All scheduling shall be coordinated through the Owner.

#### 1.5 TRAINING FOR MAINTENANCE OF INSTRUMENTATION

- A. Train the Owner's maintenance personnel as follows:
  - 1. Describe the overall function of each instrument and control loop installed under this Contract.
  - 2. Locating the probable source of malfunction in the instrumentation equipment and control loops, determining the symptoms of the trouble, establishing the probable cause and effecting a solution.
  - 3. Taking appropriate, preventive, and corrective maintenance procedures necessary to keep the instrumentation system in proper operating condition, including calibration and testing.
- B. Course materials to be used for training Owner's maintenance personnel shall include pertinent portions of the submittals specified in the Specifications such as loop diagrams, calibration data, trouble-shooting guides and maintenance instructions.
- C. The training program shall not include the time required for system start-up instructions or the field acceptance test.

#### 1.6 TRAINING FOR ELECTRICAL AND MECHANICAL MAINTENANCE

- A. Train the Owner's maintenance personnel as follows:
  - 1. Describe the functions of the equipment installed under this Contract.
  - 2. Component preventive and corrective maintenance activities required to keep unit equipment in good operating conditions.
  - 3. The Contractor shall instruct the personnel in locating the probable source of equipment malfunctions, determining the symptoms of the trouble, establishing the probable cause, and effecting a solution.
- B. Course materials to be used for training Owner's electrical and mechanical maintenance personnel to include pertinent portions of the operation and maintenance manuals as well as alignment tolerances, lubrication schedules, vibration analysis instruction and parameters, trouble-shooting guides and special calibration test and procedures.
- C. Method of training electrical and/or mechanical maintenance personnel shall include the Contractor using the Owner's equipment to demonstrate trouble-shooting, preventive and corrective maintenance procedures.

- D. The field training program shall not include the time required for system start-up instructions or the acceptance test.

#### 1.7 OPERATIONAL TRAINING

- A. Train the Owner's operations personnel as follows:
  - 1. Describe the functions of the equipment installed under this Contract, including how the components of a system are controlled together and what the effects of the control methods are on the system and on other upstream and downstream processes installed under this Contract.
  - 2. Implement start-up and shutdown procedures for each piece of equipment individually, as well as the start-up and shutdown of the systems comprising the equipment. This instruction shall include normal operation, alternative operations, and emergency operations.
  - 3. Understand the functions of the equipment installed under this Contract, describing the individual components and how each component is used in monitoring and/or controlling equipment and/or processes installed under this Contract.
  - 4. Discuss the operating modes possible as a result of the modifications and installations made under this Contract.
  - 5. Locating the probable source of system trouble determining the symptoms, establishing the probable cause, and re-stabilizing system efficiency or systems installed under this contract.
  - 6. Demonstrate necessary precautions for safe operation of the equipment, instrumentation, and control system installed under this Contract.
  - 7. Demonstrate emergency procedures for equipment and systems installed under this Contract.
- B. Course materials to be used for training Owner's operation personnel include pertinent portions of the Operations and Maintenance Manuals, including start-up and shutdown procedures; descriptions of equipment and instrumentation functions and modes of operations, control and monitoring; trouble-shooting instructions and process control instructions.
- C. Methods of training Owner's operations personnel shall include a field training program at the Owner's site consisting of classrooms and hands-on training using the Owner's equipment and systems.
- D. The field training program shall not include the time required for system start-up instructions or the field acceptance test.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

## SECTION 01950

### SPECIAL PROJECT REQUIREMENTS AND SEQUENCE OF CONSTRUCTION

#### PART 1 - GENERAL

##### 1.01 GENERAL

- A. The Contractor shall schedule and arrange his work so that the existing City utilities including the existing sewage lift stations will remain in service, without interruption, until the new pumps, wet well, force main and appurtenances have been completely constructed, installed and tested. Portions of the work will require bypass pumping to maintain uninterrupted capacity.
- B. In general, work on the new facilities may proceed on a schedule established by the Contractor to meet the completion date, agreed to in the Proposal. However, all scheduling shall be subject to the approval of the Owner.
- C. The Contractors' work hours must comply with the work hours allowed by City of Ann Arbor Ordinances.
- D. The Contractor shall be totally responsible for the construction of the project under scheduling conditions outlined herein and any other scheduling which may be necessary. All work shall be completed for the total bid price submitted in the Contractor's proposal. No additional compensation will be allowed for delays in the work necessary to prevent interruption of service whether specifically spelled out in this section or not.
- E. The Contractor shall note the construction site area limitations as they impact storage of excavated and construction materials. The Contractor shall make all necessary provisions for off-site storage as required for his operations. Prior to commencement of site excavation, the contractor shall provide the names and locations of the off-site disposal and storage area to be used for excess excavated materials.
- F. Construction sites are located within existing residential areas. Contractor activities shall take these locations into account and Contractor shall keep the sites, local roads and parking areas clean and free of construction materials, rubbish and tracked soil.

##### 1.02 PROJECT DESCRIPTION

- A. The project involves work at two sanitary lift stations, Astor Lift Station and Franklin Lift Station.
- B. The work at the Astor Lift Station generally consists of the following items of work:
  - 1. Demolition and abandonment of an existing steel can dry pit and conversion of the existing wet well into a duplex submersible lift station facility with a new valve vault, piping and associated mechanical and electrical equipment and item incidental thereto.
  - 2. Limited structural rehabilitation of the existing wet well.
  - 3. Construction of new directionally drilled forcemain to replace the existing forcemain.

4. Bypass pumping and monitoring during the construction of the improvements.
  5. Supply and installation of a packaged natural gas generator for backup emergency power supply.
  6. Site improvements including a new access drive and landscaping improvements.
  7. Miscellaneous items of demolition, construction and restoration.
- C. The work at the Franklin Lift Station generally consists of the following items of work:
1. Demolition and abandonment of an existing steel can dry pit and conversion of the existing wet well into a duplex submersible facility with a new valve vault, piping and associated mechanical and electrical equipment and item incidental thereto.
  2. Limited structural rehabilitation of the existing wet well.
  3. Bypass pumping and monitoring during the construction of the improvements.
  4. Site improvements including a new access drive and landscaping improvements.
  5. Miscellaneous items of demolition, construction and restoration.

### **1.03 COORDINATION**

- A. Prior to commencing any work, temporary construction fencing or barricades shall be installed to protect the planned excavation area. All fencing or barricades shall be removed when final grading and site restoration begins.
- B. A dewatering procedure plan shall be submitted for review. Once this plan is approved, it shall be implemented around the excavation for the Lift Stations and shall be completed to control ground water infiltration. Discharge shall be to existing catch basins or drainage structures provided appropriate erosion control is implemented by the Contractor. Contractor shall make arrangements for temporary electrical service connections to all dewatering pumps. Generators shall not be allowed for the dewatering system.
- C. Prepare the site for construction, as described on the Drawings and in Division 2 of these Specifications.
- D. Install temporary sheet piling, cofferdams, or other approved braced excavation as required for construction of the facilities and protection of adjacent utilities or structures. The chosen method of construction shall be submitted by the Contractor to the Owner for approval. Design calculations, sealed by a Professional Engineer licensed by the State of Michigan, shall be submitted for the proposed braced excavation.
- E. All equipment and facilities shall be tested with clean water prior to being accepted by the Owner. Testing shall be conducted in the presence of the Owner's representative. All equipment and the facilities shall then be cleaned and turned over to the Owner in good working order so the Lift Stations, generators and SCADA system may be made operational and a part of the Owner's Sewerage System.

### **1.04 SPECIAL PROJECT REQUIREMENTS**

- A. Soil and Concrete Testing
1. The Contractor will arrange to have all soil compaction tests and concrete quality control, including concrete compression tests, soil compaction tests, and soil bearing

capacity tests, performed by an independent testing company at the Contractor's cost. Contractor shall provide the name of the proposed testing company for review and approval by the Engineer.

2. Copies of test reports shall be furnished to the Owner and distributed to parties designated by the Owner, including the Contractor.

B. Dust Control

1. The site, haul roads, detour roads, and other public and private roads, driveways and parking lots used by the Contractor must be maintained in a dust free condition during the life of this Contract. The control of the dust shall be accomplished by the application of dust control materials and methods of application as approved and as directed by the Owner. Such dust control materials shall be applied as often as is necessary to control the dust.
2. Should the Contractor be negligent of his duties in providing dust control, the Owner may, with or without notice, cause the same to be done and deduct the cost of such work from any monies due or to become due the Contractor under this contract, but the performance of such work by the Owner, or at his insistence, shall serve in no way to release the contractor from his liability for dust control.
3. Dust Palliative may be any of the following:
  - a. Water, as required.
  - b. Other methods as approved by the Owner.

C. Bypass Pumping

1. The existing lift station capacity must remain via bypass pumping at all times during the construction of the replacement facilities. The Contractor shall provide all temporary piping, pumping etc. as required to complete the new connections while the existing pump station remains in service.
2. Bypass pumping plan submittals for temporary diversion of sewage around each lift station shall be submitted for review. The bypass pumping plan shall include details of the proposed pumps, backup power system, and pumping redundancy in the event of the failure of a lead pump. The plan shall also include details of the remote monitoring dialer system to be provided for the bypass pumping system. Contractor shall be responsible for the entire bypass system including pumps, power, piping, etc. as required for pumping of sewage. The Contractor shall also provide 24 hour/day, 7 days per week monitoring, maintenance and response of the bypass pumping system while it is in operation. The temporary pumping operation shall maintain the gradient in the influent sewer at or below existing high-water levels.
3. Bypass pumping system pump on and off levels shall be coordinated with and approved by City of Ann Arbor staff. Allowable surcharge in the temporary bypass pumping manholes shall be limited to:
  - a. Pump on level shall be no greater than 15 inches above the crown of the existing sewer pipe.
  - b. Alarm level shall be no greater than 18 inches above the crown of the existing sewer pipe.

4. The peak expected flows for each station are:
  - a. Astor Lift Station = 1,100 gpm
  - b. Franklin Lift Station = 400 gpm
  
5. The bypass pumping system shall be provided with a dialer system for remote communication of alarms including pump failure, redundant pump running and high water alarm to the on-call Contractor personnel. City staff shall also be added to the dialer call out list but it is the Contractor's responsibility to promptly respond to all pumping system alarms. Due to the potential for basement flooding, City staff, at the City's discretion, may respond to alarms if not addressed by the Contractor in a timely manner. The Contractor will be held responsible for any costs incurred by the City in response to bypass pumping system alarms.

## **PART 2 - PRODUCTS**

Not used.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. The Contractor shall assume full responsibility for performing the work and scheduling with the Owner for temporary sewage handling, storage, and bypass pumping. The Contractor shall be completely responsible for conducting construction operations to maintain sewage pumping operations throughout the progress of work.
  
- B. The Contractor shall be responsible for the submission of a detailed sequence of construction operations to the Owner within fourteen days from the Notice to Proceed. The contractor shall schedule his or her operations such that the Owner will be afforded a minimum of two weeks to review the submitted detailed sequence of construction operations. Any and all deviation from the submitted sequence of construction must be re-submitted to the Owner for review a minimum of seven working days in advance of scheduling the specific item of work.
  
- C. The Contractor shall prepare the bid based on a thorough and complete understanding of the extent of the multiple phasing of scheduling working operations to complete the work as shown on the Drawings, whether specifically described in this sequence or not. All work shall be performed at no additional cost to the Owner, regardless of alternate construction sequences proposed by the Contractor or determined to be necessary to accomplish the complete equipment removal and installation, in accordance with the project Drawings and Specifications.
  
- D. The Contractor shall conduct work operations and demonstrate adequately in the detailed sequence of construction, that the ability for sanitary sewage pumping shall be maintained.
  
- E. In no case shall the Contractor proceed with any work in uncertainty, and all work to be performed to accomplish the complete equipment removal and installation with any temporary

equipment or handling that may be determined to be necessary, will be at the Contractor's sole cost, risk and responsibility.

- F. This section includes a suggested sequence of construction. This sequence shall not be construed as mandatory, nor shall the Contractor rely on it solely for the basis of determining his or her operations as required to accomplish all of the work as shown on the Drawings or described in the project Specifications. The Contractor shall assume full responsibility for scheduling and performing the work with partial and temporary shutdowns when absolutely necessary, in accordance with the submitted sequence of construction, while having contingency plans to keep pumping systems in operation. Where specifically mentioned, work associated with a particular item may be completed only after prerequisite work items have been completed. Work items which are not dependent on prerequisite items may be completed concurrently with other work items. Other sequences may be proposed by the Contractor and will be reviewed and commented on by the Owner.
- G. New construction or demolition activities associated with the existing lift station may occur as long as there are no impacts to the facilities operations or telemetry/SCADA functionality. Any work shall be reviewed, coordinated and approved by the Owner two weeks in advance of the proposed work. No work shall hinder the Owner's ability to access, operate and maintain the station.

### **3.02 CONSTRUCTION SEQUENCE: FRANKLIN LIFT STATION**

- A. Project phasing will be required with an Initial Construction Phase, Wet Well Construction Phase, Start-up and Testing Phase, Demolition Phase and Restoration / Final Construction Phase, as detailed in this section. All shop drawing approvals must be completed and the material and equipment onsite or in storage prior to commencement of the work.
- B. Initial Construction Phase shall consist of but not be limited to the following portions of work:
  - 1. Perform site clearing and grading, excavation and placement of the temporary earth retaining system(s).
  - 2. Construct new access drive into site.
  - 3. Construct all new below grade items including the valve vault including the bypass pumping connection, below grade pump discharge lines between wet well and vault, new force main tie-in, sump pump line, and other miscellaneous below grade utilities and items.
- C. Wet Well Construction Phase shall consist of but not be limited to the following portions of work:
  - 1. Setup and perform bypass pumping as needed to allow for work in the wet well.
  - 2. Demolish existing wet well top slab, perform structural rehabilitation of wet well structure and perform wet well coating, sealing and curing.
  - 3. Install new pumps, guide rails, discharge piping and related pump appurtenances in the existing wet wells.
  - 4. Install new wet well top slab.
  - 5. Construct new control panel, and perform associated electrical work to power new panel, valve vault and new pumps in the wet well.
  - 6. Complete connections between wet well discharge piping and underground discharge piping.
  - 7. Perform all related work including wet well electrical and controls items.

- D. Startup and Testing Phase shall consist of but not be limited to the following portions of work:
1. Perform preliminary testing and debugging of the new pumping system in-the-dry to the extent possible.
  2. Divert flow back into the existing wet well.
  3. Test the operation of the new system in fully automated mode.
  4. Test the station's ATS and temporary standby power to verify operation in the event of loss of main power.
- E. Demolition Phase shall consist of but not be limited to the following portions of work:
1. Permanent bulkheading of the existing pump suction lines into the station can.
  2. Demolition and removal of existing pumps, plumbing and all equipment from the lower levels of the existing station.
  3. Additional demolition and abandonment work as detailed in the project drawings.
- F. Restoration / Final Construction Phase shall consist of but not be limited to the following portions of work:
1. Final paving of access drive.
  2. Installation of landscape plantings.
  3. Establishment of turf grass.
  4. Punch list work and final project close-out

### **3.03 CONSTRUCTION SEQUENCE ASTOR LIFT STATION**

- A. Project phasing will be required with an Initial Construction Phase, Wet Well Construction Phase, Start-up and Testing Phase, Demolition Phase and Restoration / Final Construction Phase, as detailed in this section. All shop drawing approvals must be completed and the material and equipment onsite or in storage prior to commencement of the work.
- B. Initial Construction Phase shall consist of but not be limited to the following portions of work:
1. Perform site clearing and grading, excavation and placement of the temporary earth retaining system(s).
  2. Construct new access drive into site.
  3. Construct all new below grade items including the valve vault and bypass pumping connection, below grade pump discharge lines between wet well and vault, new force main tie-in, sump pump line, and other miscellaneous below grade utilities and items.
  4. Construct new sanitary forcemain via direction drill including connections to the discharge manhole and all associated traffic control activities.
  5. Install new generator and ATS.
- C. Wet Well Construction Phase shall consist of but not be limited to the following portions of work:
1. Setup and perform bypass pumping as needed to allow for work in the wet well.
  2. Demolish existing wet well top slab, perform structural rehabilitation of wet well structure and perform wet well coating, sealing and curing.
  3. Install new pumps, guide rails, discharge piping and related pump appurtenances in the existing wet wells.
  4. Install new wet well top slab.

5. Construct new control panel, and perform associated electrical work to power new panel, valve vault and new pumps in the wet well.
  6. Complete connections between wet well discharge piping and underground discharge piping.
  7. Perform all related work including wet well electrical and controls items.
- D. Startup and Testing Phase shall consist of but not be limited to the following portions of work:
1. Perform preliminary testing and debugging of the new pumping system in-the-dry to the extent possible.
  2. Divert flow back into the existing wet well.
  3. Test the operation of the new system in fully automated mode.
  4. Startup and test new generator and automatic transfer switch to verify operation in the event of a loss of main power.
- E. Demolition Phase shall consist of but not be limited to the following portions of work:
1. Permanent bulkheading of the existing pump suction lines into the station can.
  2. Demolition and removal of existing pumps, plumbing and all equipment from the lower levels of the existing station.
  3. Additional demolition and abandonment work as detailed in the project drawings.
- F. Restoration / Final Construction Phase shall consist of but not be limited to the following portions of work:
1. Final paving of access drive.
  2. Installation of landscape plantings.
  3. Establishment of turf grass.
  4. Punch list work and Project Close-out

**END OF SECTION**



SECTION 02031

COLOR AUDIO-VIDEO ROUTE SURVEY

PART 1 GENERAL

1.1 GENERAL

- A. The bid item "Audio-Video Route Survey" is included in the proposal to cover the cost of obtaining a record of the existing conditions prior to the start of construction.
- B. The Contractor shall engage the services of a professional electrographer actively engaged in color audio-video recordings of projects similar to the work included under this Contract.
- C. The firm performing this work shall have the equipment and experience necessary to produce a digital color audio-video recording of the prescribed quality, meeting all of the requirements specified herein.
- D. The Engineer may require the video taping of a "sample" route to verify the ability of the electrographer to perform the work.
- E. All digital recordings and written records shall become the property of the Owner. The firm performing this work shall also provide one complete copy of all DVD discs and written records to the Engineer.
- F. Complete coverage shall 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 descriptions made simultaneously with video coverage. Such coverage shall include but not be limited to all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culverts, mail boxes, headwalls, and retaining walls, or buildings located within such zone of influence.
- G. Coverage shall include the entire project area impacted by construction and any portions of streets to be used by the Contractor as access roads and/or haul roads.
- H. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall not be less than twelve (12) feet to insure proper perspective.
- I. In some instances, audio-video coverage will be required in areas not accessible by conventional wheeled vehicles. Such coverage shall be obtained by walking or special conveyance approved by the Owner.
- J. All recording must be made using digital equipment, full color audio-video DVD discs. One complete copy of DVD discs and written records shall be provided to the Owner prior to commencing construction on this project.

- K. Digital audio-video discs (DVD) shall be Sony, Panasonic, J.V.C or equal on DVD discs suitable for recording and play-back on computer DVD ROM players and conventional DVD players utilizing DVD R format.
- L. Buildings shall be identified by street number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, locations shall be identified by audio or visual means at intervals not-to-exceed 100 lineal feet in the general direction of travel.
- M. The rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 30 feet/minute. Panning rates and zoom-in, zoom-out rates shall be controlled sufficiently such that stop-action during play-back will produce clarity of detail in the object viewed.
- N. All recording shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than 10% of the ground area is covered with snow or standing water, unless otherwise authorized by the Owner.
- O. Any recorded coverage not acceptable to the Owner shall be rerecorded at no additional charge.
- P. The Owner shall have the authority to designate areas for which coverage may be added or omitted and this shall be considered as incidental to the Contract.
- Q. All DVD discs shall be properly identified as to location, time and date in a manner acceptable to the Owner.
- R. A record of the contents of each DVD disc shall be supplied by a sheet identifying each segment in the DVD disc by location, disc number, disc time, starting point, traveling direction and ending point.
- S. The recording shall be done prior to placement of materials or equipment on the construction area and the DVD disc and record of contents must be furnished one week prior to the start of construction.
- T. To preclude the possibility of tampering or editing in any manner, all video recordings, must, by electronic means, display continuously and simultaneously generated transparent digital information to include the date and time of recording, as well as the corresponding engineering stationing numbers. The date information will contain the month, day and year; for example 10/5/96 and be placed directly below the time information. The time information shall consist of hours, minutes and seconds, separated by colons. For example 10:53:18. This transparent information will appear on the extreme upper left-hand third of the screen.
- U. The engineering stationing numbers must be continuous, accurate and correspond to the project stationing and must include the standard engineering symbols. For example 14+84. This transparent information will appear on the extreme area covered, direction of travel, viewing side, etc.

- V. Below the engineering station, periodic transparent alpha/numeric information will appear. This information will consist of the name of the project, name of area covered, direction of travel, viewing side, etc.
- W. Digital audio-video discs must be originally recorded with minimum horizontal resolution of 480 lines. Reprocessed DVD discs will not be acceptable.
- X. In order to produce the proper detail and perspective, artificial lighting will be required where it is necessary to fill in shadow areas caused by trees, utility poles, road signs, or other such objects.

1.2 BASIS OF PAYMENT

- A. Payment shall be by "Lump Sum" based on construction zones as identified on the construction plans.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

Not Applicable

END OF SECTION



SECTION 02050  
DEMOLITION WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building/concrete structure demolition.
- B. Selective demolition of building elements for alterations purposes.
- C. Selective demolition of mechanical equipment.
- D. Selective demolition of electrical equipment.
- E. Abandonment and removal of existing utilities and utility structures.
- F. Salvage of existing items to be reused or delivered to Owner.

1.2 RELATED REQUIREMENTS

- A. Section 02030 Sequence of Construction
- B. Division 15000 Mechanical
- C. Division 16000 Electrical.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- C. NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities, current edition.

1.4 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

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- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01300 - Administrative Requirements, and the General and Supplementary Conditions.
- B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of Owner's operations. Sequence shall be compatible with overall work sequence of construction.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
- B. The Michigan Building Code shall control the demolition, modification or alteration of the existing buildings or structures.

1.7 PROJECT CONDITIONS

- A. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- B. Protection. Erect and maintain barriers, lights and other protective devices to prevent access to areas under construction or within the influence of the ongoing work. Provide free and safe passage to and from adjacent structures which are being used by the Owner for ongoing operations of the treatment plant.
- C. The Owner and ENGINEER assume no responsibility for the actual condition of the structures/equipment to be demolished or modified. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition work.
- D. Repairs to Damage. Promptly repair damage caused to adjacent facilities by demolition operation when directed by the ENGINEER at no cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to construction.
- E. The Contractor shall be responsible for the testing, handling, removal, storage and disposal of any materials suspected to contain lead or asbestos. All testing, handling, removal, storage and disposal of lead or asbestos materials shall be performed in a manner that meets all Federal, state and local laws and regulations. The cost for testing for the presence of lead or asbestos containing materials, monitoring for permissible exposure limits during construction, and abatement shall be included in the Total Contract Lump Sum Price. The Contractor shall be completely responsible for environmental mitigation and the safety and protection of all labor forces and Owner(s) personnel due to means and methods chosen that may exacerbate

harmful lead or asbestos conditions, such as torch-cutting painted surfaces and other standard demolition practices.

#### 1.8 CONTRACTOR'S SUPERVISION

- A. Contractor's responsibility shall include a completely equipped first aid kit, provided and maintained at the site in a clean orderly condition and shall be readily accessible at all times to all the Contractor's employees.
- B. The Contractor shall designate certain employees who are properly instructed to be in charge of first aid. At least one such employee shall be available whenever work is in progress at the demolition site.
- C. Telephone call lists for summoning aids from outside sources, such as doctors, ambulances, and rescue squads, shall be conspicuously posted at the site.

#### 1.9 WARRANTY

- A. Existing Warranties: 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

NOT USED

### PART 3 EXECUTION

#### 3.1 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Comply with applicable requirements of NFPA 241.
  - 3. Use of explosives is not permitted.
  - 4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 5. Provide, erect, and maintain temporary barriers and security devices.
  - 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 8. Do not close or obstruct roadways or sidewalks without permit.
  - 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

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- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Transport items to Owner's storage area on-site.
  - 3. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
  - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
  - 2. Protect items from damage during transport and storage.
  - 3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Protect existing structures and other elements that are not to be removed.
  - 1. Provide bracing and shoring.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
  - 4. No jackhammering or other destructive methods of construction shall be used in areas where adjacent facilities which are to remain and which may be damaged by such operations exist unless approved prior by ENGINEER.
- F. Partial Removal of Paving, Concrete structures and Curbs: Neatly saw cut at right angle to surface.

3.2 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

### 3.3 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Engineer before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
  - 4. When general items are noted for demolition, it is assumed that appurtenances and incidental items associated with the general item should also be demolished and removed.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction where required.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage. Prevent freezing temperatures from occurring in areas of the settling basins which are in use while work is ongoing. Maintain a minimum temperature of 40F in all areas where are being used by the City for plant operations or higher temperature if necessary to operate remaining equipment.
- D. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on drawings. Where piping or electrical lines are removed back to a functioning point, cut/cap/properly terminate the remaining functioning component.
  - 2. When pipes, conduits other equipment are removed, all fasteners for that equipment shall also be removed and all holes/damage to the existing structures from which the equipment was attached shall be filled and repaired with like materials.
- E. Mechanical/Electrical (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  - 3. Verify that abandoned services serve only abandoned facilities before removal.
  - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
  - 5. Where vents or other pipes/conduits that are to be removed pass through an existing roof/floor/wall that is to remain, the resulting hole in the roof/floor/wall shall be patched and made watertight to match the existing materials.

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6. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation and to maintain the integrity of the grounding systems.
7. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed and disposed of off-site as required. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitably plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site.

F. Protect existing work to remain.

1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Patch as specified for patching new work.

G. Building/Structure demolition.

1. Demolish concrete and masonry in small sections.
2. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.
3. Remove structures to the lines and grades shown unless otherwise directed by the ENGINEER. Where no limits are shown, the limits shall be 4-inch outside the item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the Contractor.
4. After removal of parts of all of walls, slabs and like work which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

3.4 DEBRIS AND WASTE REMOVAL

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an approved landfill.
- B. Do not allow demolished materials to accumulate on-site.
- C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- D. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- E. Leave site in clean condition, ready for subsequent work.
- F. Clean up spillage and wind-blown debris from public and private lands.

3.5 CLEANING

- A. The Contractor shall clean existing surfaces as required to perform the Work including tanks, wells, channels, floors, walls, etc.
- B. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

3.6 SALVAGE SCHEDULE

- A. Existing Items to Be Removed by the Contractor and Salvaged to the Owner:
  - 1. Astor Station
    - a. Dehumidifier(s) in station can.
    - b. Sump pump(s) in station can
  - 2. Franklin Station
    - a. Dehumidifier(s) in station can.
    - b. Sump pump(s) in station can
    - c. Existing A-C sewage pumps and motors

These items are to be carefully salvaged and turned over to the Owner.

- B. The Owner will also select, remove and salvage specific small items prior to the commencement of the Contractors demolition as noted on the DRAWINGS.
- C. The Owner will select and identify additional specific items to be removed and salvaged by the Contractor to the Owner prior to the commencement of the Contractors demolition.

END OF SECTION

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SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of surface debris.
- B. Removal of paving, curbs, and gravel roadway materials, as required.
- C. Removal of trees, shrubs, and other plant life, including root system.
- D. Topsoil excavation and stockpiling.

1.2 RELATED SECTIONS

- A. Section 01005 - Administrative Provisions
- B. Section 02200 – Earthwork
- C. Section 02220 - Soil Erosion Control
- D. Section 02958 - Special Landscape Requirements for Site

1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable code for disposal of debris.
- B. Coordinate clearing Work with utility companies.

1.4 SITE INFORMATION

- A. The Contractor shall be held to have compared the conditions of the site where work is to be performed with the drawings and specifications and to have satisfied himself as to the conditions of the site, existing conditions, and any other conditions affecting the carrying out of the work, before delivery of his proposal. It is expressly understood that he will obtain first hand information concerning the available facilities for receiving, transporting, handling and storing construction equipment and materials and concerning other local conditions that may affect his work.
- B. The contractor shall draw his own conclusions as to soil conditions, including possible presence of groundwater, to be encountered, and he shall complete the work under any job or field condition which was present and/or ascertainable prior to bidding.
- C. He shall also complete the work under whatever conditions he may create by his own sequence of construction, construction methods, or other condition he may create at no additional cost to the Owner.

- D. No allowance or extra consideration on behalf of the Contractor will subsequently be allowed by reason of error or oversight on the part of the Contractor.

## PART 2 PRODUCTS

Not Used.

## PART 3 EXECUTION

### 3.1 WORK INCLUDED

- A. The work included under this section consists of providing all labor, equipment and services to execute all items of clearing, demolition, soil erosion control and removal as shown on the drawings, including all incidental work obviously required to effect complete work to the full intent of the drawings and specifications.

### 3.2 PREPARATION

- A. Verify that existing plant life designated to remain is tagged or identified.
- B. Identify the waste area for disposing of removed materials off site.

### 3.3 PROTECTION

- A. Locate, identify and protect utilities that remain, from damage.
- B. Protect trees, plant growth, and features designated to remain as final landscaping.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.

### 3.4 CLEARING

- A. Clear areas required for access to site and execution of Work, as shown on the Contract Drawings.
- B. Remove trees and shrubs as indicated. Remove stumps, roots, and other debris to depths indicated on the Drawings and in Section 02958 of these Specifications.
- C. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Remove topsoil and grass as indicated.

### 3.5 REMOVAL

- A. Remove debris, rock and extracted plant life from site, and dispose of in accordance with all Federal, State and Local Ordinances.

- B. Removing paving, curbs, and gravel base, as required, and dispose of off site. Neatly saw cut edges at right angle to surface.
- C. Do not burn any waste material.
- D. All combustible materials resulting from the clearing and grubbing operations shall be removed promptly from the site to a solid waste disposal site properly licensed under the latest revision, Act 87 of the Public Acts of 1965 of the State of Michigan. No open burning of debris or rubbish will be permitted at the site.

3.6 TOPSOIL EXCAVATION

- A. Excavate or strip topsoil from cleared areas without mixing with foreign or underlying materials.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site or off site as approved by the Engineer; construct piles to drain freely, and protect from erosion.
- D. Remove excess topsoil not intended for reuse from site.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 GENERAL

1.1 GENERAL

- A. All dewatering, well pointing, pumping, bailing and cleaning shall be performed that is necessary to complete the work as specified and as shown on the Drawings under this Contract.
- B. The Contractor will be held to have compared the conditions of the site where work is to be performed with the Drawings and Specifications and to have satisfied himself as to the conditions of the site, existing conditions, and any other conditions affecting the carrying out of the work, before delivery of his proposal. It is expressly understood that he will obtain first hand information concerning the available facilities for receiving, transporting, handling and storing construction equipment and materials and concerning other local conditions that may affect his work.
- C. The Contractor shall draw his own conclusions as to soil and groundwater conditions to be encountered and he shall complete the work under any job or field condition which was present and/or ascertainable prior to bidding.
- D. He shall also complete the work under whatever conditions he may create by his own sequence of construction, construction methods, or other condition he may create at no additional cost to the Owner.
- E. The Contractor shall be solely responsible for evaluating the suitability of his dewatering methods with the Plans, Specifications and Soil Information provided by the Owner for bidding purposes. The Contractor shall also obtain County records as to the depth of wells providing water to the community or private individuals within the area affected by the dewatering operation if this information is not included in the Contract Plans or Specifications. The Contractor shall be prepared to supply potable water within forty-eight (48) hours to all parties affected by the dewatering operations and shall continue supplying water for a period of thirty (30) days after ceasing dewatering operations. All costs associated with the supplying of water shall be incidental to the work as bid.  
  
If the affected parties remain without water thirty (30) days after ceasing dewatering operations, the supplying of water and resolution of the problem will be addressed by the Owner of this project.
- F. No allowance or extra consideration on behalf of the Contractor will subsequently be allowed by reason of error or oversight on the part of the Contractor.
- G. All work shall be done in a thorough and workmanlike manner and in conformance with accepted good practices and all requirements of local, state, and federal authorities having jurisdiction.

- H. The requirements of the Soil Erosion Control Permit and the Wetlands Permit shall be adhered to at all times.

## 1.2 RELATED SECTIONS

- A. Section 01000 - General Specifications
- B. Section 01900 - Soil Conditions and Boring Logs
- C. Section 02221 - Soil Erosion Control and Sedimentation Control

## PART 2 PRODUCTS

Not Used.

## PART 3 EXECUTION

### 3.1 REMOVAL OF WATER

- A. Ample means and devices shall be provided and maintained at all times during the life of this Contract to remove and properly dispose of all ground water and drainage water within, around, and entering the excavated area. The excavation and the structures within shall be kept dry until the work is completed, or as approved by the Owner.
- B. The water level within and below work areas shall be so maintained that there is no unbalanced upward pressure on the bottom of structures, sewers, or open excavations during the construction period. The Contractor shall provide means within the excavation to enable the Owner to monitor the elevation of the artesian groundwater, if present. The level of the artesian groundwater shall be maintained by the Contractor's methods to prevent the possibility of upward movement of the structure or earth within the excavation area. Water levels shall be maintained to meet the approval of the Owner.
- C. In addition, water that may occur during excavation for base slabs, pipe trenches, etc., shall be channeled to accumulate in certain low points and disposed of through a filtering device before entering into sewers, streams, or rivers in accordance with Section 02221 – Soil Erosion and Sedimentation Control, the Soil Erosion Control Permit, and as specified by the MDNR.
- D. The Contractor shall determine the extent of dewatering required to complete the work, and shall include all dewatering costs as incidental to the work as bid, unless provided otherwise in the Proposal.

All excavation dewatering shall be routed as necessary so as not to impede construction. In any event, all pumping and drainage shall be done without damage to any other property, public or private, and without interference with the rights of the public or private property owners. The Contractor shall review soil information provided under Section 01900 - Soil Conditions and Boring Logs. This information may be used as an aid to the Contractor in determining the screen material necessary for well points or relief wells to prevent the removal

of soil fines with the water removed. All pumping and drainage shall comply with Section 02221 - Soil Erosion and Sedimentation Control and with the requirements of the Soil Erosion Control Permit.

- E. The Contractor shall receive no extra compensation for providing, maintaining or operating any dewatering or drainage facilities. The removal or stoppage of artesian water which, if any, might occur in the work shall be deemed to be covered by this Section of the Specifications unless provided for otherwise in the Proposal.
- F. On completion of this project the Contractor shall fill all dewatering depressions and withdraw all dewatering facilities and drainage devices and restore the area to an acceptable condition, as approved by the Owner.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General
- B. Site Preparation
- C. Excavations
- D. Unauthorized Excavation
- E. Subgrade
- F. Slopes, Sheeting and Bracing
- G. Backfill
- H. Flowable Fill
- I. Finish Grading

1.2 RELATED SECTIONS

- A. Section 00700 - General Conditions
- B. Section 01400 - Quality Control
- C. Section 01500 - Construction Facilities
- D. Section 01900 - Soil Conditions and Boring Logs
- E. Section 02110 - Site Clearing
- F. Section 02140 - Dewatering
- G. Section 02220 - Soil Erosion Control

1.3 GENERAL

- A. All excavation and backfilling shall be performed that is necessary to complete the work under this Contract. Excavation shall include the loosening, loading, removing, transporting, stockpiling, and disposing of all materials of every sort, necessary to be removed for purposes of construction; the furnishing, placing, and maintaining of all sheeting, bracing, and timbering; the care of existing roads, existing structures, utilities; and all incidental and

collateral work necessary to complete the entire work as specified and as shown on the Drawings.

- B. Backfilling shall include the filling of the excavated and void spaces around and over the outside of completed structures and pipes. It is also the intention of these specifications to provide that backfill shall be so compacted that no appreciable subsequent settlement will occur, and so that sidewalks, driveways, roads and berms may be placed or replaced shortly after completion of backfilling.
- C. The Contractor will be held to have compared the conditions of the site where work is to be performed with the drawings and specifications and to have satisfied himself as to the conditions of the site, existing conditions, and any other conditions affecting the carrying out of the work, before delivery of his proposal. It is expressly understood that he will obtain first hand information concerning the available facilities for receiving, transporting, handling and storing construction equipment and materials and concerning other local conditions that may affect his work.
- D. The Contractor shall draw his own conclusions as to soil and/or rock conditions to be encountered, and he shall complete the work under any job or field condition which was present and/or ascertainable prior to bidding.
- E. He shall also complete the work under whatever conditions he may create by his own sequence of construction, construction methods, or other condition he may create at no additional cost to the Owner.
- F. The Contractor shall be responsible for evaluating the compatibility of his construction methods with the Plans, Specifications and Soil Information provided by the Owner for bidding purposes.
- G. No allowance or extra consideration on behalf of the Contractor will subsequently be allowed by reason of error or oversight on the part of the Contractor.
- H. This contractor shall grade all areas within his work area and provide slopes, shoulders, berms, and level surfaces defined according to existing and established grades.
- I. Care shall be taken to retain, at all times, normal flow of drainage water on the property and all present above ground and underground utilities.
- J. All work shall be done in a thorough and workmanlike manner and in conformance with accepted good practices and all requirements of local, state, and federal authorities having jurisdiction.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to applicable state and local codes for disposal of excavated materials judged not suitable for backfill.
- B. Obtain disposal permit from Local Enforcing Agency.

1.5 QUALITY ASSURANCE

- A. Comply with all code, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.
- B. Backfill materials shall be compacted to not less than specified percentage of optimum dry density as determined by ASTM D 698.
- C. Testing of backfill material will be done in accordance with ASTM D 2922, ASTM D 1556, and ASTM D 3017.
- D. Unsuitably compacted backfill materials shall be removed and recompacted.

1.6 SITE CONDITIONS

- A. Provide and maintain barricades, warning lights, warning signs, and other protection required by applicable laws for safety of persons and property.
- B. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent earth movement.
- C. Notify Owner of unexpected subsurface conditions and discontinue affected work area until notified to resume work.

1.7 HAZARDOUS/CONTAMINATED MATERIAL

- A. The following indicators shall be used by Owner onsite observers during excavation to identify materials suspected of being hazardous or contaminated and requiring disposal in a Type I or Type II landfill.
  - 1. Materials other than general construction debris of a color not consistent with the natural soils observed in the area;
  - 2. Materials other than general construction debris of a consistency that is not consistent with the natural soils observed in the area;
  - 3. Man-made containers, vessels, tanks, or barrels;
  - 4. Electric devices;
  - 5. Insulation or fibrous material that may contain asbestos;
  - 6. Material that emits a chemical or petroleum odor.

Based on these observations, materials in question shall be stockpiled separately, inspected, and representative samples should be collected and screened in the field. Materials should be stored on plastic sheeting at the predesignated, secure location on the parcel or an adjacent parcel and covered with plastic sheeting until disposal is determined.

- B. Potentially hazardous materials should be screened in the field by qualified personnel for the presence of volatile organic compounds (VOC) using a photoionization (PI) meter. It is assumed that the presence of VOCs should provide a general indicator of the presence of other potentially hazardous chemicals.

Materials to be subjected to further laboratory analysis should be selected based on the results of the field screening and observations made by the person monitoring the excavation.

- C. Based on the field screening and laboratory analysis, the Contractor will be advised by the Owner as to the required method of disposal.
- D. The Owner will be responsible for testing of hazardous/contaminated material.
- E. Refer to Section 00700 - General Conditions, Section No. 50 for additional requirements.

## PART 2 PRODUCTS

### 2.1 BACKFILL

- A. All material necessary to complete the backfill as shown on the drawings or to replace excavated unsuitable material shall be furnished by the Contractor. Backfill at the structures, unless otherwise indicated on the Drawings, backfill replacing unsuitable material, backfill under gravel or stone and paved roads, shall all be granular material conforming to Michigan Department of Transportation (MDOT) Granular Materials Class II. If suitable material for backfilling is not available on site then suitable material shall be brought in from an off-site borrow pit by the Contractor at no additional cost to the Owner.
- B. The Owner shall have the right to reject any backfill material which when used in the work, does not accomplish the required compaction.
- C. All backfill material shall be free from large or frozen lumps, concrete rubble, clay, sod, wood, debris, and other extraneous material.

### 2.2 FLOWABLE FILL

- A. Where called for on the Drawings certain areas of the excavation and areas of existing structures shall be backfilled with flowable fill.
- B. Flowable fill shall consist of a mixture of fly ash, cement and water such as "C-Fill" as manufactured by Clawson Concrete or "M-Crete" as manufactured by Michigan Foundation or equal.
- C. Cement shall be Portland Cement conforming to A.S.T.M. C 150 Type I. Air entrained cement, pozzolan, and other types of cement shall not be used. Fly ash shall conform to the requirements of A.S.T.M. C618, Class F. Water shall be potable.
- D. The stabilized fly ash mixture shall contain 4 to 5% Portland cement based on the dry weight of the fly ash. Occasional batches of mixture with a cement content of 3-4% will be allowed provided immediate action is taken to restore the cement content to the specified range. Mixtures containing less than 3% shall not be used. The mixture shall have a slump of 10 to 12 inches at the point of placement. The mix temperature shall not be lower than 50°. The mixture shall have a compressive strength of 100 psi minimum at 28 days.
- E. The method used to measure fly ash and cement shall be submitted for acceptance. The contractor's proposed method shall be one that compliments the type of mixing plant being used and provides assurance that the percentage of cement is being satisfactorily controlled. Cement content shall be based on the dry weight of the fly ash in the mix. The batched weight

of fly ash shall be corrected for its moisture content. Water shall be measured, although its control will be a function of consistency (slump and workability) of the mix.

- F. The flowable fill may be mixed by a pug mill, central concrete mixer, turbine mixer or other acceptable equipment or method. Provisions shall be made to maintain the mix temperatures and slump as stated.
- G. The material shall be placed by end or side dumping, tremie, pump, conveyors, or other suitable method. Lines and grades shall be as shown on the design drawings. Stabilized fly ash shall be protected from freezing temperatures for the initial 24 hours after placement. Protection may consist of earth cover, straw, or a sacrificial layer of the stabilized fly ash mix.

### PART 3 EXECUTION

#### 3.1 EXCAVATIONS

- A. The Contractor shall make all excavation necessary for the construction of all work called for by the drawings or specified herein.
- B. Excavations shall be made to the line and grade shown on the drawings including removal of unsuitable soils from under structures or roads, or as required to meet MIOSHA regulations. Side slopes of unbraced excavations shall be such as to prevent slides which might injure the work. The Contractor shall conduct his excavation and other operations in such a manner as to ensure that the bed for footings and foundations remains free from rutting, trampling, or other undue disturbance. The beds for footings and foundations shall be true to grade and free of all loose material before any concrete is put in place. All unauthorized excavation below grade of any structure shall be backfilled with concrete to the proper grade at the Contractor's expense. The Contractor shall make all necessary fills to bring grade to finished grade shown on the drawings. Fills and cuts shall be graded to a uniform, smooth, and even grade to grades as shown on the Drawings to meet Owner's approval. Existing underground utilities that are to remain in place shall be protected and any damage caused by excavating shall be made good.
- C. Control the grading in the vicinity of excavated areas so that the surface of the ground will be properly sloped to prevent water from running into the excavated areas. Such areas shall be kept reasonably dry at all times. Accumulated water in the excavated areas shall be removed by pumping.
- D. Broken concrete or rubbish unsuitable for backfill shall be disposed of by the Contractor. Borrow material shall be graded in such a way that surface water will continue to drain in a manner similar to the drainage patterns present before filling occurred. Broken concrete and rubbish shall be disposed of off-site.

#### 3.2 UNAUTHORIZED EXCAVATIONS

- A. Whenever the excavation is carried beyond the lines and grades established by the drawings or as approved by the Owner, the Contractor shall, at his own expense, fill all such excavated space with an approved material and in such a manner as to meet the approval of the Owner.

- B. Unauthorized excavation beneath structures shall be filled with plain concrete, or flowable fill as determined by the Owner.

### 3.3 SUBGRADE

- A. The subgrade for all structures shall be prepared so as to have as near as practicable a uniform density throughout the entire area. The subgrade shall be compacted to 95% maximum density at optimum moisture content as specified in AASHTO-180 or by Michigan Cone density, whichever is greater, by rolling or by other approved methods. After being prepared, the subgrade shall be maintained until concrete has been placed thereon.
- B. If, through neglect or delay on the part of the Contractor, the earth at subgrade elevation becomes unsuitable for the support of the work to be constructed thereon, the Contractor shall excavate down to solid earth, and shall backfill to the required subgrade elevation with plain concrete, compacted sand, or other suitable material as required to meet the Owner's approval. Unstable subgrade soil under all concrete foundations shall be replaced with plain concrete.
- C. All subgrades shall be approved by the Engineer before proceeding with backfilling and compaction, landscaping, or other construction work.
- D. Subgrades shall be level and clean of all loose rock, dirt, and debris and free of standing water prior to placing concrete.

### 3.4 SLOPES, SHEETING, AND BRACING

- A. All slopes shall be cut and maintained to the proper degree required for stability. Sheeting and bracing shall be placed and maintained as indicated and/or whenever required for safety to men and the work. The degree of slope for all excavations shall be fixed by the Contractor, and shall comply with all State and Federal safety requirements.
- B. The Contractor shall provide, install, and maintain all shoring, sheet piling, and bracing required to maintain banks of excavations and other construction, and assume full responsibility for same. The design of all shoring systems shall be performed by an Engineer registered in the State of Michigan utilizing loading diagrams as provided in Section 1900 of the Specifications. The shoring system design computations shall be sealed by the Engineer who prepared them and forwarded to the Owner for review.
- C. Sheeting, bracing and timbering shall be so placed as to allow the work to be constructed to the lines and grades shown on the drawings.

Size and placing of members shall be subject to review by the Owner but the design of members and safety of the excavation shall be the responsibility of the Contractor.

Exact areas to be sheet piled and final weight of sheet piling shall be determined by the Contractor unless otherwise indicated for permanent sheet piling. Actual quantity and location of all sheet piling required for this project shall be determined by the Contractor.

- D. The Contractor's Vibration Consultant will develop a detailed vibration monitoring program for the site. The Vibration Consultant will install down hole vibration monitoring geophones

for the purposes of monitoring during vibration inducing but not limited to the operations including braced excavation installation. Geophones shall be connected with wireless technology to an on-site monitoring station provided by the vibration consultant and located within the limits of the project. The contractor shall protect the monitoring station for the duration of the project.

E. Vibration Action Limits:

1. When vibration readings exceed 1.0 in. / sec. peak particle velocity (ppv), the Contractor must temporarily suspend operations. The Contractor and the Engineer will inspect the site for signs of settlement or damage. The Contractor shall resume operations only after it has been verified by the Engineer that the adjacent utilities have not been damaged or adversely impacted by construction activities. Should the Engineer determine that ground vibration levels exceeding 1.0 in. / sec. ppv present a risk to adjacent utilities, the Contractor shall submit a Corrective Action Plan (CAP) outlining proposed changes to means and methods such that vibration levels shall be reduced to acceptable levels and adjacent utilities are protected at all times. An acceptable level shall be 1.0 in. / sec. ppv.
2. When vibration readings exceed 2.0 in. / sec. ppv or when damage to existing utilities is detected, the Contractor must cease all operations pending a review of field conditions by the Engineer. Changes to means and methods will be required. The Contractor shall submit a CAP outlining proposed changes to means and methods such that vibration levels shall be reduced to acceptable levels and adjacent utilities are protected at all times. An acceptable level shall be 1.0 in. / sec. ppv or less or some greater value less than 2.0 in. / sec. ppv as determined by the Engineer.

F. The Corrective Action Plan (CAP) shall be developed by the Contractor and shall identify any necessary changes in equipment or procedures associated with but not limited to the installation of braced excavation. The Contractor shall not be granted additional expenses or additional time for shut down associated with preparation of the CAP including time required for review and approval of the cap by the Engineer and / or representatives of the Owner. The Contractor shall not be granted additional expenses associated with changes to means and methods as identified in the approved CAP including changing equipment, materials, or means of demolition, installation, or construction. The Contractor cannot resume operations until the cap is approved and the contractor is instructed to do so by the Engineer.

G. The Contractor shall select hammer or hammers to be used on sheet piling based on length, weight, type of pile, and depth of penetration and submit data on the hammer selected to the Owner for review. Braced excavation installation shall be by impact hammer. Double-acting hammers may be used on sheet piling. The use of a vibratory hammer shall not be permitted.

Approximate weight of hammer shall be 2-1/2 times the weight of a sheet of piling to be driven.

H. Sheet piling shall be driven to depths and lengths required by the Contractor unless otherwise indicated for permanent sheet piling. Level measurements, utilizing previously specified bench marks, shall also be made at existing structures, in the presence of the Owner's designated representative, during all driving of sheet piling to record any change in the level of present structures or utilities caused by the Contractor's Operations.

- I. Permanent sheet piling where indicated on the drawings shall be of weight, area and depth shown on the drawings and shall remain in place.
- J. Temporary sheet piling may not be withdrawn from any area until concrete within the zone influenced by vibrations set up by withdrawal operations, has attained its 28 day design strength.
- K. If the sheeting and bracing cannot be removed without detriment to the finished structure or existing structures, then the sheeting and bracing shall be left in place temporarily or permanently as the Owner shall approve. Sheeting and bracing left in place permanently shall be cut off at the required level so as not to interfere with subsequent construction. The cost of materials left in place less the eliminated expense of removal work shall be paid as an extra. No extra payment shall be allowed for the cost of placing the material.
- L. All bracing used shall be so arranged as to place no stress on any portion of the completed work until such work shall have developed sufficient strength, as determined by the Owner. Any damage to any structures occurring through settlements, water or earth pressure, slides, cave-ins, or other causes shall be repaired by the Contractor at his own expense.

All materials used for earth bracing or support shall be structurally sound, uniform in quality, and adequate in size and strength for the use intended.

### 3.5 BACKFILL AND COMPACTION

- A. It is the intent of these Specifications that backfill shall be so placed and consolidated that no appreciable subsequent settlement will occur.
- B. Backfill shall be placed in uniform layers not exceeding 12 inches in depth when measured loose and each layer shall be thoroughly compacted by tamping, sheepsfoot-roller, mechanical vibrators, or by other effective means approved by the Owner. All backfill in all areas shall be compacted to at least 95% of maximum density, at optimum moisture content as specified in MDOT Standard Specifications for Construction Controlled Density Method. Compaction by flooding will not be permitted.  
  
The Owner shall have the right to reject any backfill material which when used in the work, does not accomplish the required compaction.
- C. The Contractor shall furnish all necessary assistance and test pits as required for the Contractor to conduct compaction density tests.
- D. No backfill material shall be placed on areas where free water is standing or on frozen subsoil areas.
- E. Clean areas and excavations to be backfilled of all trash and debris before placement of backfill. In placing backfill, take special care to prevent any wedge action, eccentric loading, damage, or overloading of any adjacent structures, piping, and equipment by equipment used in compacting backfill material.
- F. Heavy equipment for spreading and compacting fill and backfill shall not be operated closer to a wall than a distance equal to the height of the fill or backfill to be placed. Power-driven

hand operated equipment shall be used against walls and where space limits the use of heavy equipment.

- G. All excavations around the walls and other foundations, etc., shall be backfilled to meet Owner approval after all work has been inspected and approved. Backfill shall not be placed against walls until all supporting slabs are in place and have attained their design strength or as indicated on the structural drawings.
- H. If compaction tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to the Owner.
- I. Porous stone filters shall be furnished and installed where shown on the Drawings. Stone filters shall be encased in a drainage geotextile fabric as specified in Section 02202 of these specifications.

### 3.6 FINISH GRADING

- A. The Contractor shall grade the entire site as indicated on the drawings to a smooth and even grade, meeting existing grades and/or the grades indicated on the drawings.
- B. Excavated material suitable and approved for backfilling shall be stored on the site in areas approved by the Owner. Reusable topsoil that is displaced shall also be stored on the site in separate area from the backfill.
- C. Finish grade under gravel road areas and under paved areas shall be limited to 1/2 inch in 10 feet from true profile, and shall be maintained until succeeding layer or surface course is placed.
- D. Finish grading shall slope uniformly to contour lines shown on the Drawings, and to meet existing adjacent levels. The Contractor shall grade all areas within his work site and provide slopes, shoulders, berms, and level surfaces defined according to existing and established grades. The work shall also include all adjacent areas disturbed by construction and as required by new pavement installation.
- E. The subgrade for all slabs and pavements shall be prepared so as to have as near as practicable a uniform density throughout the entire area. The subgrade shall be compacted to 95% maximum density at optimum moisture content, as specified under BACKFILL AND COMPACTION herein, by rolling or by other approved methods. After being prepared, the subgrade shall be maintained until concrete or pavement has been placed thereon.
- F. If, through neglect or delay on the part of the Contractor, the earth at subgrade elevation becomes unsuitable for the support of the work to be constructed thereon, the Contractor shall excavate down to solid earth, and shall backfill to the required subgrade elevation with plain concrete, or other suitable material as required to meet the Owner's approval.

Soil found to be unstable in the subgrade shall, when required to meet the Owner's approval, be excavated to firm soil and replaced with MDOT Granular Material, Class II, as specified above thoroughly compacted. Subgrade area supporting structures shall have unstable material replaced with Owner approved concrete.

G. Refer to Section 02958 - Special Landscaping Requirement for Site.

3.7 INSTALLATION OF PERIMETER DRAINS

A. Install at locations where drains are shown on Contract Drawings.

B. Install aggregate and filter cloth as shown on details on Contract Drawings.

C. Compact aggregate as specified and complete filter cloth installation prior to completion of backfill.

END OF SECTION

## SECTION 02221

### SOIL EROSION AND SEDIMENT CONTROL

#### PART 1 GENERAL

The purpose of this specification is to provide certain requirements, techniques and measures to minimize erosion damage to the construction site. In general, the contractor shall conduct his operations in such a manner as to limit any exposed area or any disturbed land for the shortest practicable period of time and any sediment caused by soil erosion due to his operations shall be restricted and reduced to a non-polluting minimum before it leaves the site.

#### 1.1 TEMPORARY SEDIMENT CONTROL

- A. The Contractor shall construct the sediment filter in the outlet drain in order to provide for erosion control, before any construction begins. Ground water from the excavation shall be directed through the settling basin.
- B. Burlap silt traps shall be placed between all catch basin, and inlet frames and covers, and also stubs, during construction, and until contributing disturbed areas are permanently stabilized. During the growing season, the area within a 10' radius of the catch basin shall be stabilized with sod within 5 days of the installation of the structure. During the non-growing season, a sediment pit (12" to 18" deep) shall be excavated around the structure to be backfilled and replaced with a 10' radius of sod upon commencement of the next growing season.
- C. It shall be the Contractor's responsibility to maintain both the sediment filter, settling basin and burlap silt traps and remove all trapped sediment periodically throughout the time of construction in such a manner that there will be adequate solids storage volume upstream of these devices. In addition, the Contractor shall, at the completion of construction and when directed by the Owner, remove said devices and all trapped sediment.

#### 1.2 EROSION PROTECTION

- A. In order to limit the length of time that the exposed area is subject to the elements and the subsequent conditions causing erosion, the contractor shall adhere to the following requirement:
- B. The stabilization of disturbed areas shall begin within fifteen (15) days of date that area has been rough graded and shall be completed within the next fifteen (15) days, in accordance with the following temporary or permanent stabilization.

#### 1.3 TEMPORARY STABILIZATION

- A. Temporary stabilization shall be required for all disturbed areas during the following periods:
- B. Temporary stabilization shall be provided during the non-growing season for all areas to be sodded. This time period is generally from October 20 through May 1.

- C. Temporary stabilization shall be provided during the non-growing season for all areas to be seeded. This time period is generally from October 1 through April 20. (If unseasonably warm weather exists after October 1, seeding may be permitted).
- D. If for any reason Permanent Stabilization cannot be provided within 15 days of the completion of final grading operations, temporary stabilization shall be provided for all disturbed areas.
- E. On all disturbed areas, provide either small grain straw (preferably wheat) or grass hay spread at the rate of 1-1/2 to 2 tons per acre or wood chips spread at a rate of 6 to 9 tons per acre. Mulch shall be anchored in place to prevent it from being blown or washed away.
- F. It shall be the contractor's responsibility to provide Permanent Stabilization as soon as practicable.
- G. Temporary stabilization shall be repeated when and as often as required by the Engineer or Owner.

#### 1.4 PERMANENT STABILIZATION

- A. All areas which have been temporarily stabilized shall be permanently stabilized immediately upon commencement of next seasonal planting period. All straw or hay shall be removed or deeply incorporated into the soil.
- B. Sodding
  1. Lawn areas disturbed by excavation or other contractor's operation shall be repaired as follows:
  2. Backfill to be suitably excavated material mechanically compacted in 12 inch layers to prevent settlement.
  3. The area to be sodded shall be made smooth and shall be covered with not less than 2 inches of approved top soil uniformly spread over the scarified ground surface.
  4. Lawn to be replaced with sod matching the existing blue grass, or with Grade A Kentucky Blue Sod. Sod shall be not less than 1 inch thick, cut in strips not less than 1/2 sq. yd. in area. Sod shall be moist and shall be laid in a moist earth bed. Pegs shall be used where required to hold the sod in place and in areas where the slope exceeds one foot vertical to two feet horizontal.
  5. It shall be the contractor's responsibility for the establishment of the sod growth regardless of weather conditions.
  6. Sod may be laid between May 1 and October 20.
- C. Seeding
  1. All vegetated areas other than lawn areas disturbed by the contractor's operation shall be restored as follows:
  2. Backfill to be suitable excavated material mechanically compacted in 12 inch layers to prevent settlement.
  3. The area to be seeded shall be made smooth and shall be covered with not less than 4 inches of approved top soil uniformly spread over the scarified ground surface.
  4. Fertilize (phosphate free fertilizer only) all areas with 12-12-12 applied at a rate of 400 lbs./acre.

5. Ditch slopes and bottom shall be seeded with MDOT "Roadside Mix" Section 8.21.09 applied at a rate in accordance with MDOT Table 8.21-1. All other areas shall be seeded with MDOT Class A applied at a rate in accordance with MDOT table 8.21-1.
6. Immediately after seeding, all areas shall be mulched with unweathered small grain straw or hay applied at the rate of 2 tons/acre.
7. Mulch shall be anchored in place to prevent it from being blown or washed away.
8. It shall be the contractor's responsibility for the establishment of the seed growth regardless of weather conditions.
9. Seed may be sown between April 20 and October 1.

1.5 ENFORCEMENT

- A. Should the requirements of the preceding sections be violated, the Owner shall require the contractor to cease all other operations and to apply his forces to meet these requirements.

1.6 BASIS OF PAYMENT

- A. All costs associated with above stated requirements shall be included in the unit prices bid.



SECTION 02530

CONCRETE CURB AND GUTTER

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. This work shall consist of constructing portland cement concrete curb, gutter or combination curb and gutter, with or without steel reinforcement as provided on a prepared base.
- B. The construction shall follow the construction of concrete base course or concrete pavement but shall be in advance of the construction of non-rigid types of pavement or base course.
- C. The materials and construction shall be as specified in MDOT Specification Section 6.09.

1.2 SUBGRADE

- A. The subgrade shall be prepared in accordance with Specification Section 02200, Earthwork, and shall be maintained as prepared, true to the required grade and cross section, until the concrete has been placed thereon.

1.3 FORMS

- A. Forms shall be of metal, straight and free from distortion, and of sufficient strength to resist springing during the process of depositing concrete against them. They shall be of an approved section with a flat surface on top. Wood forms may be used on sharp turns and for special sections when approved by the Engineer. The forms shall be of the full depth of the structure and shall be so construct as to permit the inside forms to be securely fastened to the outside form. Face and back forms will be required when constructing straight curb, and back forms with templates of the required curb shape shall be used when constructing roll curb. Approved flexible forms will be required where the radius to the back of curb is less than 200 feet.
- B. Forms shall be well built, substantial and unyielding. They shall be securely staked and braced to the required line and grade, and sufficiently tight to prevent the leakage of mortar. The forms shall be thoroughly cleaned and oiled with a light clear paraffin oil which will not stain the concrete.
- C. No concrete shall be placed until the subgrade and forms have been approved by the Engineer. The subgrade shall be wetted and the concrete deposited to the proper depth. The concrete shall be spaded sufficiently to eliminate all voids, after which it shall be finished smooth and even by means of a float.
- D. The placing and finishing of concrete curb and gutter by the use of a mechanical curb and gutter paver will be permitted, provided the required cross section and finish is obtained. Should the use of such mechanical paver produce curb or curb and gutter having an unsatisfactory cross section or finish, the use of such machine shall be discontinued and the

construction shall be done as otherwise required by these Specifications. All unsatisfactory work shall be removed and replaced as directed by the Owner at no cost to the Owner.

#### 1.4 REINFORCEMENT

- A. When steel reinforcement or tie bars are called for on the plans, the bars shall be properly spaced and held in the correct position during the placing of concrete by the use of bar chairs or other approved devices. Bars shall be lapped at least 10 inches unless otherwise shown on the Plans.

#### 1.5 JOINTS

- A. Joints shall be constructed with their faces perpendicular to the surfaces of the structure, and shall not vary more than 1/4 of an inch from their true designated position.
- B. The concrete at the faces of all joints shall be thoroughly spaded and compacted to fill all voids and all exposed surfaces shall be finished smooth and true to grade.

#### 1.6 EXPANSION JOINTS

- A. Expansion joints of 1 inch thickness shall be placed through the curb, or gutter, or combination curb and gutter, at the springline of all street returns and elsewhere as shown on the plans.
- B. The expansion joint material shall be precut so as to conform to the geometric shape and cross sectional area of the structure. The joint filler shall extend to the full depth of the joint and the top shall be flush with the finished surface of the structure. No reinforcing steel shall extend through an expansion joint.

#### 1.7 PLANE OF WEAKNESS JOINTS

- A. Plane of weakness joints shall be placed through the structure at a uniform interval of 10 feet unless otherwise directed by the Engineer. No curb or curb and gutter section shall be less than 5 feet in length.
- B. Plane of weakness joints shall be formed by steel templates 1/8 inch in thickness, shaped to conform to the required cross section of the structure, which shall not extend below the top of the steel reinforcement or which shall be notched to permit the steel reinforcement to be continuous through the joint. The templates shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

#### 1.8 CONSTRUCTION JOINTS

- A. Construction joints shall be placed at the end of each day's pour, unless the pour ends at an expansion joint.
- B. Construction joints shall be formed by steel templates 1/8 inch in thickness, shaped to conform to the required cross section of the structure. The templates shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place. No reinforcing steel shall extend through the construction joint.

### 1.9 FINISHING

- A. The edges of the gutter, the back top edge of the curb and all transverse joints shall be rounded with an approved finishing tool having a radius of 1/4 inch. The face of the curb, at the top and bottom, shall be rounded with approved finishing tools having the radii shown on the plans.
- B. The exposed surfaces of the concrete curb, gutter, or combination curb and gutter, shall be finished smooth and even by means of a moistened wooden float or other means having the approval of the Engineer. The finished surfaces shall not vary more than 1/8 inch in 10 feet from the established grade. Neat cement or mortar shall not be used to facilitate the finishing of surfaces.
- C. Immediately after the forms are removed, all visible areas of honeycomb and minor defects shall be filled with mortar, composed of one part portland cement and two parts fine aggregate from the same sources as used in the structure, applied with a wooden float. Immediate steps shall be taken by the Contractor to correct the conditions contributing to these defects.

### 1.10 CURING

- A. After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the concrete shall be completely coated and sealed with a uniform layer of white membranous curing compound. The compound shall be applied in one or two applications as directed by the Engineer. When the compound is applied in two increments, the second application shall follow the first application within 30 minutes.
- B. The compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at the rate directed by the Engineer, but not less than one gallon per 200 square feet of surface. 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.
- C. If the compound is too thick for satisfactory application during cold weather, the material may be warmed in a water bath at temperatures not over 100 deg. F. Thinning with solvents will not be permitted.

### 1.11 DAMAGED SURFACES

- A. 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 equal in curing value to that specified for the original coat. The treated surface shall be protected by the Contractor from injury for a period of at least 7 days. Immediately after the forms are removed, the entire area of the sides of the curb shall be coated with the curing compound.
- B. The Contractor shall provide on the project sufficient burlap or cotton coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. If hair checking develops before the curing compound can be applied, the procedure as specified herein shall be modified in that preliminary curing with wetted burlap or cotton coverings, as specified under the general requirements for curing, shall be performed before curing compound is applied.

1.12 BACKFILLING

- A. After the concrete has sufficiently cured, the curb, gutter or combination curb and gutter, shall be backfilled to the required elevation with approved material, which shall be compacted and left in a neat and workmanlike condition.

1.13 MEASUREMENT AND PAYMENT

- A. Concrete curb, gutter and curb and gutter will be measured in place, by length in lineal feet, along the base of the curb face or along the flow line of the gutter, with no deductions in length for catch basins or inlet castings.
- B. "Concrete Curb," "Concrete Gutter," and "Concrete Curb and Gutter," will be paid for at the contract unit price per lineal foot, which price shall be payment in full for furnishing the materials, including steel reinforcement, where called for on the plans, and for performing the work complete as herein specified.
- C. "Concrete Driveway Opening, Detail M" will be measured in linear feet from springline to springline.
- D. Gapping required to accommodate local traffic will not be paid for separately unless provided for elsewhere in the plans or proposal.
- E. No additional compensation or increase in pay quantities will be considered if the contractor elects to use a mechanical paver. If directed by the Owner, curbing cast monolithically with concrete pavement will be measured and paid for as being part of the adjacent concrete pavement.

END OF SECTION

SECTION 02840

SIDEWALKS

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**1. GENERAL**

This work shall consist of constructing portland cement concrete sidewalk on a prepared base as shown on the plans or as directed. The prepared base shall be defined as the subgrade of the proposed sidewalk section to be constructed. The prepared base shall utilize on site excavated materials, excluding peat, muck, marl, blue or grey clay or other organic materials, or as otherwise specified. Backfilling and final restoration will be part of constructing sidewalks, unless otherwise provided.

**2. CONCRETE**

Concrete shall contain a minimum cement content of 564 pounds per cubic yard with a maximum slump of three inches (3”) and a minimum 28 day compressive strength of 3500 psi, and shall contain between 4.5% and 6.5% entrained air. No fly ash additives will be permitted.

**3. PREPARATION OF BASE**

Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a minimum of 95% of ASTM D-1557 on a uniform surface conforming to the section as shown on the plans. All soft and yielding material, exposed roots and vegetation shall be removed and replaced with MDOT granular material, Class III, compacted to a minimum of 95% of maximum density utilizing ASTM D-1557.

**4. FORMS**

Forms shall be of wood or metal, straight and free from warp, former buildup and debris, and of sufficient strength to resist springing during the process of depositing concrete against them. The forms shall be the full depth of the concrete.

Forms shall be placed in such a manner as to provide a smooth and continuous edge of walk, free of deflections.

The side forms shall be firmly staked to the required line and grade and shall provide for a minimum transverse slope of 1/4" per foot and a maximum slope of 1/2" per foot, toward the street, unless otherwise provided.

## **5. PLACING AND FINISHING CONCRETE**

The sub-base shall be moist and the concrete shall be deposited thereon to the depth specified on the plans or in the proposal. In no case shall the walk be less than 4" thick in pedestrian areas and 6" thick in vehicle and sidewalk ramp areas. The concrete shall be thoroughly spaded along the faces of the forms before finishing operations are begun. The concrete shall be struck off to the required grade and cross section. Except where not feasible to measure because of vertical curves, the surface tolerance of the path will be measured using a 10 foot straight edge at selected locations. The variation of the surface from the testing edge of the straight edge between any two contacts with the surface shall at no point exceed 1/8". The transverse tolerance will be the same. The surface shall be floated just enough to produce a smooth surface free from irregularities. All edges and joints shall be rounded to a radius of 1/4 inch with an approved finishing tool. The surface shall then be broomed to slightly roughen the surface and remove the finishing tool marks. The Contractor shall take extreme care to prevent overfilling of the forms.

The utilization of slip form equipment to place sidewalks is permitted. The Contractor shall furnish a copy of the list of equipment to be utilized, previous experience, and references to assist the Owner in determining that satisfactory results have been previously achieved by the Contractor. All sidewalk placed utilizing the slip form method shall meet all the provisions of the specification pertaining to finishing, jointing, base preparation, curing, protection, backfilling and ramping, as well as Section 6.11 of MDOT Standard Specifications for Construction. All costs incurred by the Contractor to provide a stable track area for the slip form equipment to operate shall be incidental to the unit prices bid for the sidewalk's construction.

## **6. JOINTS**

Joints shall be constructed true to line with their faces perpendicular to the 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, unless otherwise required. Transverse joints shall be placed at an equal spacing throughout the entire length of the project. The spacing shall be determined to be equal to the sidewalk's width, i.e., a four foot wide walk would have transverse joints at four foot on center, five foot wide walk would have transverse joints at five foot on centers, etc. In no case shall a single sidewalk flag exceed a maximum of eight feet by eight feet.

## **7. TRANSVERSE EXPANSION JOINTS**

Transverse expansion joints 1/2 inch wide and extending the full depth of the pour shall be placed through the sidewalk at uniform intervals of not more than 50 feet. The top of the joint filler shall be slightly below the finished grade.

## **8. LONGITUDINAL EXPANSION JOINTS**

Longitudinal expansion joints 1/2 inch wide and extending the full depth of the pour shall be placed between the sidewalk and back of abutting parallel curb and between the sidewalk and driveways and buildings or other rigid structures.

All expansion joints adjacent to buildings or rigid structures shall be sealed with a hot poured rubber sealant to a depth 1" below top of walk.

## **9. CONTRACTION JOINTS**

Contraction joints shall be placed at uniform intervals (normally 5 feet) between expansion joints. They shall be constructed with a double edger having a radius not exceeding 1/4 inch.

## **10. CURING AND PROTECTION**

After the finishing operations have been completed and immediately after the free water has left the surface, it shall be thoroughly coated and sealed with a uniform layer of white membranous curing compound applied with a pressure sprayer.

All freshly laid concrete shall be protected against damage by erecting suitable barricades with battery operated flashers for a minimum of seven (7) days unless otherwise provided, except that foot traffic may be permitted after 48 hours. All normal precautions shall be observed to prevent damage from rain, hot or cold weather, and debris.

## **11. REMOVING FORMS AND BACKFILLING**

After the concrete has gained sufficient strength, the side forms shall be removed and the space on both sides shall be backfilled with approved sound earth. The backfill shall be compacted and leveled to meet established grades with excess material removed from the construction site. Backfilling will not be paid for separately unless provided for by other contract items.

## **12. SIDEWALK RAMPS**

Ramps shall be constructed at locations as shown on the plans or as directed.

Sidewalk ramp slopes shall be uniform and free of sags and short grade changes. The slope shall be as required to meet sidewalk grades with the maximum desirable slope being 3/4 inch per foot and the maximum allowable slope being 1 inch per foot.

Where gutters are replaced in conjunction with sidewalk ramps, the gutter shall be constructed to the same dimensions and profile as the existing gutter, unless otherwise provided. The normal gutter line profile shall be maintained through the area of the ramp.

Sidewalks shall be ramped where the driveway curb is extended across the walk.

The surface of sidewalk ramps shall be textured with a coarse broom transversely to the ramp slope.

The top of the joint filler for all ramps shall be flush with adjacent concrete.

END OF SECTION

SECTION 02929

SEEDING

PART 1 GENERAL

1.1 SUMMARY OF WORK

- A. Provide a dense stand of turf grass free from weeds. Extent of seeded lawns is shown on drawings and by provisions of this section.
- B. Types of work required include the following:
  - 1. Soil preparation
  - 2. Top Soil installation and fine grading
  - 3. Seeding (Hydroseeding, Slit seeding, Drill seeding, Broadcast seeding)

1.2 RELATED WORK

- A. Related work specified elsewhere:
  - 1. Section 02200: Site Preparation and Earthwork
  - 2. Section 02950: Trees, Plants and Ground Covers
  - 3. Section 02970: Landscape Maintenance and Guarantee Standards

1.3 QUALITY ASSURANCE

- A. Seeding Subcontractor shall have a minimum 5 years experience with hydroseeding and related work.

1.4 SUBMITTALS

- A. Submit certification of grass seed from seed vendor for each grass seed mixture.
- B. Manufacturer's certification of fertilizer.
- C. Hydroseeder's certification of experience.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver seed in original sealed, labeled and undamaged containers.

1.6 PROJECT CONDITIONS

- A. Work notifications: Notify Engineer at least 7 working days prior to start of seeding operation.
- B. Protect existing utilities, paving and other facilities from damage caused by seeding operations.

- C. Perform seeding work only after planting and other work affecting ground surface has been completed.
- D. Restrict traffic from lawn areas until grass is well established. Erect signs and barriers as required.
- E. Provide all equipment, labor, materials needed or as required (water, fertilizer, and other provisions) to promote and establish lawn areas.

## 1.7 WARRANTY

- A. All seeding shall be warranted for a period of 1 year following acceptance

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Grass Seed:
  - 1. Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' - Rules for Testing Seeds - for purity and germination tolerances.
  - 2. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated below:  
  
Turf grass:
    - 20% Chewing Fescue
    - 20% Creeping Red Fescue
    - 40% Turf-type perennial Ryegrass-2 varieties
    - 20% Kentucky Bluegrass
- B. Fertilizer:
  - 1. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.
  - 2. Type A: Starter fertilizer containing 15% nitrogen, 0% phosphoric acid and 15% potash by weight or similar approved composition.
- C. Ground limestone: Containing not less than 85% of total carbonates and ground to such fineness that 50% will pass through a 100 mesh sieve and 90% will pass through a 20 mesh sieve. Use if determined by soil tests to be necessary.
- D. Water: Free of substance harmful to grass seed and grass growth. Hoses or other methods of transportation furnished by Contractor.
- E. Topsoil
  - 1. Topsoil shall be fertile, friable and representative of productive soil, capable of sustaining vigorous plant growth and shall be free of clay lumps, sub-soil, weeds, seeds and other foreign debris.
  - 2. Acidity range shall be between pH 5.0 and 7.5.

3. Organic content shall be not less than 5% and not greater than 30%.
4. Clay content shall range between 5% and 15%.

## 2.2 EXECUTION

## 2.3 EXAMINATION

- A. Examine finish surfaces, grades, topsoil quality and depth. Do not start seeding work until unsatisfactory conditions are corrected.

## 2.4 PREPARATION

- A. Limit preparation to areas which will be immediately seeded. Spread topsoil, fine grade.
- B. Scarify surface of lawn areas to minimum depth of 3". Remove stones over 1" in any dimension and sticks, roots, rubbish and extraneous matter.
- C. Apply 3" minimum topsoil to entire area to be seeded.
- D. Grade lawn areas to smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake; remove ridges and fill depressions as required to drain.
- E. Apply limestone, if required by soil test results, at rate determined by the soil test, to adjust pH of topsoil to not less than 6.0 nor more than 6.8. Distribute evenly by machine and incorporate thoroughly into topsoil.
- F. Apply Type A fertilizer at the rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. (43 lbs./acre). Apply fertilizer by mechanical rotary or drop type distributor, thoroughly and evenly incorporated with the soil to depth of 1" by disking or other approved methods. Fertilize areas inaccessible to power equipment with hand tools and incorporate it into soil.
- G. Dampen dry soil prior to seeding.
- H. Restore prepared area to specified condition if eroded, settled or otherwise disturbed after fine grading and prior to seeding.

## 2.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
- B. Mix slurry with nonasphaltic tackifier.
- C. Apply slurry uniformly to all areas to be seeded in a 1-step process. Apply mulch at the minimum rate of 1500 lb per acre (16.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.
- D. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb per acre (5.5 kg per 100 sq. m) dry weight but not

less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb per acre (11 kg per 100 sq. m).

2.6 MAINTENANCE

- A. Proper maintenance shall be performed to adequately establish seed

2.7 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris and equipment. Repair damage resulting from seeding operations.

END OF SECTION

SECTION 02930

GENERAL LANDSCAPE MATERIALS AND FINAL GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Handling and installation of existing top soil materials.
- B. Supply and installation of additional top soil materials.
- C. Final grading of topsoil for finish landscaping.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control
- B. Section 02200 – Earthwork
- C. Section 02220 - Soil Erosion Control
- D. Section 02958 – Special Landscaping Materials for Site

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil, as provided by the Contractor, shall meet the following requirements:
- B. Topsoil shall be fertile, friable and representative of productive soil, capable of sustaining vigorous plant growth and shall be free of clay lumps, sub-soil, weeds, seeds and other foreign debris.
- C. Acidity range shall be between pH 5.0 and 7.5.
- D. Organic content shall be not less than 5% and not greater than 30%.
- E. Clay content shall range between 5% and 25%.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify building and trench backfilling have been inspected.
- B. Verify subsoil has been contoured and compacted.

### 3.2 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove and replace subsoil contaminated with petroleum products.
- C. Scarify surface to a depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

### 3.3 PLACING TOPSOIL

- A. Place topsoil in areas as designated on the Contract Drawings, Thickness shall be as called for on the Contract Drawings. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to existing plant life, buildings and other above grade appurtenances to prevent damage.
- E. Compact placed topsoil as called for on the Contract Drawing.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping, on both the facility site and remote storage site.

### 3.4 TOLERANCES

- A. Top of Topsoil: Plus or minus 1/2 inch or as called for in Section 02958.

### 3.5 PROTECTION

- A. Protect landscaping and other features remaining as final work.
- B. Protect all other structures, utilities, paving and other above grade appurtenances.

END OF SECTION

SECTION 02934

SODDING

PART 1 GENERAL

1.1 SUMMARY OF WORK

- A. Provide a dense stand of turf grass free from weeds. Extent of sodded lawns is shown on drawings and by provisions of this section.

1.2 DESCRIPTION

- A. Provide sodded lawns as shown and specified. The work includes:
  - 1. Soil Preparation
  - 2. Sodding Lawns

1.3 RELATED WORK

- A. Related work specified elsewhere:
  - Section 02200: Site Preparation and Earthwork
  - 1. Section 02950: Trees, Plants and Ground Covers
  - 2. Section 02970: Landscape Maintenance and Guarantee Standards

1.4 QUALITY ASSURANCE

- A. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.
- B. Provide and pay for materials testing. Testing agency shall be acceptable to the Architect. Provide the following data:
  - 1. Test representative materials samples proposed for use.
  - 2. Topsoil:
    - a. pH factor
    - b. Cation Exchange Capacity
    - c. Mechanical Analysis
    - d. Percentage of organic content
    - e. Recommendations on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

1.5 SUBMITTALS

- A. Submit sod growers certification of grass species. Identify source location.
- B. Submit materials test report.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cut, deliver, and install sod within a 24-hour period.
  - 1. Do not harvest or transport sod when moisture content may adversely affect sod survival.
  - 2. Protect sod from sun, wind, and dehydration prior to installation.
  - 3. Do not tear, stretch, or drop sod during handling and installation.

1.7 PROJECT CONDITIONS

- A. Work notification: Notify Architect at least 7 working days prior to start of sodding operations.
- B. Protect existing utilities, paving, and other facilities from damage caused by sodding operations. Contractor shall be responsible for any damage to utilities and existing facilities.
- C. Perform sodding work only after planting and other work affecting ground surface has been completed.
- D. The irrigation system will be installed prior to sodding. Locate, protect, and maintain the irrigation system during sodding operations. Repair irrigation system components damaged during sodding operations at this Contractor's expense.

1.8 WARRANTY

- A. Refer to Landscape Maintenance and Guarantee Standards in Section 02970.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sod: An "approved" nursery grown blend of improved turf type tall fescus and rye grass varieties.
  - 1. Sod containing Common Bermudagrass, Quackgrass, Johnsongrass, Poison Ivy, Nutsedge, Nimblewill, Canada Thistle, Timothy, Bentgrass, Wild Garlic, Ground Ivy, Perennial Sorrel, or Bramegrass weeds will not be acceptable.
- B. Provide well-rooted, healthy sod, free of diseases, nematodes and soil borne insects. Provide sod uniform in color, leaf texture, density, and free of weeds, undesirable grasses, stones, roots, thatch, and extraneous material; viable and capable of growth and development when planted.
  - 1. Furnish sod machine stripped and of Supplier's standard width, length, and thickness: Uniformly 1" to 1-1/2" thick with clean cut edges. Mow sod before stripping.
- C. Fertilizer
  - 1. Granular, non-burning product composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.
  - 2. Starter fertilizer containing 12% nitrogen, 0% phosphoric acid, and 15% potash by weight, or similar approved composition.

- D. Water: Free of substance harmful to sod growth. Hoses or other methods of transportation furnished by Contractor.

### PART 3 EXECUTION

#### 3.1 INSPECTION

- A. Examine finish surfaces, grades, topsoil quality, and depth. Do not start sodding work until unsatisfactory conditions are corrected.

#### 3.2 PREPARATION

- A. Limit preparation to areas which will be immediately sodded.
- B. Loosen topsoil of lawn areas to minimum depth of 4". Remove stones over 1/2" in any dimension and sticks, roots, rubbish, and extraneous matter.
- C. Grade lawn areas to smooth, free draining and even surface with a loose, uniformly fine texture. Roll and rake; remove ridges and fill depressions as required to drain.
- D. Apply soil amendments at rate determined by the soil test, to adjust pH of topsoil to not less than 6.0 nor more than 6.8. Distribute evenly by machine and incorporate thoroughly into topsoil.
- E. Apply Type A fertilizer at the rate equal to 1.0 lb. of actual nitrogen per 1,000 sft (220 lbs./acre). Apply fertilizer by mechanical rotary or drop type distributor, thoroughly and evenly incorporated with the soil to a depth of 3" by discing or other approved methods. Fertilize areas inaccessible to power equipment with hand tools and incorporate it into soil.
- F. Dampen dry soil prior to sodding.
- G. Restore prepared areas to specified condition if eroded, settled, or otherwise disturbed after fine grading and prior to sodding.

#### 3.3 INSTALLATION

- A. Sodding
  1. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints in adjacent courses. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.
  2. Do not lay dormant sod or install sod on saturated or frozen soil.
  3. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and lightly against previously installed row. Offset subsequent rows by 1/2 length of sod strip to break up sod strip joints.
  4. Water sod thoroughly with a fine spray immediately after laying.
  5. Roll with light lawn roller to ensure contact with sub-grade.

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6. Sod indicated areas within contract limits and areas adjoining contract limits disturbed as a result of construction operations.

3.4 MAINTENANCE

- A. Refer to Section 02970: Landscape Maintenance and Guarantee Standards.
  1. Apply Type A fertilizer to lawns approximately 30 days after sodding at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sft (140 lbs./acre). Apply with a mechanical rotary or drop type distributor. Thoroughly water into soil.
  2. Remove sod pegs.

3.5 ACCEPTANCE

- A. Refer to Section 02970: Landscape Maintenance and Guarantee Standards.

3.6 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from sodding operations.

END OF SECTION

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SECTION 02950

TREES, PLANTS, AND GROUND COVER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preparation of subsoil and topsoil.
- B. Topsoil bedding.
- C. New installation and Relocation of trees, plants, and ground cover.
- D. Mulch and fertilizer.
- E. Maintenance.

1.2 RELATED SECTIONS

- A. Section 02200 – Earthwork.
- B. Section 02211 - Rough Grading.
- C. Section 02930 – General Landscape Materials and Final Grading.
- D. Section 02958 - Special Landscaping Requirements.

1.3 MAINTENANCE DATA

- A. Submit under provisions of Section 01300.

1.4 QUALITY ASSURANCE

- A. Certification: - The contractor shall be responsible for all certificates of inspection of plant materials required by Federal, State or other authorities. Copies of these certificates shall be filed with the Owner.
- B. Selection: - All trees and shrubs required by contract shall be tagged at the source prior to digging and shipment.
- C. It shall be the contractor's responsibility to see that this is done, and to notify the Owner of the location(s) of such material prior to digging.
- D. The Owner will have the option to inspect all material at the source, regardless of location, and to reject any plants that do not meet with his approval.

### 1.5 QUALIFICATIONS

- A. Nursery: Company specializing in growing and cultivating the plants with five years documented experience.
- B. Installer: Company specializing in installing and planting the plants with five years documented experience and approved by nursery.
- C. Maintenance Services: Performed by installer under the provisions of these specifications.

### 1.6 REGULATORY REQUIREMENTS

- A. Comply with regulatory agencies for fertilizer composition.
- B. Provide certificate of compliance from all authorities having jurisdiction indicating approval of plants and fertilizer mixture.
- C. Plant Materials: Certified by federal and state department of agriculture to be free of disease or hazardous insects.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Protect plants until planted.
- D. Deliver plant life materials immediately prior to placement. Keep plants moist until planting.
- E. All shrubs shall be bound and secured by twine to protect against broken branches. Twine shall be removed after planting.

### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees F or above 90 degrees F.
- B. Do not install plants when wind velocity exceeds 30 mph.

### 1.9 COORDINATION

- A. Coordinate work under provisions of Section 01039.

### 1.10 WARRANTY

- A. The contractor shall guarantee that all plants are true to botanical name and that the quality and size meet specifications, as are required herein.

- B. The contractor shall fully guarantee that all plants are in a vigorous growing condition during and at the end of the guarantee period. The guarantee period shall expire one (1) year from the date of acceptance by the Owner.
- C. The contractor shall replace plants that do not meet these specifications or ones that have lost their natural shape due to dead branches excessive pruning, or inadequate or improper contractor maintenance. All plants rejected shall be removed from the site and legally disposed of by the contractor at no additional cost to the Owner.
- D. Replacement plants and planting operations shall be in accordance with the original specifications. All costs for such replacements shall be considered to be included in the bid price. Replacement planting shall be completed no later than the next succeeding planting season. All replacement plants shall be guaranteed for an additional period of one (1) year. All areas damaged by replacement operations shall be fully restored by the contractor to their original and/or specified condition.
- E. The contractor shall not assume responsibility during the guarantee period for damages resulting from natural causes such as floods, lightning storms, freezing rains or winds over 60 miles per hour. The Contractor will also not be held responsible for damages resulting from acts of negligence on the part of the Owner or others occupying the site, fire or vandalism.

#### 1.11 MAINTENANCE SERVICE

- A. Maintenance of trees, shrubs and evergreens by the contractor consists of pruning, keeping guys taut and trees erect, raising tree balls which settle below grade and weekly irrigation for a period of twelve (12) weeks.
- B. General maintenance, including weekly irrigation throughout the remainder of the growing season, shall be accomplished by the Owner's personnel following the initial maintenance requirements as noted above.
- C. At the end of this period of initial maintenance, the Owner will accept the various portions of the work, provided the requirements of the specifications have been fulfilled.
- D. It shall be the contractor's responsibility to conduct monthly inspections and advise the Owner of watering excesses or deficiencies during the guarantee period.
- E. Additional maintenance to include:
  - 1. Cultivation and weeding plant beds and tree pits.
  - 2. Applying herbicides for weed control, as required in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
  - 3. Remedy damage from use of insecticides.
  - 4. Disease control.

#### PART 2 PRODUCTS

##### 2.1 ACCEPTABLE NURSERIES

- A. Refer to Section 02960 for any special requirements.

## 2.2 TREES, PLANTS, AND GROUND COVER

- A. Refer to the Plant List on the drawings for plant materials that are required, or the list of suitable trees contained herein.
  - 1. Quality and Size: Plant materials shall have a habit of growth that is normal for the species, shall conform to the sizes given in the Plant List, shall be sound, vigorous and free from plant diseases, insects and their eggs.
  - 2. All plants shall have a normal and healthy root system, as designated by horticultural standards. All standards, i.e., quality designations and measurements (ball sizes, heights and caliper of plants) shall be in accordance with the latest edition of "USA Standards for Nursery Stock." This booklet is available from the American Associate of Nurserymen, Inc., 835 Southern Bldg., Washington D.C. 20005.
  - 3. Root Protection: Plants designated "B & B" in the Plant List 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 systems 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.

## 2.3 PLANTING MIXTURE

- A. Planting mixture is the material which is used for tamping around the earth balls in the process of planting.
- B. It shall be prepared on the site by mixing two parts topsoil, two parts soil excavated from the pit, and one part peat. Five (5) pounds of Superphosphate shall be added to each cubic yard of planting mixture.
  - 1. PEAT
    - a. Peat shall be granulated raw peat or baled peat and shall be essentially brown to black in color.
  - 2. SUPERPHOSPHATE
    - a. Superphosphate, as is commonly used for agricultural purposes, shall be used and will contain approximately 20% available phosphoric acid.
  - 3. MULCH MATERIALS
    - a. Mulching Material: Wood chips, ground bark, free of growth or germination inhibiting ingredients.
    - b. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that site is ready to receive work.

### 3.2 EXCAVATION

- A. Circular pits with vertical sides shall be excavated for all plants.
- B. Diameter of all plant pits shall be at least one (1) foot greater than the diameter of the ball.

- C. Depth of pits shall be enough to accommodate the ball of B & B material in the manner shown on the planting detail drawing.
- D. The earth in the bottom of the pits shall be loosened by spading or other approved means, to a depth of four (4) inches.

### 3.3 PLANTING

- A. All planting, unless otherwise directed, shall be performed as herein stated.
  - 1. Plants shall be set in the planting pit to the proper grade and position. Set plants upright and face to give the best appearance or relationship to each other or adjacent structures. Planting mixture, as specified, shall then be carefully worked around the ball or roots until approximately 2/3 of the planting pit has been backfilled. At this time, trees and shrubs with balled roots shall have burlap and straps cut away and folded back from the top of the balls. The remaining portion of the planting pit can then be filled with planting mixture and tamped to grade. Note: Planting mixture in a frozen or muddy condition shall not be used for backfill.
  - 2. Water is to be worked around the balls during or immediately after the plants have been backfilled. The entire ball area of each plant shall be soaked and the backfill solidly worked in and settled around the plants.

### 3.4 PLANT RELOCATION AND RE-PLANTING

- A. Re-locate plants as indicated on the contract Drawing.
- B. Re-plant plants in pits or beds, partly filled with prepared topsoil mixture, at a minimum depth of 6 inches, or as called for in Section 02960, under each plant. Loosen burlap, ropes, and wires, from the root ball.
- C. Place bare root plant materials so roots lie in a natural position. Backfill soil mixture in 6 inch layers. Maintain plant materials in vertical position.
- D. Saturate soil with water when the pit or bed is half full of top soil and again when full.

### 3.5 GUYING AND STAKING

- A. All trees shall be guyed and staked immediately after planting.
- B. Work shall be done as illustrated in the planting detail drawing.
- C. Trees shall be guyed securely with pliable, zinc coated iron or steel wire No. 10 gauge and covered at contact with the tree with dark fabric rubber hose.
- D. No eye bolts or nails are to be driven into the tree.
- E. Trees shall be secured by two double twisted wire guys secured to two 3" diameter cedar posts set four (4) feet into the ground and standing a minimum of 4'-5' above grade.

### 3.6 MULCHING AND WATERING

- A. All plants shall be mulched with cover 4" in depth.
- B. This cover shall extend in all directions to the edge of the excavated hole.
- C. After mulching, all plants shall be thoroughly soaked.

### 3.7 PRUNING AND REPAIR

- A. Upon completion of work, all plants shall have been pruned and injuries repaired.
- B. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs or branches, remove badly formed and interfering limbs and to compensate for the loss of roots from transplanting.
- C. Pruning shall be done so as not to change the natural habit or shape of the plant.
- D. All cuts shall be made flush, leaving no stubs, and shall be dressed with an approved pruning paint.
- E. All pruning shall be done by workmen experienced in this type of work.

### 3.8 WRAPPING

- A. The trunks of all trees shall be wrapped.
- B. As a minimum, the standard tree wrapping paper shall begin at ground level and end just above the first branch.

### 3.9 FINAL APPROVAL

- A. All planted material shall be subject to final approval by the Owner's representative after completion of all phases of the contractor's work.
- B. Materials that do not meet specifications as listed herein or material that has been damaged due to shipment or installation may be rejected.
- C. Acceptable replacements for rejected plants will be made, at no cost to the Owner.

### 3.10 CLEAN-UP

- A. Upon completion of the work, or any portion thereof, the ground shall be cleared of all debris and of all other superfluous materials resulting from landscape development.

### 3.11 SCHEDULE - PLANT LIST

- A. Refer to Contract Drawings for Plant Lists for Plant Materials that are required or the list of trees required to be provided or relocated.
- B. Refer also to Section 02958 - Special Landscaping Requirements.

END OF SECTION



SECTION 02958

SPECIAL LANDSCAPING REQUIREMENTS FOR SITE

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish all labor, materials, equipment and services necessary for the following work:
  - 1. Providing and applying topsoil for planting and turf areas.
  - 2. Providing and planting trees, plants, etc. shown on the Drawings, including specified maintenance.
  - 3. Seeding, fertilizing and mulching as shown on the Drawings and/or as specified, including specified maintenance.
  - 4. Sodding, fertilizing, furnishing and placing the sod, and disposal of any surplus material as shown on the drawings and/or as specified, including specified maintenance.
  - 5. Providing and installing any landscape accessory called for in these Specification and/or Drawings.

1.2 QUALITY ASSURANCE

- A. Landscape work shall be done by a single firm specializing in commercial landscape installations.
- B. Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
- C. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Consultant, together with proposal for use of equivalent material.
- D. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
- E. Trees, Shrubs and Plants: Provide trees, shrubs and plants of quality, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60. 1 "American Standards for Nursery Stock". Provide healthy, vigorous stock, grown in a recognized nursery in accordance with good horticultural practice and free from disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions or disfigurement.
- F. Label at least one tree and one shrub of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.
- G. Turf seed: Provide seed mixed by the dealer. Provide dealer's guarantee statement of composition, mixture and percentages of purity and germination of each variety as specified.

- H. Sod: Comply with American Sod Producers Association (ASPA) classes of sod materials.
- I. Inspection: The Consultant or Owner's Representative may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size and quality. Consultant retains right to further inspect trees and shrub for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.
- J. All plants shall be nursery grown under climatic conditions similar to those in the locality of the project for a minimum of 2 years. Stock furnished shall be at least the minimum size indicated. Larger stock is acceptable, at no additional cost, and providing that the larger plants will not be cut back to size indicated. Provide plants indicated by two measurements so that only a maximum of 25% are of the minimum indicated and 75% are of the maximum size indicated.

### 1.3 SUBMITTALS

- A. The Contractor is responsible for providing the following submittals to the Consultant in triplicate. These submittals must be reviewed by the Consultant prior to any authorized landscaping operations.
  - 1. Submit the following materials certification:
    - a. Topsoil source and pH value, including test results specified.
    - b. Peat moss, including test results specified.
    - c. Plant fertilizer.
    - d. Turf seed.
  - 2. Certification: Submit certificates of inspection as required by governmental authorities. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.
  - 3. Planting Schedule: Submit proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
  - 4. Maintenance Instructions: Submit typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for two full years. Submit prior to expiration of required maintenance period(s).

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
- B. Take all precautions customary in good trade practice in preparing plants for moving. Workmanship that fails to meet the highest standards will be rejected. Spray deciduous plants in foliage with an approved "anti-desiccant" immediately after digging to prevent dehydration. Dig, pack, transport, and handle plants with care to ensure protection against injury. Inspection certificates required by law shall accompany each shipment invoice or order in

stock and on arrival. The certificate shall be filed with the Consultant. Protect all plants from drying out. If plants cannot be planted immediately upon delivery, properly protect them with soil, wet peat moss, or in a manner acceptable to the Consultant. Water heeled-in plantings daily. No plant shall be bound with rope or wire in a manner that could damage or break the branches.

- C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery, unless otherwise approved by Consultant. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
- D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
- E. Do not remove container-grown stock from containers until planting time.

#### 1.5 JOB CONDITIONS

- A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
- B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstruction, notify Owner's Representative before planting.
- D. Planting Time: Plant or install materials during normal planting season for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.
- E. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Owner's Representative. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

#### 1.6 SPECIAL PROJECT WARRANTY

- A. Warrant turf through specified turf maintenance period, and until final acceptance.
- B. Warrant trees and shrubs, for a period of two years after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the landscape contractor's control. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition.

- C. Inspection will be conducted at end of the warranty period, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

## PART 2 PRODUCTS

### 2.1 TOPSOIL AND PEAT MOSS

- A. Topsoil for planting: Fertile, friable, natural topsoil of loamy character, without admixture of subsoil material, obtained from a well-drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks, and other foreign materials, with acidity range of between pH 6.0 and 6.8.
  - 1. Identify source location of topsoil proposed for use on the project. On-site stored topsoil may not be used for planting.
  - 2. Material samples of new topsoil from off-site sources shall be inspected by the Consultant prior to planting operations.
- B. Peat Moss: Brown to black in color, weed and seed free granulated raw peat or baled peat, containing not more than 9% mineral on a dry basis.

### 2.2 PLANTS

- A. Provide plants typical of their species or variety; with normal, densely-developed branches and vigorous, fibrous root systems. Provide only sound, healthy, vigorous plants free from defects, disfiguring knots, sun-scald injuries, frost cracks, abrasions of the bark, plant diseases, insect eggs, borers, and all forms of infestation. All plants shall have a fully developed form without voids and open spaces. Plants held in storage will be rejected if they show signs of growth during storage.
- B. Dig balled and burlapped plants 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. Provide ball sizes complying with the latest edition of the American Standard for Nursery Stock. Cracked or mushroomed balls are not acceptable.
- C. Container-Grown Stock: Grown in a container for sufficient length of time for the root system to have developed to hold its soil together, firm and whole.
  - 1. No plants shall be loose in the container.
  - 2. Container stock shall not be pot bound.
- D. Provide tree species that mature at heights over 25' with a single main trunk. Trees that have the main trunk forming a "Y" shape are not acceptable.
- E. Plants planted in rows shall be matched in form.
- F. If the use of larger plants is acceptable, increase the spread of roots or root ball in proportion to the size of plant.
- G. No pruning wounds shall be present with a diameter of more than 1" and such wound must show vigorous bark on all edges.

- H. Evergreen trees shall be branched to the ground.

### 2.3 FERTILIZERS

- A. Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:

1. For trees and shrubs, provide fertilizer with not less than 5% total nitrogen, 10% available phosphoric acid and 5% soluble potash.
2. For lawns, provide fertilizer with percentage of nitrogen required to provide not less than 1lb. Of actual nitrogen per 1,000 sq. ft. of lawn area and not less than 4% phosphoric acid and 2% potassium. Provide nitrogen in a form that will be available to lawn during initial period of growth; at least 50% of nitrogen to be organic form.

### 2.4 TURF GRASSES

- A. Apply turf seed over mowed and rough areas in accordance with the following schedule:

1. Seed: Seed, where specified on the Drawings, shall be fresh, clean, new crop seed composed of the specified varieties mixed in the proportions by weight. Seed shall be purchased from an established, reputable seed dealer, tagged to comply with the requirements of the seed mixture shown in these Specification, and shall be approved by the Consultant before use. Seed must come from domestic sources and shall be certified as to purity of variety by the state certifying agency in the state of origin.
2. Certification Tags: Shall be provided to the Consultant for his records.
3. Mowed lawn areas: Seed mix shall be Tall Fescue blend composed of:
  - a. 90% Tall Fescue (use any of three varieties)
    - 1) Amigo
    - 2) Arid
    - 3) Finelawn I
    - 4) Rebel
    - 5) Trident
    - 6) Silverado
    - 7) Apache
    - 8) Bonanza
  - b. 10% Kentucky Bluegrass (use one variety)
    - 1) Glade
    - 2) Freedom
    - 3) Rugby
    - 4) Palmer II
  - c. Seeding Rate: 250 lbs. per acre
  - d. Mow above 1-2/3 inches.
4. Unmowed roughs under tree groups: Seed mix shall be Fine Fescue blend composed of (one variety each):
  - a. 25% Hard Fescue
    - 1) Reliant
    - 2) Aurora
  - b. 25% Sheep Fescue
    - 1) Bighorn
  - c. 25% Chewings Fescue
    - 1) Banner
    - 2) Kokat

- 3) Jamestown II
- 4) Wintergreen
- 5) Shadow
- d. 25% Creeping Red Fescue
  - 1) Pennlawn
  - 2) Dawson
  - 3) Shademaster
- e. Seeding rate: 175 lbs. per acre unmowed or above 3 inches.
- f. Sod shall be densely rooted blue grass or other approved perennial grasses, free from noxious weeds and reasonably free from other weeds. Sod shall not be less than two (2") inches thick, cut in strips not than ten (10") inches wide by eighteen (18") inches long. The type of grass shall match the adjacent lawn.

## 2.5 OTHER

- A. Mulch: Mulch around plants and over seeded areas shall be as follows:
  - 1. Plants: after backfilling has been completed, apply shredded bark over plant hole area to a depth of five or six inches.
  - 2. Seeded areas: Following seeding and fertilizing operations, apply straw mulch at a rate of 1,000 lbs. per acre. Mulch shall be straw, hay, or marsh hay. Mulch anchoring shall be used to hold organic mulch in place as specified in the most recent edition of MDOT Standard Specifications for construction.
- B. Water: Free of substances harmful to plant growth. Hoses or other methods of transportation furnished by Contractor.
- C. Stakes for staking: Hardwood, 2" x 2" x 8' long.
- D. Staking wires: No. 10 or 12 gauge galvanized wire.
- E. Staking hose: Two-ply, reinforced garden hose not less than 1/2" inside diameter.
- F. Tree wrap: Standard waterproofed tree wrapping paper, 2-1/2" wide, made of 2 layers of crepe craft paper weighing not less than 30 lbs. per ream, cemented together with asphalt.
- G. Twine: Two ply jute material.
- H. Anti-Desiccant: Protective film emulsion providing a protective film over plant surfaces; permeable to permit transpiration. Mixed and applied in accordance with manufacturer's instructions.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Examine proposed planting areas and conditions of installation. Do not start planting work until unsatisfactory conditions are corrected.

- B. Time of Planting:
  - 1. Evergreen Material: Plant evergreen material between September 1 and November 1 or in spring before new growth begins. If project requirements require planting at other times, plants shall be sprayed with anti-desiccant prior to planting operations.
  - 2. Deciduous Material: Plant deciduous materials in a dormant conditions. If deciduous trees are planted in-leaf, they shall be sprayed with an anti-desiccant prior to planting operation.
- C. Planting shall be performed only by experienced workmen familiar with planting procedures under the supervision of a qualified supervisor.
- D. Locate plants as indicated or as approved in the field after staking by the Contractor and or the Consultant. If obstructions are encountered that are not shown on the Drawings, do not proceed with planting operations until alternate plant locations have been selected by the Consultant.
- E. Plant largest sized materials first, proceeding to next smallest size, completing planting operations with minimal sizes.

### 3.2 PREPARATION

- A. Preparation of Planting Soil:
  - 1. Before mixing, clean topsoil of roots, plants, sod, stones, clay lumps and other extraneous materials harmful or toxic to plant growth.
  - 2. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
  - 3. Provide pre-mixed planting mixture for use around the balls and roots of the plants consisting of five parts planting topsoil to one part peat moss and 12 lbs. plant fertilizer for each cu. yd. of mixture.
  - 4. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.
- B. For pit and trench type backfill, mix planting soil prior to backfilling and stockpile at site.
- C. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

### 3.3 LAWN AREAS

- A. Preparation for Planting Lawns: Loosen subgrade of lawn areas to a minimum depth of 4". Remove stones over 1-1/2" in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
  - 1. Spread topsoil to a minimum depth required to meet lines, grades and elevations shown, after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4" of topsoil.
  - 2. Place approximately 1/2 of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Add specified soil amendments and mix thoroughly into upper 4 inches of soil.

- B. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operation, prepare soil for lawn planting as follows: Till to a depth of not less than 6"; apply soil amendments and initial fertilizers as specified; remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
  - 1. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2" of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days.
- C. Fine grade lawn areas to a smooth, even surface with loose, uniformly fine texture. Roll, rake and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- E. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to seeding or sodding.
  - 1. Water new lawn areas and keep moist until lawn is established.
- F. Where called for in the Specifications, or on the drawings, the Contractor shall furnish all labor and material and Grade "A" sod to the finished grade shown or to conform to existing grades and provide a smooth and uniform surface to meet existing ground surface.
  - 1. The cost of providing for and meeting the sodding requirements shall be included in the bid price or at no extra cost to the Owner.
  - 2. Sod shall be moist and shall be laid in a moist earth bed. Pegs shall be used to stabilize the sod on slopes over 50% and/or where required on drawings or in Specifications.

### 3.4 PLANTS/TREES

- A. Excavation for Trees and Shrubs:
  - 1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
  - 2. For balled and burlapped (B&B) trees and shrubs, make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill.
  - 3. For container-grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
- B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
- C. Fill excavations for trees and shrubs with water and allow to percolate out before planting.
- D. Planting Trees:
  - 1. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms.

- When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
2. Set container grown stock as specified for balled and burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
  3. Dish top of backfill to allow for mulching.
- E. Mulch pits, trenches and planted areas. Provide not less than 2 inch thickness of mulch and work into top of backfill and finished level with adjacent finish grades. Provide finished 4" thickness of mulch.
- F. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Consultant, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- G. Remove and replace excessively pruned or mis-formed stock resulting from improper pruning.
- H. Wrap tree trunks of 2" caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures before wrapping. Secure tree wrap in place with twine wound spirally downward in opposite direction, tied around the tree in at least three places in addition to the top and bottom.
- I. Stake all trees immediately after lawn seeding or sodding operations and prior to acceptance. When high winds or other conditions which may affect tree survival or appearance occur, the Consultant may require immediate staking.

### 3.5 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain trees, conifers and other plants until final acceptance but in no case less than 60 days after substantial completion of planting.
- C. Maintain trees, conifers and other plants by pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.
- D. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as the following: regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

### 3.6 CLEAN UP AND PROTECTION

- A. During landscape work, keep pavements clean and work areas in an orderly condition.

- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.

END OF SECTION

SECTION 03310  
CONCRETE WORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the furnishing and mixing of all materials required for concrete, the furnishing, erection, care and removal of forms; the furnishing placement, finishing, curing and protection of all concrete, and the furnishing and placing of steel reinforcement for all concrete.
- B. Concrete shall be composed of a mixture of Portland Cement, fine aggregate, coarse aggregate and water. The materials and methods used shall produce a dense, homogeneous, impervious, durable and workable concrete of the highest quality and without defects of any kind.
- C. The Contractor shall provide Portland cement concrete mixtures that are resistant to excessive expansion caused by alkali-silica reactivity (ASR). The evaluation as to the resistance of submitted concrete mixtures to excessive expansion caused by ASR shall be by the Owner as described herein.

1.2 REFERENCES

- A. American Concrete Institute (ACI):
  - 1. ACI 301 Specifications for Structural Concrete
  - 2. ACI 305.1 Specification for Hot Weather Concreting
  - 3. ACI 306.1 Specification for Cold Weather Concreting
  - 4. ACI 347 Guide to Formwork for Concrete
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - 2. ASTM A 1064 Standard Specification for Steel Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - 3. ASTM C 33 Standard Specification for Concrete Aggregates
  - 4. ASTM C 31 Standard Practice for Making and Curing Concrete Specimens in the Field
  - 5. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
  - 6. ASTM C 94 Standard Specification for Ready-Mixed Concrete
  - 7. ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete
  - 8. ASTM C 150 Standard Specification for Portland Cement
  - 9. ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete
  - 10. ASTM C 172 Standard Specification for Sampling Freshly Mixed Concrete
  - 11. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
  - 12. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
  - 13. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

14. ASTM C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars
  15. ASTM C 1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
  16. ASTM C 1293 Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
  17. ASTM C 1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- C. Concrete Reinforcing Steel Institute (CRSI):
1. CRSI Manual of Standard Practice
- D. US Army Core of Engineers (C.O.E.):
1. CRD-C621 Specification for Non-Shrink Grout
- E. Michigan Department of Transportation (MDOT):
1. MDOT Materials Source Guide
  2. MDOT Standard Specifications for Construction, Latest Edition

### 1.3 SUBMITTALS

- A. One week after the Owner awards this project the Contractor shall submit to the Owner all proposed concrete mix designs. These shall include the following:
1. Sources for all fine and coarse aggregates proposed to be used identified by their MDOT A.S.I # as listed in the Qualified Products List from the current MDOT Materials Source Guide if applicable or by an identifiable name if not applicable.
  2. Sources and recent mill test reports for all cementitious materials and supplementary cementitious materials proposed to be used.
  3. Proposed concrete shall obtain the specified minimum strength concrete at 28 days, when sampled in accordance with the requirements of current ASTM Specification C 31, and tested in accordance with the requirements of current ASTM specification C 39, together with a statement of the sources of the materials upon which such concrete design mix is based, and recent certified tests of all components including gradation and physical properties of fine and coarse aggregates. Submittal shall be based upon compliance with ACI 301 Chapter 4.
- B. The Contractor also may submit for consideration the following:
1. Recent ASTM C 1260 test results for the fine and /or coarse aggregates indicated on the proposed concrete mix designs.
  2. Recent ASTM C 1567 test results for the specific proportionate combinations of cementitious, supplementary cementitious, fine, and coarse aggregate materials indicated on the proposed concrete mix designs.
  3. Recent ASTM C 1293 test results for the fine and /or coarse aggregates indicated on the proposed concrete mix designs.
- C. Reinforcing Steel Schedules:
1. Reinforcing bar schedules and detail shop drawings, showing complete details as to size, length, weight, arrangement, and bending of all reinforcing steel shall be submitted by the Contractor to the Owner's Representative for review. A complete

schedule of reinforcement chairs, supports, saddles, spacers, and other accessories shall be included. No reinforcement shall be cut, bent, or fabricated before these schedules and/or drawings are reviewed by the Owner's Representative.

- D. Forms:
1. When requested by the Owner, drawings showing details of the forms and shoring proposed by the Contractor shall be submitted to the Owner's Representative for approval.
  2. When requested by the Owner, designs of sectional forms shall be submitted to the Owner's Representative for approval before using in the work.

#### 1.4 RELATED SECTIONS

- A. Materials Concrete  
Notes: Should any conflict occur between this section and related sections; the provisions of this section shall apply.

#### 1.5 QUALIFICATIONS

- A. Reinforcement Fabricator shall be MDOT Approved supplier.

### PART 2 MATERIALS

#### 2.1 CEMENT

- A. Cement shall be "Portland Cement" conforming to current ASTM Specification C 150, Type I or Type II. When authorized for use in the work by the Owner, High Early Strength Cement shall conform to current ASTM Specification C 150, Type III.
- B. Only one type of cement shall be used in the same portion or element of the work. All cement shall be of the same brand and shall be produced by a single mill unless otherwise authorized. Cement salvaged by cleaning sacks or from discarded sacks of cement, shall not be used in the work. Any cement which for any reason has become partially set, contaminated or which contains lumps will be rejected and shall be immediately removed from the site.

#### 2.2 FLY ASH

- A. Fly ash shall conform to the requirements of ASTM C 618 Class F.

#### 2.3 GROUND GRANULATED BLAST FURNACE SLAG

- A. Ground Granulated Blast Furnace Slag (GGBFS) shall conform to the requirements of ASTM C 989, Grade 100 or 120.

#### 2.4 AGGREGATES

- A. Fine Aggregate shall be natural sand, 2NS.

- B. Coarse aggregate shall conform to ASTM C 33, Class 4S and be graded in accordance with the following Michigan Department of Transportation Specifications for Construction Classifications:

<b>Element</b>	<b>MDOT Class</b>
Walls, Slabs & Other Concrete less than 8" thick	26A
All other concrete	6AA

## 2.5 WATER

- A. Tap water of potable quality shall be used for mixing concrete and at the time of use shall be clean and free from oil, alkalis, or organic matter.

## 2.6 ADMIXTURES

- A. An air entraining admixture conforming to the requirements of current ASTM Specification C 260 shall be used for all concrete.
- B. All concrete shall contain a water reducing admixture, complying with current ASTM Specification C 494, Type A. The admixture shall, be free of significant amounts of chloride, and shall be used in accordance with the manufacturer's recommendation for the type of cement to be used, except that only volumetric dispensing will be allowed.
- C. The manufacturer shall certify, in writing, that the materials supplied for use under this Contract are identical in all respects, including concentration and chloride content, to the material tested in accordance with current ASTM Specification C 494. When requested by the Owner, the Contractor shall make available the services of a manufacturer's qualified field representative, to assure proper use of the admixture.

## 2.7 REINFORCING STEEL

- A. Unless otherwise indicated, reinforcing steel shall be deformed steel bars conforming to the requirements of current ASTM Specification A 615, Grade 60. Reinforcing steel for ties and stirrups shall be new billet steel intermediate grade conforming to the requirements of the current edition of ASTM Spec. A 615 Grade 40.
- B. All reinforcing steel shall be free from defects, kinks, and bends not shown on the drawings.
- C. Wire mesh for reinforcement shall conform to the current requirements of ASTM Specification A 1064.
- D. All bars shall be of the shape, size, class, and grade of steel specified and shown on the drawings, and each bar shall have at all points a net section not less than that of a plain round bar of corresponding size.
- E. The Contractor shall furnish the manufacturer's written certification to the Owner that all reinforcing steel of each shipment meets the pertinent requirements of ASTM Specifications.
- F. Samples for the inspection and testing of the reinforcing steel shall be chosen by the Owner, and sampling and testing methods shall conform to the requirements of the General Conditions.

## 2.8 FORMS

- A. Forms for structural concrete shall be of metal, plywood, first class dressed lumber, or other material approved by the Owner. The forms shall be true in every respect to the required shape, size, grade, and alignment of the finished structure and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and curing the concrete. The forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surface of the finished concrete will be reasonably free from ridges, fins, offsets or similar defects. Suitable molding or beveled strips shall be placed in the forms to chamfer or bevel all exterior corners of the concrete to prevent breaking and spalling at the edges when the forms are removed. Adequate and suitable means for removing the forms without injury to the surface of the finished concrete shall be provided.
- B. The Contractor shall locate and provide adequate shoring to safely support the work at all times. Shoring shall be spaced to insure that no member will be excessively loaded or will be subjected to adverse stresses during construction operations.
- C. Shores shall be continuous between supports and shall be aligned vertically with respect to each other. No adjustable or spliced wooden shores shall be used, unless specifically approved by the Engineer.
- D. The forms shall be maintained at all times in good condition as to shape, strength, rigidity, water-tightness and smoothness of surface. Before each use, forms shall be thoroughly cleaned of all debris and water before concrete is placed and shall be coated with a non-staining type mineral oil which shall not discolor or otherwise injuriously affect the concrete. The coating shall be applied before reinforcing steel is placed. Temporary openings shall be provided at the bottom of wall forms and at other points where necessary to facilitate cleaning and inspection.
- E. Sectional form panels may be used throughout where practicable.
- F. The Owner may at any time condemn any section or sections of forms found deficient in any respect and such forms shall be promptly corrected or removed and replaced. Form alignment tolerances shall conform to current requirements of ACI 347, latest edition.
- G. Wire ties shall not be used as form ties.
- H. Metal inserts for anchorage of materials or equipment to concrete construction shall be provided as required in the work.
- I. The type and kind of form ties and spreaders used shall be subject to the Owner's approval. Form ties shall not project through the finished concrete, but shall be of such type that, upon removal of the forms, the ends of the ties or spreader will remain one inch or more within the face of the concrete.

## 2.9 WATERSTOPS

- A. Waterstops shall be manufactured from a plastic compound, the basic resin of which shall be polyvinyl chloride (PVC), and shall not contain any scrap or reclaimed material. In all construction joints where required, the water stop shall be Sealtight, Type No. 6380 as

manufactured by W. R. Meadows, Inc. or Serviced Durajoint, Type No. 5, as manufactured by W. R. Grace Co., Vulco Type VP-8073 as manufactured by Vulcan Metal Products, Inc. or Owner approved equal

- B. Plastic waterstops shall have the following physical properties:
- |                    |                                  |
|--------------------|----------------------------------|
| Specific Gravity   | 1.33 Max.                        |
| Durometer Hardness | 65-80                            |
| Tensile Strength   | 2000 psi min.                    |
| Elongation         | 300% min.                        |
| Temperature Range  | from +176 deg. F. to -35 deg. F. |
- C. Waterstops shall be chemically resistant to chlorinated water, salt water, acids, alkalis, sewage wastes and oil.
- D. Splices in the continuity of waterstops shall be performed by heat sealing or other methods but always in strict accordance with the manufacturer's recommendations. Corners, tees, and other intersections shall be prefabricated in the shop.

## 2.10 NON-SHRINK GROUT

- A. Non-shrink grout shall meet C.O.E. specification CRD-C621 and be equivalent to the following:
1. Crystex (L & M)
  2. Sure-Grip High Performance (Dayton Superior)
  3. Masterflow 713 (Master Builders)

## PART 3 EXECUTION

### 3.1 PROPORTIONING AND STRENGTH OF CONCRETE

- A. The mixing proportions and water cement ratio shall be such as to produce a dense, homogeneous, workable and durable air-entrained concrete having a minimum compressive strength of 4000 psi @ 28 days for all concrete work.
- B. The Contractor shall provide Portland cement concrete mixtures for the project that are resistant to excessive expansion caused by alkali-silica reactivity (ASR).
- C. The evaluation as to the resistance of submitted concrete mixtures to excessive expansion caused by ASR shall be by the Owner as described herein.

### 3.2 RELATED SECTIONS

- A. This provision is supplemental to all other sections within the specifications of the Contract related to the construction of concrete items for the project.

### 3.3 QUALITY ASSURANCE

- A. The Engineer shall review the submitted information and testing data submitted with the proposed concrete mixtures and any information and/or any test results with respect to ASR

the Engineer has on record for the proposed aggregates and/or proportionate combinations of cementitious materials and aggregates.

1. The criteria for approval of a proposed concrete mixture for resistance to excessive expansion caused by ASR shall be as follows:
  - a. If a proposed concrete mixture contains cement with an alkali level of less than 0.60% expressed as equivalent sodium oxide (percent  $\text{Na}_2\text{O} + 0.658 \times$  percent  $\text{K}_2\text{O}$ ) the mixture shall be considered to be resistant to the potential for excessive expansion caused by ASR.
    - 1) The determination of the alkali level of the proposed cement shall be made from the mill test reports submitted per Section 1.03.
  - b. If a proposed concrete mixture contains both fine and coarse aggregates for which there is testing per ASTM C 1260 that shows that both the fine and coarse aggregates produce expansions of less than 0.10%, the fine or coarse aggregate used to construct the mortar bar shall be considered to be “innocuous” (per Appendix X1 of ASTM C 33). Concrete mixtures that include both fine and coarse aggregates considered to be innocuous shall be considered to be resistant to excessive expansion caused by ASR.
  - c. If a proposed concrete mixture for which there is previous testing per ASTM C 1567, shows the proposed combination of cementitious materials and aggregates produce expansions of less than 0.10% the mixture shall be considered to be resistant to excessive expansion caused by ASR.
  - d. If a proposed concrete mixture for which there is previous testing per ASTM C 1293 shows that both the fine and coarse aggregates meets the criteria of Appendix XI of ASTM C 1293 with respect to the non-reactivity of the aggregate, the mixtures shall be considered to be resistant to excessive expansion caused by ASR.
  - e. If, based on the Engineer’s evaluation, additional testing of the fine and / or coarse aggregates is needed to make the evaluations as discussed herein; the Owner shall perform such testing.
    - 1) The Owner shall have access to all materials, including aggregate pits, in order to obtain samples for such additional testing.
    - 2) The Owner shall perform the following test using the fine and/or coarse aggregates proposed for each concrete mixture: ASTM C 1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar – Bar Method).
    - 3) All samples submitted for testing per ASTM C 1260 shall first be tested to establish conformance to the required material specification for gradation.
    - 4) All samples submitted shall meet the required material specification for gradation prior to being submitted for testing per ASTM C1260.
2. If, based on the Engineer’s evaluation, the submitted concrete mixture does not meet any one of the criteria of 1.05A.1. the mixture shall be rejected or be mitigated by Methods 1. or 2. as follows:
  - a. Method 1. Use of a cement with an alkali level of less than 0.60% expressed as equivalent sodium oxide (percent  $\text{Na}_2\text{O} + 0.658 \times$  percent  $\text{K}_2\text{O}$ ).
    - 1) The determination of the alkali level of the proposed cement shall be made from the mill test reports submitted per Section 1.03.
  - b. Method 2. Substitution of a portion of the cement with Ground Granulated Blast Furnace Slag (GGBFS) Grade 100 or 120 (ASTM C 689).

- 1) For Method 2, the maximum substitution of cement with the GGBFS permitted shall be 35% by weight of total cementitious material (cement plus GGBFS).
  - 2) For Method 2, the effectiveness of the proposed cement-GGBFS combination to resist the potential for excessive expansion caused by ASR for each aggregate that is considered to be potentially reactive shall be demonstrated.
  - 3) The effectiveness of the proposed cement-GGBFS combination shall be based on test mortar bars per ASTM C 1260 using each fine or coarse aggregate that has been considered to be potentially reactive and the proposed cement-GGBFS combination for the concrete mixture.
  - 4) The criteria for evaluating the mitigation of a proposed concrete mixture with respect to ASR by Method 2. shall be as follows:
    - a) If a mortar bar constructed of an aggregate that is considered to be potentially reactive and the proposed cement-GGBFS combination produces an expansion of less than 0.10%, the aggregate and proposed cement-GGBFS combination shall be considered to be resistant to excessive expansion caused by ASR.
    - b) Concrete mixtures that include both fine and coarse aggregates considered to be resistant to excessive expansion caused by ASR by mitigation Method 2. as described herein shall be considered to have been adequately mitigated with respect to and resistant to excessive expansion caused by ASR.
    - c) If a mortar bar constructed of an aggregate that is considered to be potentially reactive and the proposed cement-GGBFS combination produces an expansion of 0.10% or greater, concrete mixtures containing these materials shall not be considered resistant to the potential for excessive expansion caused by ASR and the concrete mixture shall be rejected.
- c. The contractor shall be responsible for all costs associated with the mitigation of a concrete mixture for ASR and any delay costs incurred from the Owner if, due to the mitigation method selected by the Contractor, it takes the Contractor beyond their completion dates.
- B. If the Contractor intends to change suppliers or if the supplier intends to change concrete mixtures after the evaluation and/or Mortar-Bar tests are performed, the Contractor shall inform the Owner immediately, but not less than forty-five (45) days prior to concrete batching.
1. Upon notification, all concrete work will be postponed, without any additional costs or extension of time allowed by the Owner, until evaluation of the new mixtures and testing of the new materials, if needed, have been completed.
- C. The Owner will be testing the concrete that is delivered to the project site so as to ensure that the approved mix design is being followed.
1. To assist the Owner in establishing that the approved mix design is being followed, the supplier shall include on the delivery ticket for each batch of concrete delivered to the job, the identification and proportions of each material batched.

- D. The cost associated with the testing of the aggregates, or aggregates with the proposed cement-GGBFS combinations as described herein shall be borne by the Owner. The price for assisting the Owner in such testing is included in the item (s) of the concrete being supplied. If, during the testing process, it is determined that alkali-silica reaction (ASR) is not a condition that requires mitigation, the Contractor will not be entitled to any compensation whatsoever, for assisting the Owner in addressing the ASR issue.
- E. The design mix shall be proportioned by weight and shall designate: the weight in pounds of fine and coarse aggregates, in saturated surface dry condition, per sack (94 pounds) of cement; the cement content in sacks per cubic yard; the gallons of water per sack of cement; and the volume of admixtures per hundredweight of cement which will be required for the concrete design mix; gross weight and yield per cubic yard and slump of trial mixes; compressive strength developed at 7 days and 28 days from not less than three test cylinders cast for each 7 day and 28 day test and each design mix.
- F. The Concrete mix design to produce concrete of the required minimum strength shall be the sole responsibility of the Contractor, except that not less than 5 1/2 sacks of cement per cubic yard shall be used for 4000 psi concrete and the water cement ratio shall not exceed 0.45 unless noted otherwise. The maximum allowable slump shall be that consistent with the proper placement of the mix and as specified herein, but in no case shall the water content exceed that specified. Air entrainment shall equal 5% ± 1% unless noted otherwise.
- G. The Contractor may, at his option, substitute up to 20% of fly ash or 35% of GGBFS' by weight of cement for the specified cement content, provided that the resulting concrete meets specified requirements for strength, workability, and appearance.
- H. Recent certified copies of test results of the fine and coarse aggregates proposed by the Contractor shall be provided with the mix design. Test results shall indicate aggregate grading, physical and chemical properties.

I. Schedule of Concrete Mixes (Unless noted otherwise):

<i>Structural Element</i>	<i>Concrete Mixture Mark</i>	<i>Min. 28 Day Compressive Strength</i>	<i>Min. Cement Content</i>	<i>W/C</i>	<i>Air Entrainment</i>	<i>Max. Slump</i>
<i>Mudmat &amp; Fill for excess excavation below structures</i>	Mudmat	2,000 psi	4.0 Sacks/cyd	-	Not Required	No Limit
<i>Baffle, Beams &amp; Columns</i>	5.5 Air / 1.5 Agg	5,500 psi	6.5 Sacks/cyd	0.41	5% ± 1%	4
<i>Mass Concrete (Least dimension greater than 30")</i>	4.0 Mass/ 1.5 Agg	4,000 psi	5.0 Sacks/cyd	0.45	5% ± 1%	2
<i>Elements 8" or less in least dimension (fiber reinf.)</i>	4.0 Air / 0.75 Agg	4,000 psi	5.5 Sacks/cyd	0.443	6% ± 1%	4
<i>Drilled Pier</i>	4.0 Air / 0.75 Agg	4,000 psi	5.5 Sacks/cyd	0.443	5% ± 1%	4
<i>All other concrete</i>	4.0 Air / 1.5 Agg	4,000 psi	5.5 Sacks/cyd	0.443	5% ± 1%	4

3.4 READY MIXED CONCRETE

- A. Ready mixed concrete shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete," ASTM C 94. Full batch ticket information including all items of C 94 Section 16.2 shall be furnished. Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the national Ready Mixed Concrete Association.

3.5 CONSTRUCTION JOINTS

- A. General  
Construction joints shall be provided in the locations indicated on the Drawings, or at such locations as designated or approved by the Engineer. They shall be so designed and located as to least impair the strength, water-tightness and appearance of the structure. The distance between construction joints shall in no case be greater than 25 feet, unless otherwise indicated on the Drawings.  
Keyways shall be provided in all construction joints. Unless otherwise indicated, the width of keyways shall be approximately one-third of the width of the section at that point and their depth one-third their width, except that the width of keyway shall not exceed 12 inches.

- B. Location  
Construction joints in the base slab, walls, and upper slab of structures shall be located in the same vertical plane.  
Joints in slabs on grade shall be located at a maximum 16' spacing and shall be perpendicular to the horizontal surfaces. All joints shall be truly vertical or horizontal unless otherwise shown on the Drawings or as ordered by the Owner. The surfaces of horizontal joints shall be screeded level.
- C. Treatment of Hardened Concrete  
Before depositing fresh concrete on or against hardened concrete, the surface of the hardened concrete shall be roughened, as required by the Engineer, in a manner that will not leave loosened particles of aggregate or concrete at the surface. Such roughening of the surfaces may be accomplished by bush-hammering as required, or by the use of Sika Chemical Corporation Rugasol S or B, ChemMasters H, or equal, applied in accordance with the manufacturer's directions in order to produce a naturally roughened surface. Such hardened surfaces shall be thoroughly cleaned of foreign matter and laitance. Just before the fresh concrete is deposited, the cleaned surface shall be thoroughly wetted, the excess water removed, and the wetted surfaces slushed with a mortar of the same proportions as the mortar in the concrete mix. The coat of mortar on horizontal joints shall not be less than two inches in thickness. The fresh concrete shall be deposited before the mortar has attained its initial set.

### 3.6 INSTALLING WATERSTOPS

- A. Waterstops shall be provided as shown on drawings including all connecting construction joints. Waterstops shall be held rigidly in place and shall extend through slots in the forms. In no case shall waterstops be bent over inside the forms.
- B. The waterstops shall be adequately protected from oil, dirt and damage and shall be maintained and left clean, ready to receive future concrete placement. Damaged waterstops shall be repaired to the satisfaction of the Engineer
- C. Care shall be taken in placing and maintaining waterstops in their correct position during the placing of concrete.

### 3.7 PLACING CONCRETE

- A. Concrete shall not be placed in water other than by tremie method and/or unless authorized by the Engineer nor shall water be allowed to rise or flow over concrete which has not attained its initial set. Concrete shall not be placed in contact with frozen earth.
- B. Concrete shall be placed in the forms only after the forms, bracing, and reinforcing steel have been checked and the space within the forms has been cleaned of all debris and water. This check shall be made by the Owner's designated representative and no concrete shall be placed except with his approval.
- C. When concrete is deposited directly on ground, care shall be taken to prevent loss of moisture from the concrete either by means of sprinkling the ground or by placing a waterproof membrane over the ground prior to placing the concrete.

- D. Concrete shall be promptly placed with a minimum of handling so as to avoid segregation or loss of any ingredients. Each placement shall be completed in a continuous operation and the concrete shall be placed as nearly as possible in its final position to avoid rehandling.
- E. Concrete shall be placed in layers not to exceed 24 inches deep and shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping. Vibrators shall not be used to transport concrete inside the forms. Under no circumstances shall concrete that has partly hardened be deposited in the work.
- F. During freezing weather Contractor shall take whatever steps are necessary to prevent the freezing of ground against which concrete has to be placed. This protection will not be considered provided by a mud mat or other thin membrane but shall be provided by insulation, covering and heating, or other Owner approved means.
- G. Sufficient and suitable equipment and labor shall be provided so that, regardless of the method of transporting, handling, and placing the concrete when deposited in the forms shall have the quality and consistency specified. Concrete shall not be pumped through aluminum pipe.
- H. Mixing, handling and transporting equipment and tools shall be kept clean and free from lumps and incrustations of hardened concrete. Buggies, buckets, chutes, conveyors, and other devices used for the transportation of concrete shall be watertight, and their design and the method of transporting the concrete shall be subject to the approval of the Owner. Overloading of vehicles or chutes so that spillage or leakage occurs will not be permitted.
- I. The Contractor shall use the least slump possible consistent with workability for proper placing of concrete. Unless otherwise specified, maximum slumps permitted are:
  - 1. 4" slump For sections with side forms
  - 2. 3" slump For foundation slabs poured with curb forms only
- J. Slump will be determined by the Owner's designated representative by means of the slump cone test as outlined in current ASTM Designation: C 143.

### 3.8 BUILT IN WORK

- A. All necessary ties, anchors, bolts, inserts, dowels, waterstops, sleeves for pipe of every kind, and all other work to be anchored or set in the concrete shall be accurately set and securely held in place in accordance with details shown on the Contract Drawings or in accordance with standard practice, including such anchor bolts as may be necessary for equipment furnished by the Owner, or under other contracts.
- B. Sleeves of a suitable size and type shall be set in the concrete where all pipes, conduits, ducts, plumbing and other work are to pass through the concrete work, except where pipe wall castings or other devices are shown to be cast in place on the Contract Drawings.

### 3.9 PROTECTION AND CURING

- A. General
  - 1. Fresh concrete shall be protected from rain, and other adverse conditions by means of tarpaulins or other suitable equipment or methods. After placing and finishing

operations have been completed, concrete shall not be subjected to loading or otherwise disturbed until it has attained its specified design strength.

B. Initial Curing

1. One of the following methods shall be used to initially cure freshly placed concrete. This curing shall be employed for a period not less than 24 hours.
  - a. Ponding or continuous sprinkling
  - b. Fogging
  - c. Absorptive mat or fabric kept continuously wet
  - d. Sand or other covering kept continuously wet
  - e. Continuous steam (not exceeding 150 degrees F within the enclosure)
  - f. Exposed surface of concrete shall be protected against premature drying by curing in a manner subject to approval by the Owner.

C. Final Curing

1. Immediately following the initial curing, for a period of not less than six days before concrete has dried, additional curing shall be accomplished by one of the following materials or methods.
  - a. Continuing the method used in initial curing
  - b. Waterproof paper conforming to current Specifications for Waterproof Paper for Curing concrete ASTM C 171
  - c. Other moisture retaining coverings as approved by the Owner.

### 3.10 MEASURES FOR COLD WEATHER PROTECTION

- A. When the mean daily temperature is less than 40°F the Contractor shall provide the necessary temporary heat, protection and enclosures so that newly placed concrete is kept at a temperature of not less than 50 degrees F for 7 days in accordance with ACI 306.1 specifications. At the end of the curing period, artificial heating shall be discontinued and protections and enclosures removed in such a manner that the fall in temperature at any point in the concrete will not exceed 50°F in any 24 hours. Excessive heating shall be avoided to assure no undue loss of moisture from the concrete during the curing period. Fire prevention facilities shall be provided. Admixture of calcium chloride will not be allowed.
- B. Concrete placed when the ambient temperature is lower than 40°F shall have a temperature of not less than 55°F and not greater than 90°F.

### 3.11 MEASURES FOR HOT WEATHER PROTECTION

- A. When a combination of high air temperature, lower humidity and higher wind velocity tend to impair concrete quality, the Contractor shall provide the windbreaks, shading, sprinkling or other means and methods necessary to protect the concrete in accordance with ACI 305.1 specifications.
- B. The maximum temperature of concrete at placement shall not exceed 90°F in hot weather. Steps shall be taken to control concrete temperature and water evaporation by proper attention to ingredients mixing, placing, handling, protection and curing.

### 3.12 TESTING CONCRETE

- A. All finished concrete testing shall be at the expense of the Owner.
- B. Field cured cylinder test results will be used by the Engineer to verify the specified curing and protection, and to evaluate time intervals for removal of forms and shoring, and imposition of service loads.
- C. When test results are such that there is reasonable doubt that the specified concrete strength and other characteristics have been attained in the structure, the Owner may require the Contractor to take cores from the questionable areas and conduct tests to determine the strength and other characteristics of the in-place concrete. Such tests will be paid for by the Contractor.
- D. Concrete failing to meet specified requirements will be rejected, and may be required to be removed and replaced; or, additional approved construction may be required to compensate for rejected concrete; all without additional cost to the Owner, and as required to meet Owner's approval.
- E. Sampling shall be done in accordance with the methods specified in the current edition of ASTM Specification C 172.

### 3.13 FINISHING

- A. General
  - 1. Immediately following the removal of forms all fins, rough spots and hardened mortar shall be removed from all surfaces except those to be covered by backfill.
  - 2. On all surfaces including those to be covered by backfill, the cavities caused by form tie cones shall be repaired with Portland Cement and sand grout. All other holes, honeycomb spots, broken corners or edges shall be thoroughly cleaned to solid concrete but of not less than a minimum depth of one inch with edges cut perpendicular to the surface. After the cuts and surrounding areas have been saturated with water for a period of not less than three hours and the surface to be repaired has been brushed with a grout of equal parts of Portland Cement and sand, they shall be carefully pointed and trued with a mortar of cement and fine aggregate mixed in the same proportion used in the concrete being repaired. Fine aggregate for mortar shall pass a No. 14 screen. The quantity of water used shall be no more than necessary for handling and placing.
  - 3. The repair mortar shall be thoroughly mixed before using until it has reached the stiffest consistency that will permit placing.
  - 4. Repair areas shall be kept moist for seven (7) days by a method meeting the approval of the Engineer.
  - 5. Rough spots, stains, and hardened mortar on surfaces which will be exposed to view shall be removed by rubbing lightly with a fine abrasive stone or hone. Water shall be used freely and rubbing shall be sufficient only to remove the stains without working up a mortar lather or changing the texture of the concrete.
  - 6. Stains caused by excessive use of form oil shall be removed by scrubbing with a 5 to 10 percent solution of muriatic acid, using a stiff bristle brush. The acid solution shall be applied to a thoroughly wetted surface and shall be rinsed off the surface with an abundance of water.

B. Floated Surface Finish

1. A fine floated surface finish shall be given to all slabs. The concrete surface shall be struck off with a straight edge which shall move on suitable guides set to the required elevation for the finished surface. After striking, the surface shall be finished without excessive working to a smooth even surface without any unevenness of more than 1/8 inch in any 10 ft. length in any direction.

3.14 REMOVAL OF LAITANCE

- A. All laitance and concrete which in the opinion of the Owner is of questionable quality shall be removed completely from the top surface of all concrete walls.

3.15 SHOP FABRICATION OF REINFORCING STEEL

- A. Bars shall be bent cold to the shapes and dimensions shown on the Drawings or as specified herein. Bends shall be made in accordance with the requirements of the current CRSI Manual of Standard Practice.
- B. Reinforcement shall not be field bent, except as shown in the Contract Documents or permitted by the Engineer.
- C. Steel shall not be bent or straightened in a manner injurious to the material. Bending of reinforcing steel by heating will not be permitted. Bent up bars in beams and slabs shall be bent at an angle of 45 degrees unless otherwise shown on the Drawings.
- D. Details of reinforcement not covered in Contract Documents shall be in accordance with CRSI Manual of Standard Practice.

3.16 SHIPPING AND STORAGE OF REINFORCING

- A. Reinforcing bars shall be shipped to the site of the work in standard bundles, tagged and marked in accordance with the current Code of Standard Practice of the Concrete Reinforcing Steel Institute.
- B. Reinforcing steel shall be stored above the ground on platforms, skids or other supports, and shall be protected from the weather at all times with suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate inspection and checking. Labor and other assistance shall be furnished to the Owner by the Contractor as may be required to check the steel as it is being stored or after storage on the site.

3.17 PLACING REINFORCING STEEL

A. General

1. All reinforcing steel shall be accurately placed in the position shown on the drawings, or as otherwise specified, and it shall be securely held in place before and during the placing of concrete. When placed in the forms the steel shall be free from dirt, rust, millscale, paint, oil, or other foreign material. In case there is a delay in pouring concrete after the steel has been placed, the steel shall be re-inspected, and when necessary, recleaned prior to placing the concrete. Bases shall be wire tied or clipped at intersections, such fastenings being not more than 18 inches apart in either

direction, unless otherwise approved by the Owner. Supports for reinforcement which are to remain in the finished work shall be precast concrete or plastic tipped metal.

2. The minimum clear distance between parallel bars shall be not less than the nominal diameter of the bars. In no case shall be clear spacing between bars be less than one inch, nor less than 1 1/3 times the maximum size of the coarse aggregate.
3. The minimum concrete cover for reinforcing steel shall be as called for in the current edition of ACI 301, where not specified otherwise on the drawings.
4. The clear distance between reinforcing steel and the face of the concrete shall be maintained at all points in order that the designed strength of the structure shall not be reduced. No reinforcing steel shall be bent or welded in the field without specific permission of the Owner.
5. Tolerances for location of reinforcing steel shall be as called for in current edition of ACI 301 and ACI 117.
6. No splicing of reinforcing bars shall be made at points of maximum stress, except with prior approval of the Owner. Splices in adjacent bars shall be staggered. Lapped splices shall not be used for bars larger than Size No. 11. For bars size No. 11 and smaller in tension or compression lap splicing shall be used.
7. Lapped ends of bars shall be placed in contact and securely wired. Unless otherwise indicated on the Drawings, bars shall have a minimum lap of 40 bar diameters.

B. Dowels

1. All dowels shall be in position before the concrete is placed. Dowels shall not be inserted after the concrete has been placed.

3.18 REMOVAL OF FORMS AND SHORES

- A. Forms shall not be disturbed until the concrete has adequately hardened. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and any superimposed load upon it without exceeding the normal amount of deflection. Members subject to additional loads during construction shall be adequately shored to support both the member and the construction loads in such a manner as will protect the member from damage.

3.19 APPROVAL REQUESTS

- A. The following approval requests shall be submitted to the Owner for review. No such items or the materials therefore shall be ordered fabricated, delivered, or incorporated in the work until the proper approvals for the same have been received from the Owner.

**Approval Requests**

Concrete Design Mix

Concrete Mix Materials

Waterstop

Measures for Cold Weather Protection

Measures for Hot Weather Protection

**Shop Drawings**

Steel Reinforcement

END OF SECTION

SECTION 06610

GLASS FIBER AND RESIN FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass fiber reinforced, pultruded, fire retardant, vinyl ester resin fabrications as indicated on the drawings.
  - 1. Ladders.
  - 2. Structural shapes.
  - 3. Miscellaneous connection members.

1.2 RELATED SECTIONS

- A. Section 07900 - Joint Sealers: Perimeter sealant to adjacent construction.
- B. Section 08305 - Access Doors: Ladder up safety device.
- C. Section 11510 - Safety Equipment: Ladder fall arrest devices.

1.3 REFERENCES

- A. UL - Underwriters Laboratories.
- B. American Society of Testing and Materials (ASTM):
  - 1. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
  - 3. ASTM D 3917 Standard Specification for Dimensional Tolerance of Thermosetting Glass-Reinforced Plastic Pultruded Shapes.
  - 4. ASTM D 3918 Standard Definition of Terms Relating to Reinforced Plastic Pultruded Shapes.
  - 5. ASTM D 3647 Standard practice for Classifying Reinforced Plastic Pultruded Shapes According to Composition.
  - 6. ASTM D 4385 Standard Practice for Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products.
- C. MIOSHA - Part 2 Floor and Wall Openings, Stairways and Skylights.
- D. MIOSHA - Part 3 Fixed Ladders.
- E. Michigan Building Code, Latest Edition.

1.4 DESIGN REQUIREMENTS

- A. General:

1. The Manufacturer shall design FRP items, including associated connections, anchorages, appurtenances and accessories.
2. Design items in compliance with Manufacturer's requirements, current MIOSHA structural guidelines, ASTM standard testing procedures, all governing Building Codes and generally accepted design practices.
3. Pultruded components shall meet or exceed specified Manufacturer's mechanical property tables and minimum ultimate coupon properties data.

B. Ladders:

1. Ladders shall comply with MIOSHA, OSHA 1910.23 and 1926.1053, including construction requirements and loading.
2. Ladder equipped with a fall protection device, such as but not limited to ladder safety devise or self-retracting lifeline, shall comply with MIOSHA requirements for fall protection systems for fixed ladders.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. The Manufacturer shall review the details shown on the Drawings and request substitution of any Manufacturer detail that does not follow the Drawing Details, prior to submittal of shop drawings.

C. Manufacturer quality assurance certificates.

D. Shop Drawings:

1. Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, all components, and anchorages, material types.
2. FRP designs shall bear the seal and signature of a professional engineer currently registered in the State of Michigan as required under Qualifications.

E. Calculation Package:

1. Indicate design load parameters, dimensions, adjacent construction, materials, thicknesses, fabrication details, required clearances, field jointing, tolerances, colors, finishes, methods of support, all components, and anchorages, material types.
2. FRP designs shall bear the seal of a professional engineer currently registered in the State of Michigan as required under Qualifications.

F. Product Data: Provide data on specified components and products including dimensions, finishes, storage and handling requirements and recommendations, and installation recommendations.

G. Samples: Submit two samples, minimum 3 x 3 inch in size, illustrating color, texture, actual size and finish for each type of grating, handrail/guardrail and ladder section.

1.6 QUALIFICATIONS

A. Shop Fabricator: Company specializing in architectural glass fiber and resin components with sufficient production capacity to produce the required units without causing delay in the work.

The Fabricator shall have a minimum of 5 years of documented experience with FRP materials.

- B. FRP items shall be designed by a Professional Structural Engineer, currently registered in the State of Michigan, experienced in design of this work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Protect components from damage by retaining shipping protection in place until installation.
- C. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- D. Identify and match mark all materials, items and fabrications for installation and field assembly. Identify all components with waterproof, removable tags.

#### 1.8 QUALITY ASSURANCE

- A. Do not install site fabricated components when site conditions may be detrimental to successful installation.
- B. Maintain temperature and humidity conditions favorable to proper curing of resin during and after installation.
- C. Manufacturer shall be certified to the ISO 9001 standard, latest edition.
- D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or its products.
- E. Provide three year warranty under provisions of Section 01700.
- F. Warranty: Include coverage for materials and installation of FRP items, appurtenances, and accessories which exhibit deterioration, including fading of color during the coverage period.

### PART 2 PRODUCTS

#### 2.1 FABRICATORS/SYSTEMS

- A. Strongwell Fiberglass Company –SAFRAIL ladders.
- B. Seasafe (AMICO) –Seasafe FRP ladders.
- C. Fibergrate –Dynarail FRP ladders.
- D. Substitutions: approved equal.

## 2.2 MATERIALS

### A. General:

1. New stock, free from all defects and imperfections that could affect the performance of the finished product.
2. Manufacture FRP products using a pultruded process utilizing a flame-retardant vinyl ester resin with a synthetic surface veil in the outermost layer covering the exterior surface meeting the requirements of ASTM E 84, Class 1.
3. FRP items exposed to weather shall contain ultraviolet inhibitors.
4. Connectors for FRP fabrications may be the same material as the FRP. Metal connectors, if used, shall be Type 316 stainless steel.
5. Anchors for base plates shall be Type 316 stainless steel.
6. Pultruded profiles shall meet the requirements of ASTM D 4385.

### B. Ladders:

1. Resin shall be integrally colored, "safety yellow."

## 2.3 FABRICATION

### A. General

1. Die formed, pultruded FRP product.
2. Surface: Smooth and true to form meeting the requirements of ASTM D 4385.
3. Finish trim corners and edges, true to form.
4. All cut ends, holes and abrasions of FRP items shall be sealed with a compatible resin coating to prevent intrusion of moisture and corrosion.
5. Cure components prior to shipment and remove material which may be incompatible with adjacent building materials.
6. Fabricate FRP items as specified and shown on the Drawings.

### B. Ladders:

1. Dimension of side rails and rungs shall conform to MIOSHA.
2. Rungs 1.25 inch diameter fluted circular rod; square rungs are not acceptable.
3. Epoxy and rivet all joints, including rung to side rail attachment. Thru bolting for rung connections shall not be permitted. Connections shall permit hand clearance throughout the length of the ladder. Rungs shall be squared off at point of entry into side rail, riveted and epoxied in place.
4. Shop assemble ladders, pre-drill holes for field attachment of stainless-steel standoff clips.
5. For standoff clips designed by the Manufacturer to transfer lateral loads only, holes for the anchors shall be slotted to allow vertical displacement of the ladder and anchor's nut(s) shall be hand tightened.

### C. Color: "Safety Yellow" unless noted otherwise.

### D. Surface Texture: Smooth ladder gripping surfaces; ladder rungs shall be non-slip.

### E. Exterior ladders shall additionally receive one mil thick U.V. coating of industrial grade polyurethane paint to shield from ultra-violet light.

## 2.4 TOLERANCES

- A. Maximum variation of part thickness: 1/16 inch (1.5 mm).
- B. Maximum variation of part length: 1/8 inch (3 mm).
- C. Maximum variation from square: 1/8 inch (3 mm).
- D. Maximum variation of hardware location: 1/8 inch (3 mm).

## 2.5 IDENTIFICATION

- A. Each part shall be permanently marked with a serial number.
- B. Serial numbers shall coordinate with the shop drawings.

## 2.6 ANCHORS AND FASTENERS

- A. Provide anchors, fasteners and other accessories required for installation of the fabrication as recommended by the Manufacturer.
- B. Anchors and fasteners shall be stainless steel as required under Materials.
- C. Connections to concrete structures shall utilize cast-in-place or post-installed adhesive anchors. Mechanical anchors or directly embedding FRP items into concrete is not permitted.
  - 1. Exception: directly embedding FRP embedment angles into concrete is permitted.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate openings under provisions of Section 01039.
- B. Verify that surfaces and substrate are ready to receive work and dimensions are as indicated on shop drawings.

### 3.2 INSTALLATION

- A. Install fabrications in accordance with shop drawings and fabricator's instructions.
- B. Cutting, fitting and placement required for the installation of miscellaneous FRP fabrications shall be performed. Set FRP fabrications accurately in locations, alignment and elevation, with edges and surfaces level, plumb, true and free of rack, and measured from established lines and levels.
- C. Temporary bracing or anchors in formwork shall be provided for items that are to be built into concrete, masonry or similar construction.
- D. All field cuts shall have the cut edges sealed with a catalyzed resin compatible with the original resin and recommended by the Manufacturer, to protect the member. The cut edges

shall also be touched up with the 1 mil U.V. polyurethane coating specified for the exterior installations.

3.3 TOLERANCES

- A. Maximum variation from true position: 1/4 inch (6 mm).
- B. Maximum offset from true alignment: 1/8 inch (3 mm).

3.4 CLEANING

- A. Clean work under provisions of 01700.
- B. Clean components of foreign material.
- C. Clean fabrications in accordance with fabricator's instructions.

3.5 PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01500.
- B. Place protective covering over installed units.

END OF SECTION

SECTION 08305

ACCESS HATCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Floor access hatches.
- B. Ladder safety post device.

1.2 RELATED SECTIONS

- A. Section 03300 - Concrete Work: Openings in concrete.

1.3 DESIGN REQUIREMENTS

- A. Fabricate structure access hatches at grade for H-20 wheel loading.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate exact position of all access units.
- C. Product Data: Provide sizes, types, finishes, scheduled locations, and details of adjoining work.
- D. Manufacturer's Installation Instructions: Indicate installation requirements, rough-in dimensions and required hardware for complete installation.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Record actual locations of all access hatch units.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's requirements.
- B. Maintain one copy of each document on site.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on approved shop drawings.

1.8 COORDINATION

- A. Coordinate work under provisions of Section 01039.

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- B. These hatches will be incorporated into the pre-cast concrete top slabs, and thus required coordinatoin of the work with structural concrete work, in

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bilco
- B. Halliday
- C. Flygt
- D. Substitutions: Under provisions of Section 01300.

2.2 ACCESS UNITS - FLOORS AND EXTERIOR

- A. Interior and exterior: Single and double leaf hatches with 1 1/2 inch drain coupling for concrete opening sizes as shown on the Drawings:
  - 1. Model "J-AL" and "J-DAL" as manufactured by Bilco.
  - 2. Model "H1R" and "H2R" as manufactured by Halliday.
- B. All hatches shall be supplied with fall protection grating.
  - 1. Grating shall be fiberglass, rated for a 300 PSF live load
  - 2. Grating shall be attached to the hatch and hinged.
  - 3. Pump hatches shall be provided with two (2) fall protection gratings; so that one can be left in the down position while the other grating is in the up position.
- C. All hatches shall be equipped with exposed padlock clips and slam locks with removable key wrenches.
- D. Weatherproof Locks
  - 1. Each access hatch shall be provided with a Master/American A6571 weatherproof padlock.
  - 2. Padlocks shall be keyed to Owners WWTP key system.

2.3 LADDER SAFETY POST DEVICE

- A. "Ladder-Up" Safety Post (stainless steel), as manufactured by Bilco. One post unit required for each ladder located at a hatch opening. Mount post on backside of ladder.

2.4 FABRICATION

- A. Fabricate floor hatch frames of 1/4 inch aluminum. Non-drainage type units shall have built-in neoprene perimeter cushion with strap anchors bolted to the exterior. Drainage coupling type units shall have channel flange with built-in continuous perimeter anchor flange.
- B. Fabricate floor hatch door leaf of 1/4 inch aluminum diamond plate.
- C. Reinforce hatches as specified under Design Requirements.

- D. Weld, fill, and grind joints to assure flush and square unit.
- E. Hardware for Floor Access Hatches:
  - 1. All hardware including all parts of the latching and lifting mechanisms shall be stainless steel.
  - 2. Hinge: 90 degree, heavy duty stainless steel with stainless steel pins, lock open device, counter balanced or compression spring assisted operation.
  - 3. Lock:
    - a. Interior hatches - snap lock with removable handles.
    - b. Exterior hatches - Padlock hasp installed in frame recess protected by a hinged door. Provide two, tamper-proof, security type stainless steel threaded bolts thru hinged door to fasten door in place when hatch is not in use.
  - 4. Automatic hold open arm with vinyl grip release handle.

## 2.5 FINISHES

- A. Floor/Basin Access Hatch Base Metal: Aluminum shall be mill finish,
- B. Aluminum Surfaces shall be backcoated with an Owner approved epoxy/sealer (Tnemec Series N69, Carboline Rustbond penetrating sealer; or Sherwin-Williams Macropoxy 646 or Amerlock sealer) prior to installation in the concrete top slab to provide separation of dissimilar materials.
- C. Finish: Exterior hatches – Factory mill finish.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate conditions under provisions of Section 01039.
- B. Verify that rough openings for hatch and frame are correctly sized and located.

### 3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Turn all keys, removable key wrenches and padlock keys over to the Owner.

END OF SECTION

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SECTION 09900

PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of paints and coatings.
- B. New surfaces and construction shall be painted. Existing surfaces and areas shall be painted as called for on the Drawings.

1.2 RELATED SECTIONS

- A. Section 11390 – Pumping Station Equipment
- B. Section 15060 – Pipe and Pipe Fittings
- C. Section 15100 – Valves
- D. Section 16620 – Packaged Engine Generator Set

1.3 REFERENCES

- A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
- B. AWWA (American Water Works Association) - D102 - Painting Steel Water Storage Tanks.
- C. International Concrete Repair Institute (ICRI) Guideline No. 310.2-1997 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- D. NACE (NACE International) -Industrial Maintenance Painting.
- E. SSPC (SSPC: The Society for Protective Coatings) SSPC Painting Manual Volumes 1 and 2.

1.4 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data on all products and special coatings. Data shall include manufacturer's suggested surface preparation and coating thicknesses.
- C. Samples: Submit two samples, 1 x 3 inch (25 x 76 mm) in size illustrating range of colors and textures available for each surface finishing product scheduled.

- D. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention, environmental considerations and any restrictions regarding time recoat.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section and one of the four companies listed.
- B. Applicator: Company specializing in performing the work of this section with minimum three years, approved by manufacturer.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01600.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Only materials approved for use on this project shall be delivered to the site.
- E. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.
  - 1. Any material found on the project that is stored in areas that are outside of the above temperature requirements shall not be used on the project and shall immediately be removed from the site.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the coating product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints:
  - 1. Minimum application temperatures shall be as required by the coating manufacturer's instructions.
  - 2. If there are no explicit printed recommendations by the manufacturer, minimum temperature of the air and surface to be painted shall be 50° Fahrenheit.
- D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface during coating operations in the area being painted.

#### 1.9 SURFACES NOT REQUIRING PAINTING

- A. Aluminum.

- B. Stainless Steel.
- C. FRP Doors and Frames.
- D. PVC and Fiberglass Pipe and Ductwork.
- E. Inside of pipe spaces, duct shafts, and similar areas not exposed to view.
- F. Exterior galvanized grating or checkered plate need not be painted, except to meet MIOSHA requirements.

#### 1.10 EXISTING PAINTED SURFACES

- A. Existing painted surfaces that will be affected by project activities are to be tested by the Contractor as part of this work scope to determine if they contain lead. Any lead-based paint at affected areas are to be removed and abated in accordance with all federal, state and local regulations and guidelines as part of this work scope. Provide documentation of compliance methods to Owner for record as part of submittals.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers - Paint and Special Coatings
  - 1. Tnemec Company
  - 2. Carboline Company
  - 3. Sherwin-Williams Company
- B. Substitutions: No substitutions are allowed.
- C. All products used on this project shall be from the same manufacturer unless written authorization is received from the Engineer.

#### 2.2 MATERIALS

- A. Coatings:
  - 1. Ready mixed, except field catalyzed coatings.
  - 2. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials:
  - 1. As recommended by the manufacturer and required to achieve the finishes specified, of commercial quality.
- C. Patching Materials:
  - 1. Latex filler.

## 2.3 FINISHES

- A. Refer to schedule at end of section for surface finish schedule.
- B. Colors will be selected by the Owner from color samples submitted.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify site conditions under provisions of the General Conditions.
- B. Verify that surfaces and/or substrate conditions are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Commencement of the coating operations will signify acceptance of the substrate(s) as being suitable for the coating and ability to achieve the final results specified.
- E. Test shop applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  - 1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  - 2. Concrete Floors: 8 percent. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.” And add to references - ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.; and ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

### 3.2 PREPARATION

- A. Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Correct defects and clean surfaces which affect work of this section.
  - 1. Remove existing coatings that exhibit loose surface defects.
- C. Marks:
  - 1. Seal with a stain-blocking primer marks which may bleed through surface finishes.
- D. Impervious Surfaces:
  - 1. Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach.
  - 2. Rinse with clean water and allow surface to dry.
- E. Aluminum Surfaces shall be backcoated with an Owner approved epoxy/sealer (Tnemec Series N69 or Carboline Rustbond penetrating sealer; or Sherwin-Williams Macropoxy 646 or Amerlock sealer) prior to installation to provide separation of dissimilar materials.

1. Contractor shall note that all dissimilar materials shall be kept from direct contact by the use of approved insulating and isolating materials.
  2. All surfaces shall be clean and if necessary treated with Clean'n Etch, Great Lakes Laboratories – Livonia, Michigan.
- F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish:
1. Remove foreign particles to permit adhesion of finishing materials.
  2. Apply compatible sealer or primer.
- G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- H. Fiberglass and PVC piping and connected items as shown on the drawings shall remain unpainted.
1. However, stenciled painted arrows, color bands, etc. shall be provided to agree with the Owner's Standard Color Code.
  2. Surface shall be lightly sanded below code markings prior to painting to obtain a roughened surface.
  3. Surface shall then be wiped with approved thinner solution.
  4. Markings shall then be applied as soon as the thinner has dried.
- I. Galvanized Surfaces Priming:
1. Galvanized surfaces scheduled for painting shall not be water quenched at the end of the galvanizing process.
  2. Remove gloss from the new spangled galvanizing by sweep blasting in accordance with the SSPC, SP-15.
    - a. Non-abrasive organic blasting media shall be utilized.
    - b. Environmental conditions shall be maximum 50% relative humidity and minimum piece and room temperature of 70 degrees F.
  3. An alternate cleaning method of phosphating may be utilized if a detailed procedure is submitted for approval prior to the start of work.
  4. Cleaned surfaces shall not remain overnight without a prime coat.
  5. Galvanize metal primer shall be Tnemec, Tneme-Zinc 90G, Carboline, Carbozinc 859 Primer, Sherwin-Williams DTM Wash Primer or Amercoat 68MCZ.
- J. Galvanized Surface Repair:
1. Damaged or welded galvanized areas shall have the galvanizing repaired in accordance with the current edition of ASTM A780.
    - a. Areas shall be repaired utilizing paints containing zinc dust.
    - b. Paint shall be stirred periodically in accordance with the manufacturer's recommendations to maintain the zinc in suspension.
    - c. The repair areas shall be painted with a brush, spray painting will not be allowed.
  2. Abraded galvanized areas shall be spot primed with a cold galvanizing compound, Tnemec 90-97 Tneme-Zinc, Carbozinc 11 HSN Carboline, Sherwin-Williams Zinc Clad 5 (aerosol), Amercoat 68MCZ or ZRC product with 95% pure zinc dust.
  3. Spot prime all abraded galvanized areas not primed by other trades, to present a complete, protected area, to receive finish coats.
- K. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish:
1. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.

2. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry.
3. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water.
4. Allow to dry.
5. Application of block filler will be by roller or brush.
6. Spraying will not be allowed.

L. Uncoated Steel and Iron Surfaces:

1. Remove grease, , dirt, and other visible contaminants by washing with solvent (SSPC-SP-1)
2. Where mill scale, weld spatter, and rust are evident, remove by power tool wire brushing (SSPC-SP-3) or where required, abrasive blast cleaning (SSPC-SP-10 or SSPC-SP-6);
3. Spot prime paint after repairs.
4. Actual surface preparation procedure shall be based on approved coating manufacturer's published recommendations.

M. Shop Primed Steel Surfaces:

1. Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous.
2. Clean surfaces with solvent.
3. Prime bare steel surfaces.
4. Prime metal items including shop primed items.

N. Mechanical Equipment components to be field painted are to be pre-coated on site prior to assembly.

### 3.3 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Vacuum clean surfaces free of loose particles and/or use tack cloth just prior to applying next coat.
- F. Allow applied coat to dry before next coat is applied.
- G. Insulated pipe, fittings and equipment without an approved surface material or color shall be painted with 2 coats of Tnemec Series 115 Uni-Bond DF, Carboline Carbocrylic 3359, Sherwin-Williams DTM Acyclic or PPG Pitt-Tech DTM Enamel 90-374 Series which complies with the Color Code prescribed herein.
- H. Material labels and accompanying direction of flow arrows shall be applied to all distribution mains on maximum spacing of 50'.

1. They shall be placed at those points on all main lines where branch mains are extended therefrom, and on the distribution mains at both sides of all solid building partitions.
  2. Material labels and flow arrows shall be custom made for all piping systems governed by this contract, signifying the kind of material to be conducted and its direction of flow.
  3. All labels shall be self-adhesive and suitably coated to make them waterproof, and impervious to dirt.
  4. These labels shall have the identifying names superimposed on an Owner's approved background color in full or abbreviated, to meet the Owner's requirements and print the width of the label.
- I. Where letters and arrows cannot be applied to pipe lines, they shall be applied to metal panels, and in a manner to agree with identification listed in the Color Code.
1. Panels shall be 18 gage painted steel and hung on pipes every 50', near branch line connections and on either side of solid building partitions that pipes pass thru.
  2. On lines where there is flow in both directions, double arrows shall be used.
  3. On pipes where there is flow in one direction, single arrows shall be used.
- J. Substation equipment, control panels, panel boards, and other equipment specified to receive factory finish shall not be painted.
1. However, factory painted equipment which is chipped or defaced due to handling, installation or construction activities shall be refinished in a manner satisfactory to the Owner.
  2. This shall include glazing, sanding, and refinishing entire surface to a suitable boundary to avoid a patched effect.
  3. Suitable boundaries shall be changes in planes of surfaces such as corners, frames, mouldings, recesses, etc.
- K. Hazardous areas, moving machinery, handrails, and all other similar areas shall be finished to agree with the Owner's Standard Safety Code and all MIOSHA requirements, as approved by the Owner.

### 3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to Division 16 Electrical for information on Electrical Identification requirements.
1. Refer to the end of this Section for color coding and identification banding of equipment, duct work, and piping.
- B. Paint shop primed equipment.
- C. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- D. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports.
- E. Paint dampers exposed behind louvers, grilles, to match face panels.
- F. Paint exposed conduit and electrical equipment occurring in painted areas.

- G. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- H. Color code equipment, piping, conduit, and exposed duct work in accordance with requirements indicated.
  - 1. Color band and identify with flow arrows and names, to match the existing installation.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

### 3.5 FIELD QUALITY CONTROL

- A. Contractor shall refer to the SSPC Paint Inspection: Daily Coating Inspection Report that is a part of this section of the Specifications
  - 1. This report shall be filled out daily for every day that the painter is on site and working.
  - 2. The reports shall be filled out in their entirety as applicable for the work being performed.
  - 3. Provide multiple reports if necessary because the work for the day will include several coatings so each paint/coating type is properly documented.
  - 4. All reports shall be available to the Owner and the Owner's representative upon request at the site.
  - 5. Copies of these daily reports shall be submitted with each Payment Application for painting and coating work performed on this project for the period that is covered by the Payment Application.
  - 6. Failure to submit reports or deficient reports shall be reason to not approve the requested payment for the work.
- B. Field inspection and testing will be performed under provisions of Section 01400.
- C. Areas will be tested at random with dry film thickness gage.
  - 1. Any areas not meeting the minimum dry film thickness shown in the schedule or on approved Shop Drawing submittals shall have additional coats applied so the minimum dry film thickness is achieved.
  - 2. Each coat shall achieve the minimum dry film thickness specified, without regards to the overall system thickness.
- D. If an existing surface or area is not called out for painting but is defaced or damaged due to new Work under this Contract, then this surface or area shall be repainted to match adjacent areas, at no additional cost to the Owner.
  - 1. Repair areas shall be to a suitable area boundary as determined by the Engineer in the field.
  - 2. A repaired area may include an entire wall or the entire floor in a room or gallery.
  - 3. Patched effect repairs shall not be acceptable.

### 3.6 CLEANING

- A. Clean work under provisions of 01700.

- B. Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
- C. Make good all damage done to floors and other work through neglect or carelessness or from failure to properly protect work from damage resulting from the execution of this work.

3.7 SCHEDULE - ALL INTERIOR AND EXTERIOR SURFACES

Paint  
System

Surfaces

- 1 Interior and Exterior Ferrous Metals.
  - 2 Piping and Equipment Located Indoors (not specified elsewhere).
  - 3A Interior Masonry units.
  - 3B Interior exposed precast and poured in place concrete, including all interior concrete wall surfaces below grade (not specified elsewhere).
  - 4 Miscellaneous Iron/Ferrous Metals covered with Masonry and Concrete Not Accessible for Painting.
  - 5 Non-Submerged Mechanical Equipment Components, unless otherwise noted.
  - 6 Submerged Ferrous Mechanical Equipment Components and piping, unless otherwise noted.
  - 7 Drywall and Interior Wood.
  - 8 Building Ceiling Suspension System.
- A. Contractor shall note that PVC/fiberglass designation painting in addition to lightly sanding and wipe off with approved thinner solution shall consist of two coats of finish specified under PAINTING SYSTEM NO. 2 for the area to receive the identification.
  - B. All painted walls, without applied base, shall be scribed 4" and painted with a 4" high, gloss black base.
    - 1. Material for base shall be compatible with the wall material.
  - C. Aluminum Surfaces shall be backcoated with an Owner approved epoxy/sealer. Refer to Section 3.2.E of this Painting Specification.

3.8 PAINTING - SYSTEMS

(Contractor shall refer to Products Section herein with regard to acceptable material manufacturers.)

		<b>Min. No. of Coats per Coating Layer</b>	<b>Product Name</b>	<b>Min. Total Thickness of Coating Layer Dry</b>	<b>Type</b>
A.	PAINTING SYSTEM NO. 1 - Interior and Exterior Ferrous Metals Surface Preparation - SSPC-SP 6				
	Primer	1	Tnemec Series N69	3.0	Polyamide Epoxy
	Intermediate	1	Tnemec Series N69	4.0	Polyamide Epoxy
	Finish	1	Tnemec 1075 Endura Shield	3.0	Aliphatic/ Acrylic Polyurethane
	Or				
	Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
	Intermediate	1	Carboline 890	4.0	Cycloaliphatic Amine Epoxy
	Finish	1	Carboline 134 HG	3.0	Aliphatic/ Polyurethane
	Or				
	Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
	Intermediate	1	Sherwin-Williams Macropoxy 646	4.0	Epoxy
	Finish	1	Sherwin-Williams Acrolon 218 or Hi-Solids Polyurethane (hot weather alternative)	3.0	Aliphatic/ Polyurethane

Total Thickness of System – 10.0/12.0 Dry Mills Min.

Contractor shall note curing times required between coats, per actual product used.

	<b>Min. No. of Coats per Coating Layer</b>	<b>Product Name</b>	<b>Min. Total Thickness of Coating Layer Dry</b>	<b>Type</b>
B. PAINTING SYSTEM NO. 2 - Piping and Equipment Located Indoors Surface Preparation - SSPC-SP 6.				
Primer	1	Tnemec Series N69 EpoXoline	3.0	Epoxy
Finish	2	Tnemec Series N69 EpoXoline	8.0	Epoxy
Or Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
Finish	2	Carboline 890	8.0	Cycloaliphatic Amine Epoxy
Or Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Finish	2	Sherwin-Williams Macropoxy 646	8.0	Epoxy

Total Thickness of System – 11.0 Dry Mills Min.

	<b>Min. No. of Coats per Coating Layer</b>	<b>Product Name</b>	<b>Min. Total Thickness of Coating Layer Dry</b>	<b>Type</b>
C. PAINTING SYSTEM NO. 3A - Interior Masonry units Surface Preparation - SSPC-SP 13/NACE 6.				
Undercoater	1	Tnemec 130-6602 Envirofill	60-80 s.f. gal.	Waterborne Cementitious Acrylic
Primer	1	Tnemec Series N69 Hi-Build Epoxoline II	4.0	Epoxy
Finish	1	Tnemec Series N69 Hi-Build Epoxoline II	4.0	Epoxy
Or				
Undercoater	1	Carboline Sanitile 500 Block Filler	60-100 s.f. gal.	Water Based Epoxy Filler
Primer	1	Carboline 890	3.0	Cycloaliphatic Amine Epoxy
Finish	1	Carboline 890	3.0	Cycloaliphatic Polyurethane
Or				
Undercoater	1	Sherwin-Williams Cement-Plex 875	60-100 s.f. gal.	Cementitious Waterborne Block filler
Primer	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy
Finish	1	Sherwin-Williams Macropoxy 646	3.0	Epoxy

Total Thickness of System – 6.0/8.0 Dry Mills Minimum over filled surface.

D. PAINTING SYSTEM No. 3B - Interior exposed precast and poured in place concrete  
Surface Preparation - Same as above

Primer and Finish - Same as above, but without Undercoater

Total Thickness of System – 6.0/8.0 Dry Mills Min.

	<b>Min. No. of Coats per Coating Layer</b>	<b>Product Name</b>	<b>Min. Total Thickness of Coating Layer Dry</b>	<b>Type</b>
E.	PAINTING SYSTEM NO. 4 - Miscellaneous Iron/Ferrous Metals covered with Masonry and Concrete Not Accessible for Painting. Surface Preparation - SSPC-SP 6/NACE 3.			
	Primer	1	Sherwin-Williams Macropoxy 5500LT	2.0 – 4.0 Epoxy
	Finish	1	Sherwin-Williams Dura-Plate 600 Epoxy 1 coat Or 2 coats	40.0 20.0 ea. Epoxy
	Total Thickness of System – 40.0 Dry Mills Min			
F.	PAINTING SYSTEM NO. 5 - Non-Submerged Mechanical Equipment Components Surface Preparation - SSPC-SP 6.			
	Primer	1	Tnemec Series N 69	3.0 Epoxy
	Intermediate	1	Tnemec Series N69	4.0 Epoxy
	Finish	1	Tnemec 1075 Endura Shield	3.0 Aliphatic/ Acrylic Polyurethane
	Or Primer	1	Carboline 880	3.0 Epoxy Polyamide
	Intermediate	1	Carboline 880	4.0 Epoxy Polyamide
	Finish	1	Carboline 134 HG	3.0 Aliphatic Acrylic Polyurethane
	Or Primer	1	Sherwin-Williams Macropoxy 646	3.0 Epoxy
	Intermediate	1	Sherwin-Williams Macropoxy 646	4.0 Epoxy
	Finish	1	Sherwin-Williams Acrolon 218 HS or Hi-Solids Polyurethane	3.0 Acrylic Polyurethane Aliphatic/ Polyurethane

**Min. No. of Coats  
per Coating**

**Min. Total Thickness  
of Coating**

	<b>Layer</b>	<b>Product Name</b>	<b>Layer Dry</b>	<b>Type</b>
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PAINT SYSTEM NO. 5 – Cont’d

Total Thickness of System - 10.0 Dry Mills Min.

Contractor shall note curing times required between coats, per actual product used.

- G. PAINTING SYSTEM NO. 6 - Submerged Ferrous Mechanical Equipment Components and piping (non-potable)  
Surface preparation - SSPC-SP10

Primer	1	Sherwin-Williams Macropoxy 5500LT	2.0 – 4.0	Epoxy
Finish	1	Sherwin-Williams Dura-Plate 600 Epoxy		Epoxy
		1 coat	40.0	
		Or 2 coats	20.0 ea.	

Total Thickness of System – 40.0 Dry Mills Min.

		<b>Min. No. of Coats per Coating Layer</b>	<b>Product Name</b>	<b>Min. Total Thickness of Coating Layer Dry</b>	<b>Type</b>
H.	PAINTING SYSTEM NO. 7 –		Drywall and Interior Wood Surface Preparation - Dry and clean wood surfaces in accordance with Mfr's printed Recommendations.		
	Primer (drywall)	1	Tnemec Series 115 Uni-Bond DF	2.0	Acrylic
	Finish	2	Tnemec Series 6 Tneme-Cryl	4.0	Acrylic
	Or				
	Primer	1	Carboline Carbocrylic 120	2.0	Acrylic
	Finish	2	Carboline Carbocrylic 3359 MC	4.0	Waterborne
	Or				
	Primer	1	Sherwin-Williams DTM Acrylic B66W1	2.0	Vinyl Acrylic
	Finish	2	Sherwin-Williams Acrylic DTM B66-200	4.0	Acrylic

Total Thickness of System – 6.0 Dry Mills Min.

Contractor shall note curing times required between coats, per actual product used.

I.	PAINTING SYSTEM NO. 8 - Building Ceiling Suspension System.		Surface Preparation - Dry and clean surfaces in accordance with Mfr's printed Recommendations.		
	Primer	1	Tnemec Series 151 Elasto-Grip	1.0	Waterborne Modified Polyamide Epoxy
	Finish	1	Tnemec Series 113 Tneme-Tufcoat	4.0	Waterborne Acrylic
	Or				
	Primer	1	Carboline Carbocrylic 120	2.0	Acrylic
	Finish	2	Carboline Carbocrylic 3359 MC	4.0	Waterborne Acrylic
	Or				
	Primer	1	Sherwin-Williams Waterborne Acrylic Dryfall	3.0	Waterborne Acrylic
	Finish	2	Sherwin-Williams Waterborne Acrylic Dryfall	3.0	Waterborne Acrylic

Total Thickness of System - 6.0 Dry Mills Min.

3.9 SCHEDULE -EQUIPMENT COLORS

<b><u>EQUIPMENT</u></b>		<b><u>COLOR</u></b>
D.	Blowers	*
E.	Compressors	*
F.	Couplings	Yellow
G.	Cranes (Hoists)	Yellow
H.	Blocks	Yellow and Capacity in Black
I.	Fans	Orange
J.	Flow Meters	*
K.	Gear Reducers	Yellow
L.	Guards	Orange
M.	Motors	Orange
N.	Pumps	*
O.	Screens	*
P.	Switch Enclosure	Orange
Q.	Tanks	*
R.	Valves	*
S.	Valve Operators	Yellow
T.	Handrail/Guardrail	Orange **
U.	Handrail/Guardrail-Removable	Yellow & Black **
V.	Fire Protection Equipment	Red
W.	Emergency Stop Bars, Buttons, Etc.	Red
X.	First Aid Kits and Enclosures- containing First Aid Equipment	Green
Y.	Safety Showers, Face Washes, etc. (Area Around)	Green
Z.	Transformers	Orange
AA.	Switchgear	Grey or Buff
BB.	Misc. Metal	Black (unless otherwise noted)
AA.	* Color will depend on service. The color will be obtained from the "PIPE COLOR CODE" for the service. (No stripes used on equipment.)	
BB	** Brass, aluminum or stainless steel need NOT be painted.	

The following colors shall be in conformity with the current ANSI Z553.1-2006 as referred to by MIOSHA.

1. Red
2. Orange
3. Yellow
4. Green
5. Blue
6. Purple
7. Black
8. White

Note: Colors shall meet the tests specified in Section 3, Color Definitions, of the current ANSI/NEMA Z535.1-2006

3.10 SCHEDULE - PIPING COLORS

<u>SERVICE</u>	<u>COLOR</u>	<u>STRIPE</u>
A. Potable Water - Cold	Green	
B. Potable Water - Hot	Green	Aluminum (1)
C. Emergency Shower Water		Green Yellow (1)
D. Flushing Water	Gray	Blue (1)
E. Decant Water	Gray	White (1)
F. Industrial Water	Blue	
G. Ground Water	Blue	Green (1)
H. Instrument Air	Purple	Blue (1)
I. Natural Gas	Yellow	
J. Vacuum	Purple	Aluminum (1)
K. Roof Conductors	Match Background	
L. Floor Drains	Match Background	
M. Sump Pump Discharge	Gray	Black (1)
N. Sanitary Drains & Vents	Black	
O. Raw Sewage or Waste Water		Gray
P. Sample Lines	Match System Being Sampled	
Q. Electrical Conduit	Match Background	
R.	Stainless Steel	6" band with 3/4" stripes at 1"
S.	Copper	6" band with 3/4" stripes at 1"
T.	Plastic	6" band with 3/4" stripes at 1"

END OF SECTION

**Paint Inspection:  
Daily Coating Inspection Report**

Date: / / M T W Th F S Su		Pg. Of
Project #:		COPY To:
Inspector:		<input type="checkbox"/> QC Mgr <input type="checkbox"/> Owner
Project/Client:		<input type="checkbox"/> Contr <input type="checkbox"/> _____
Location:		Attachments:
Description:		<input type="checkbox"/> DFT Sheet <input type="checkbox"/> NCR/CAR
Requirements:		<input type="checkbox"/> _____
Contractor:		Revision #
Spec #		
<b>Description of Areas &amp; Work Performed</b>		<b>Hold Point Inspections Performed</b>
		<input type="checkbox"/> 1 Pre Surface Prep/Condition & Cleanliness
		<input type="checkbox"/> 2 Surface Preparation Monitoring
		<input type="checkbox"/> 3 Post Surface Preparation/Cleanliness & Profile
		<input type="checkbox"/> 4 Pre Application Prep/Surface Cleanliness
		<input type="checkbox"/> 5 Application Monitoring/Wet Film Thickness (WFT)
		<input type="checkbox"/> 6 Post Application/Application Defects
		<input type="checkbox"/> 7 Post Cure/Dry Film Thickness (DFT)
		<input type="checkbox"/> 8 Nonconformance/Corrective Actions Follow-up
		<input type="checkbox"/> 9 Final Inspection
		Approved By: _____
<b>Surface Conditions</b>		<b>Ambient Conditions</b>
<input type="checkbox"/> New <input type="checkbox"/> Maint <input type="checkbox"/> Primer/Paint <input type="checkbox"/> Age/Dry/Cure _____		Time (Indicate AM or PM) : : : :
<input type="checkbox"/> Steel <input type="checkbox"/> Galvanize <input type="checkbox"/> Concrete <input type="checkbox"/> Other _____		Dry Bulb Temp <sup>o</sup> (C/F) : : : :
<input type="checkbox"/> Hazard _____ <input type="checkbox"/> Sample Report # _____		Wet Bulb Temp <sup>o</sup> (C/F) : : : :
<input type="checkbox"/> Degree of contamination: _____		% Relative Humidity : % : % : % : %
Test: <input type="checkbox"/> Cl _____ µg/cm <sup>2</sup> / ppm <input type="checkbox"/> Fe _____ ppm <input type="checkbox"/> pH _____		Surface Temp <sup>o</sup> (C/F) Min/Max : / : / : / : /
<input type="checkbox"/> Degree of Corrosion: _____		Dew Point Temp <sup>o</sup> (C/F) : : : :
<input type="checkbox"/> Scale <input type="checkbox"/> Pitting/Holes <input type="checkbox"/> Crevices <input type="checkbox"/> Sharp Edges		Wind Direction/Speed : : : :
<input type="checkbox"/> Weld _____ <input type="checkbox"/> Moisture <input type="checkbox"/> Oils <input type="checkbox"/> Other _____		Weather Conditions: : : : :
<input type="checkbox"/> Painted Surface Condition: _____		<b>Application</b>
Dry to: <input type="checkbox"/> Touch <input type="checkbox"/> Handle <input type="checkbox"/> Recoat		Start Time : Finish Time : Est. Sq/ft.
<input type="checkbox"/> Dry/Over Spray <input type="checkbox"/> Runs/Sags <input type="checkbox"/> Pinholes <input type="checkbox"/> Holidays		<input type="checkbox"/> Primer <input type="checkbox"/> Intermediate <input type="checkbox"/> Topcoat <input type="checkbox"/> Touch-up
<input type="checkbox"/> Abrasion <input type="checkbox"/> Fall Out <input type="checkbox"/> Other _____		Generic Type: Qty Mixed:
<b>Surface Preparation</b>		Manuf.: Mix Ratio:
Start Time: Finish Time: Est Sq/ft:		Prod Name: Mix Method:
<input type="checkbox"/> Solvent Clean <input type="checkbox"/> Hand Tool <input type="checkbox"/> Power Tool		Prod #: Strain/Screen:
<input type="checkbox"/> HP Wash PSI _____ <input type="checkbox"/> Other _____		Color: Material Temp: °F
<input type="checkbox"/> Abrasive Blast <input type="checkbox"/> Abrasive Type _____ <input type="checkbox"/> Sample		Kit Sz/Cond.: Sweat-in Time: Min/Hrs
<input type="checkbox"/> Blast Hose Size _____ <input type="checkbox"/> Nozzle Size / PSI _____		Shelf Life: Pot Life: Min/Hrs
<input type="checkbox"/> Air Supply CFM _____ <input type="checkbox"/> Air Supply Cleanliness		<b>Batch #'s</b>
<input type="checkbox"/> Water/Oil Trap Check <input type="checkbox"/> Equipment Condition Check		(A) Reducer #: Qty Added: Pt/Qt/Gal
		(B) % by Vol: %
		(C) Specified WFT Avg: Mils
		Achieved WFT Avg: Mils
<b>Surface Cleanliness &amp; Profile Measurement</b>		<input type="checkbox"/> Airless/Conv. Spray <input type="checkbox"/> Brush <input type="checkbox"/> Roller <input type="checkbox"/> Other _____
<input type="checkbox"/> Job Specification <input type="checkbox"/> SSPC/NACE - SP- _____		Pump Pot Hose Dia. Air Check
<input type="checkbox"/> SSPC/NACE Spec / Visual Stds <input type="checkbox"/> _____		Ratio/Size Hose Lng. SEP/Trap
Profile Check: _____ <input type="checkbox"/> Disc <input type="checkbox"/> Tape <input type="checkbox"/> Gauge		GPM/CFM Spray Gun Filter
<input type="checkbox"/> Specified _____mils avg. / Achieved _____mils		PSI Tip Sz. Agitator
<input type="checkbox"/> Surface effect on DFT Gauge/BMR _____mils		
<b>Dry Film Thickness</b>		
Gage Type / Model	Gage Serial #	Gage Calib. Verified
Spec Avg. DFT	Total Avg DFT	DFT Last Coat
		DFT This Coat
Inspector's Signature		Date



## **SECTION 11390**

### **PUMPING STATION EQUIPMENT**

#### **PART 1 GENERAL**

##### **1.1 GENERAL REQUIREMENTS**

- A. Furnish all labor, materials, tools, equipment and supervision required to install the pumping equipment, as indicated on the drawings and specified herein, and all other work incidental thereto, except as otherwise noted.
- B. The work under this section is intended to include the necessary materials and workmanship which are required for the completion of the pumping station, as shown on the drawings, unless otherwise specified.
- C. The work shall be complete and ready for satisfactory operation whether or not each and every item is shown on the drawings or specifically mentioned in these specifications.

##### **1.2 ITEMS SPECIFIED ELSEWHERE**

- A. Sequencing and other specific provisions are specified in 01950 Special Project provisions
- B. Force mains and sanitary sewers external to the pumping station shall be as specified in Division 2 and in Section 15060 of these Specifications.
- C. Piping and fittings internal to the Pump Station shall be as specified in Section 15060. Valves shall be as specified in Section 15100.
- D. Pump Control Panel is specified in Section 11392.
- E. The requirements of all applicable Sections of Division 16, "Electrical," and all other applicable Sections of these Specifications, form a part of this Section and govern work covered in this Section.

##### **1.3 ELECTRICAL REQUIREMENTS**

- A. Refer to Division 16 and Section 15010 of the Specifications for the supply and installation of all electrical equipment, wiring, conduit, control cabinets, level systems, and other electrical devices furnished under this Section of the Specifications.
- B. Wire and terminal numbering and wire color requirements shall be as specified in the "Electrical" Division of these Specifications. Wiring diagrams are required in the form as called for in the "Electrical" Division of these Specifications.

##### **1.4 SHOP DRAWINGS & OPERATION & MAINTENANCE MANUALS**

- A. Submit Shop Drawings per Section 01300, including certified pump curves
- B. Submit O&M Manuals per Section 01730

- C. Submit Training Materials per Section 01800
- D. Also see Section 15000, Item 1.3 for detailed requirements.
- E. Submit Extended Warranty

## **1.5 INSPECTION TRAINING REQUIREMENTS**

- A. A factory representative employed by the pump manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment and to instruct the Owner's operating personnel in the maintenance and operation of these units. The scheduling of this service shall be coordinated with the Owner and the cost of this service shall be included in the contractor's bid price.
- B. Training requirements shall be two (2) days (4 hours per day at site) unless otherwise specified. Training shall occur on separate, non-sequential days.

## **1.6 PAINTING**

- A. All piping, valves, pumping equipment, access covers and miscellaneous metals shall be painted as described in Section 09900 - Painting.

## **1.7 GUARANTY**

- A. The required guaranty period for all items covered by this section of the Specifications shall be one year, unless a greater period is otherwise specified and required. All guaranty periods shall start at the date of equipment acceptance as specified in the General Conditions.
- B. The pump manufacturer shall warrant all pumps being supplied to the Owner against defects in workmanship and material for a period of five (5) years from the date of acceptance under normal use, operation and service.

## **PART 2 PRODUCTS**

### **2.1 WORK INCLUDED**

- A. This section covers the supply and installation of pumping equipment, piping, valves and associated electrical work.
- B. The Contractor shall furnish and install all necessary supports, framing, motors, cable supports, and all other appurtenances specified herein or required for a complete installation.
- C. The Contractor shall provide certified copies of head capacity curves for all pumps based on test data from similar pumps. Curves shall also include pump efficiency and horsepower. The motor horsepower specified or shown on the drawings shall be considered the maximum acceptable horsepower for the pump.
- D. Pumps shall have grease or oil lubricated bearings with a minimum AFBMA B-10 rating of 50,000 hours, unless otherwise specified.

- E. All pumps shall be mounted on rigid cast iron base elbows as specified hereinafter. Baseplates shall be capable of supporting pumps without additional support.
- F. Rotation of all pumps shall be field checked and adjusted as required prior to startup of pumps.

## 2.2 PUMPS

- A. Pumps shall be provided by Xylem/Flygt, KSB, or ABS/Sulzer as specified herein. Alternate manufacturers or substitutions will not be considered.
- B. Pumps shall be submersible, explosion-proof, non-clog pumps capable of handling raw, unscreened sewage and wastewater. Their design shall be such that each pump shall be automatically and firmly connected to its discharge piping when lowered into place on its mating discharge connection, permanently installed in the wet well. The pumps shall be easily removable for inspection or service requiring no bolts, nuts or other fastenings to be disconnected.
- C. Each pump shall be fitted with a Type 316 stainless steel forged link chain of adequate strength and length to permit lifting of the pump to 5 ft. above the top slab of the wet well. Each chain shall be securely attached at the top of the wet well to a stainless-steel eye bolt with a spring loaded stainless steel clevis located within or adjacent to the wet well access hatch to prevent the chain from falling into the wet well. The pump chain and all appurtenances required to provide a complete pump removal system shall be supplied by the pump manufacturer.
- D. Each pump, with its appurtenances and chain, shall be certified to have withstood a test for continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
- E. The pump shall be capable of running with the motor exposed for a period of 24 hours in a Class I, Division I, Group D hazardous atmosphere. The pump motor cable and cable entry shall be rated explosion-proof by UL or FM and shall be suitable for operating continuously in the above described hazardous atmosphere.
- F. The pump shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data.
- G. Major pump components shall be of ASTM A-48, Class 30 or 40 gray cast iron with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be ASTM A-276, Type 316 stainless steel. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage resistant coating. Pump exterior shall be sprayed with manufacturer's standard epoxy paint system.
- H. All mating surfaces where watertight sealing is required shall be machined and fitted with Buna-N or nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of o-rings without requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices shall be used.

- I. The cable entry water seal design shall preclude specific torque requirements to ensure a watertight seal and shall be strain relieved. The cable entry shall be designed with a gland or grommet having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body. The cable entry shall be suitable for operation in a Class I, Division I, Group D hazardous atmosphere. The cable entry design shall incorporate those features necessary to preclude entry of water to the terminal board and motor even if the cable is damaged or severed below water level.
- J. Each pump motor shall be an explosion-proof squirrel-cage, induction, shell type design motor, housed in an air-filled, watertight chamber, NEMA Design B type. The stator winding and stator leads shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155°C (311°F). The motor shall be designed for continuous duty, capable of sustaining a minimum of twenty starts per hour. The motor shall also have cooling characteristics suitable for continuous operation in a totally, partially or non-submerged condition in a hazardous atmosphere. The pump shall be capable of running dry for a period of 24 hours without damage or overheating. The rotor bars and short circuit rings shall be made of aluminum. The pump motor shall not rely on circulated sewage to satisfy its cooling requirements.
- K. Connection between the cable conductors and stator leads shall be made with threaded compressed type binding post permanently affixed to a terminal board within the junction chamber on top of the motor.
- L. Thermal sensors shall be used to monitor stator temperatures. The stator shall be equipped with three (3) thermal switches, or detectors, embedded in the end coils of the stator winding (one switch in each stator phase). These shall be used in conjunction with and supplemental to external motor overload protection and wired to the control panel. The thermal switches or detectors shall be wired to an over-temperature protective relay used to indicate an alarm condition. An over-temperature detector relay compatible with the pump temperature switches or detectors shall be provided by the pump supplier. The relay shall provide protective contacts, and additional dry contacts for monitoring by the control system.
- M. The pump shaft shall be ASTM A-276, Type 420 stainless steel or ASTM A-576-1045 carbon steel protected by an ASTM A-276, Type 420 stainless steel shaft sleeve.
- N. Each pump shall be provided with a tandem mechanical rotating shaft seal system. Seals shall run in an oil reservoir. Lapped seal faces shall be hydrodynamically lubricated at a constant rate. The lower seal unit, between the pump and oil chamber, shall contain one stationary and one positively driven rotating tungsten carbide or silicon carbide ring. The upper seal unit, between the oil sump and motor housing, shall contain one stationary silicon carbide or tungsten carbide ring and one positively driven rotating carbon ring. Each pump shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed to assure that air is left in the oil chamber, to absorb the expansion of the oil due to temperature variations. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
- O. A seal failure leak detector shall be furnished to detect the presence of moisture in the motor stator chamber or the oil chamber. The leak detector shall be a float switch mounted in the stator chamber or a probe in the oil chamber. The float switch or probe shall be wired to a leak detector relay used to indicate an alarm condition. A leak detector relay compatible with

the pump leak detector shall be provided by the pump supplier. The relay shall provide protective contacts, and additional dry contacts for monitoring by the control system.

- P. The pump shaft shall rotate on two (2) permanently lubricated bearings. The upper bearing shall be a roller or ball bearing and the lower bearing shall consist of one, single row angular contact ball bearing and a single row roller bearing or a double row ball bearing.
- Q. The impeller shall be of gray cast iron, Class 35, with hardened edge, dynamically balanced, non-clogging design having a long throulet without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The fit between the impeller and the shaft shall be a sliding fit with one key, and the fastening of the impeller to the shaft shall be made by a locking assembly consisting of a bolt threaded to the shaft terminal. Impeller shall be combined with a hardened cast iron cutter plate. Fibers shall be caught by the cutter grooves and sheared between the hardened edge of the impeller and the hard cutter plate.
- R. The volute shall be of single piece design and shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller, the volute bottom shall be of a suction bell design. The volute shall be provided with a cleanout hand hole with a removable cover.
- S. The pump motor cable shall be suitable for submersible pump application with P122-MSHA approval indicated by a code or legend permanently embossed on the cable or on a stainless-steel nameplate attached to the pump. Cable sizing shall conform to National Electrical Code requirements for motors. The cable shall also be suitable for use in Class I, Division 1, Group "D" hazardous locations per N.E.C. requirements, including requirement that cable is incapable of transmitting gases or vapors through the cable core.
- T. Chains for pump removal shall be provided and shall be 316 stainless steel.
- U. A 316 stainless steel sliding guide bracket shall be an integral part of each pump unit. Each volute casing shall have machined discharge flange to automatically and firmly connect with the cast iron discharge connection, which when bolted to the floor of the wet well and discharge line, shall receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps or similar devices.
- V. Installation of the pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit, guided by a dual guide rail system. Sealing of the pumping unit to the discharge connection shall result from the simple linear downward motion of the pump, with the entire weight of the pumping unit guided to and pressing against the discharge connection; no portion of the pump unit shall bear directly on the floor of the wet well. Guide rails, an upper guide bracket, chain hook, and cable holder shall be provided for each pump. All components shall be of 316 stainless steel construction. Lower guide holders shall be integral with pump discharge connection pipe. Guide bars shall be made of Schedule 40, 316 Stainless Steel Pipe as shown on the Drawings.
- W. Pumps shall be suitable for connection to the electric service shown on the Drawings. Each pump shall be furnished with a sufficient length of electrical cable to run from the pump to the junction box mounted as shown on the Drawings. The lugged connection must be coordinated with the electrical subcontractor and their junction box and conduit work. The electric cable

shall contain sufficient conductors for power, thermal switches, leak detectors and ground, sized as required by the National Electrical Code as a minimum. Prior to shipment the cable end shall be sealed with a high-quality protective covering to make it impervious to moisture or water.

- X. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from the factory:
  - 1. Impeller, motor rating and electrical connections shall be checked for compliance with the specification requirements.
  - 2. A motor and cable insulation test for moisture content or insulation defects shall be made.
  - 3. Prior to submergence, the pump shall be run dry to establish mechanical integrity.
  - 4. The pump shall be run submerged for 30 minutes, at a minimum of six (6) ft. depth under water.
  - 5. After operational test #4, the insulation test #2 shall be performed again.
- Y. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.
- Z. Each pump shall be rated to deliver the minimum specified flow of wastewater at the total dynamic head listed in the table below. Each pump shall also provide the minimum shut-off head listed in the table.

Station	Capacity per Pump (gpm)	TDH (Ft)	S.O.H. (Ft)	Motor (HP)	Quantity
Astor	1,021	42	75	15	2
Franklin	350	58	83	10	2

**2.3 ACCESS HATCHES**

- A. Refer to specification section 08305 – Access Hatches for information on the wet well and valve vault access hatches.
- B. The pump shop drawings including chain and cable hooks and placement, must be coordinated with the access hatch drawings so that there are no interferences.

**2.4 PRESSURE GAUGES**

- A. Pressure gauges shall be installed as shown on the Drawings or specified herein. Each gauge shall be 2-1/2" dia. dial size, liquid filled (glycerin & water), 316 S.S. case, stem mounted, accurate to 2% of scale at mid-scale, SS movement, adjustable micrometer pointer, stainless steel bourdon tube and socket, dial range is indicated on the Drawings, Model D831 as manufactured by H.O Trerice Co., Ashcroft or Owner approved. All pressure gauges shall be furnished with a gauge isolator. Gauge isolators shall be 1-1/2" dia. Red Valve Company, Series 42 threaded end sensor complete with 3/4" dia. valved hose connection for flushing,

stainless steel body and Buna-N sensing sleeve and isolation valve. Ball valves shall be of type 316 stainless steel construction, Jamesbury Clincher, Style 21-36 or equal.

## **2.5 COMPATIBILITY OF PUMPS AND ACCESSORIES**

- A. To ensure compatibility between the pumps and the various accessories in the pumping station, including electrical components, the pump manufacturer shall furnish the mounting hardware, float switches, access hatch guides, and pump motor cables.

## **2.6 PUMP CONTROL PANEL**

- A. The pump manufacturer shall also furnish a Pump Control Panel including all electrical and control equipment as detailed on the Drawings and as specified in Section 11392.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, Contractor shall inspect all pumping station equipment and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. The Contractor shall validate all serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

### **3.2 INSTALLATION**

- A. Install, level, align, and lubricate each pump station in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence (rotation) and ground before actual start-up.

### **3.3 OPERATIONAL TEST**

- A. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition and conforms to the specified operating characteristics.
- B. After construction debris and foreign material has been removed from the wet well, Contractor shall supply clear water volume adequate to operate station through several pumping cycles.

Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

### **3.4 MANUFACTURER'S START-UP SERVICES**

- A. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician shall inspect the completed installation, calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

**END OF SECTION**

**SECTION 11392**

**PUMP CONTROL PANEL**

**PART 1 GENERAL**

**1.1 GENERAL REQUIREMENTS**

- A. Furnish all labor, materials, tools, equipment and supervision required to provide and install the Pump Control Panel, as indicated on the Drawings and specified herein, and all other work incidental thereto, except as otherwise noted.
- B. The work under this section is intended to include the necessary materials and workmanship which are required for the completion and operation of the pumping station, as shown on the drawings, unless otherwise specified.
- C. The work shall be complete and ready for satisfactory operation whether or not each and every item is shown on the drawings or specifically mentioned in these Specifications.
- D. The Pump Control Panel, as described herein, and as indicated on the Drawings shall coordinate in every respect with the other equipment being provided so as to result in an operational and reliable Pump Station installation.

**1.2 ELECTRICAL REQUIREMENTS**

- A. Refer to Division 16 and Section 15010 of the Specifications for the supply and installation of all electrical equipment, wiring, conduit, control cabinets, level systems, and other electrical devices furnished under this Section of the Specifications.
- B. Wire and terminal numbering and wire color requirements shall be as specified in the "Electrical" Division of these Specifications. Wiring diagrams are required in the form as called for in the "Electrical" Division of these Specifications.

**1.3 SHOP DRAWINGS & OPERATION & MAINTENANCE MANUALS**

- A. See Section 15000, Item 1.3 for detailed requirements.

**1.4 INSPECTION TRAINING REQUIREMENTS**

- A. A factory representative employed by the pump manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment, and that all required features meet the requirements of the manufacturer for the operation and protection of the equipment, and to instruct the Owner's operating personnel in the maintenance and operation of these units. The scheduling of this service shall be coordinated with the Owner and the cost of this service shall be included in the contractor's bid price.
- B. Training requirements shall be 1 day (8 hours at site) unless otherwise specified.

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**1.5 GUARANTY**

- A. The required guaranty period for all items covered by this section of the Specifications shall be one year, unless a greater period is otherwise specified and required. All guaranty periods shall start at the date of equipment acceptance as specified in the General Conditions.

**PART 2 PRODUCTS**

**2.1 WORK INCLUDED**

- A. This section covers the supply and installation of the Pump Control Panel, ISR and Emergency Control (backup hardwire) panel, and the continuous Level Transmitter Indicator and Sensor, and coordination with the pumping equipment, and associated electrical work.
- B. The Contractor shall furnish and install all necessary supports, framing, field conduit and wire, and all other appurtenances specified herein or required for a complete installation.

**2.2 COMPATIBILITY OF PUMPS AND ACCESSORIES**

- A. To ensure compatibility between the pumps and the accessories as listed herein, the pump manufacturer shall furnish the Pump Control Panel including all electrical control wiring and devices as detailed on the Drawings and specified hereinafter. All electrical and control equipment shall be as specified hereinafter and shall be installed under Division 16 of these Specifications. All Power Distribution and motor control equipment shall be as specified under Division 16 and pumps control shall be provided by the equipment Specified under this Section.

**2.3 PUMP CONTROL PANEL**

- A. The Pump Control Panel to be provided and installed in the Pump Station Control Cabinet at the station as a part of this project. The Pump Control Panel shall be a rack mounted enclosure containing all the devices and equipment in accordance with and as required to afford the operations for the pump station as herein described and as shown on the Drawings. Pump Control Panel shall be furnished with the pumps and delivered to the site for installation, and shall include all the devices and appurtenances required for proper operation and protection of the pumps as hereinafter specified and as required by the pump manufacturer including pump protective devices/circuitry, etc., as described hereinafter.
- B. The panel shall be of gasketed NEMA 12 construction, fabricated from 10 gage (U.S. Standard) Type 304 stainless steel, with a brushed finish.
- C. The panel shall have full height gasketed doors equipped with heavy-duty, vault type hardware, removable hinge pins, and pad-locking handle.
- D. All front mounted equipment requiring connection and/or service from the rear or inside of the panels shall be furnished with identification plates mounted on the rear in duplicate to the front panel identification. Any Front mounted equipment shall be supported by an inner door, having the required structural strength and support for all mounted equipment and devices.

All equipment devices mounted within the panels shall be identified as to function and schematic identification abbreviation.

- E. Front panel nameplates shall be 1" X 3" engraved white lamicaid with black letters, internal device nameplates may be smaller; both types shall be attached with corrosion resistant screws. Rear of face nameplates shall be attached with silicon adhesive.
- F. All engraved legends shall be a minimum 3/16" high block type characters. Legends shall be completely worded without abbreviations except as approved by the Owner.
- G. Pilot lights, push buttons and other panel devices shall be furnished with anti-rotation key ways or other means to prevent slewing after mounting.
- H. Plastic wireway shall be used to train wires in all cabinets. Wireway fill shall not exceed 40% and shall be run in continuous lengths with snap on plastic covers.
- I. Panel wiring and wire tagging shall be as specified under Division 16 of these Specifications.
- J. Wiring shall not be spliced. Wire shall be run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.
- K. Each wire for external connection shall be terminated on screw type terminals. Ten percent spare terminals shall be provided.
- L. All foreign circuit 120 VAC wiring shall be yellow and each foreign circuit shall be provided with a clearly labeled circuit disconnect switch. Foreign circuit disconnect switches shall be switch type terminal blocks complete with engraved nameplates.
- M. The pump control panel manufacturer shall be a U.L. listed control panel manufacturer.

## 2.4 CONTROL PANEL WIRING AND LOGIC

- A. The control panels shall be fabricated based on the wiring and power distribution diagrams as indicated on the Drawings.

## 2.5 CONTROL PANEL DEVICES AND COMPONENTS

- A. The control panels shall be fabricated using components as specified in Section 16910, and as described below.
- B. Devices and components specified in Section 16910 include:
  - 1. Terminal Blocks
  - 2. Power Distribution Blocks
  - 3. Selector Switches
  - 4. Pushbutton Switches
  - 5. Indicating (Pilot) Lights
  - 6. Control Relays
  - 7. Alternating Relays
  - 8. Time Delay Relays
  - 9. DC Loop Power Supplies

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- 10. DC Power Supplies with Battery Backup
- 11. Panel Heaters

**2.6 MULTISMART PUMP CONTROLLER**

- A. The Microprocessor pumps controller shall be a MultiSmart, with continuous analog ultrasonic level sensor, graphical HMI, and appurtenances, and shall be fully compatible with the pumps being provided.

**2.7 PUMP CONTROLS**

- A. All level signals for alarms and controls shall be from float switches which shall operate through intrinsically safe relays mounted in the control panel, or derived from the continuous level signal from the sonic level instrument monitoring the wet well. The float switches will be provided under this Section and installed under Division 16 as indicated on the Drawings.
- B. The MultiSmart controller shall be programmed to provide each Pump with a 'selector switch' with positions for "Run-Off-Auto" and with all pumps in the automatic mode, the controls shall operate at elevations scheduled on the Drawings.
- C. The MultiSmart controller shall be programmed to provide each Pump with a 'Pump Sequence Selector switch' with positions for "Auto", a "Lead", and "Lag" shall allow auto or manual selection of the starting sequence of the pumps. In the "Auto" mode, the pumps shall automatically alternate in a lead-lag-standby fashion. In any of the manual sequence selections, the pumps sequence shall be fixed in the selected sequence.
- D. In the manual mode of operation with a pump 'selector switch' in the "Run" position, the pump starts and runs. The pump stops when the wet well level drops to minimum, (empty) level for an operator adjustable time delay, and/or the pump is detected to be running in an underload condition. In either the manual or automatic mode of operation, the pump shall shutdown and lockout if its motor thermal switch detects high temperature and the circuit shall activate a "Pump High Temperature" alarm light.
- E. Starting of the Standby pump shall activate an alarm circuit consisting of a seal-in relay and "Standby Pump Started" alarm light.
- F. All alarm seal-in and pump shutdown circuits shall be reset by a common "alarm reset" pushbutton switch. This Reset Function shall also be designed so as to allow a Supervisory Reset thru the SCADA Communications.
- G. The MultiSmart controller shall be programmed to provide two (2) time delays of range 0-60 seconds each to allow for sequential starting of the pumps upon power restoration after an interruption.
- H. The high level alarm float switch shall activate an alarm circuit consisting of a seal-in relay and "Wet Well High Level" alarm light. The seal-in relay shall have dry and isolated, single pole, double throw contacts for activation of a remote "High Level" alarm.

- I. If the High Level float switch activates, the pump control shall transfer to a separate, simple hardwire lead-lag relay type controller. This Emergency control shall continue until reset by an operator.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, Contractor shall inspect all pumping station equipment and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. The Contractor shall validate all serial numbers and parts lists with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

#### **3.2 INSTALLATION**

- A. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

#### **3.3 OPERATIONAL TEST**

- A. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition, and conforms to the specified operating characteristics.
- B. After construction debris and foreign material has been removed from the wet well, Contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

#### **3.4 MANUFACTURER'S START-UP SERVICES**

- A. Coordinate station start-up with manufacturer's technical representative. The representative or factory service technician shall inspect the completed installation, calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

END OF SECTION

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SECTION 15000

EQUIPMENT, GENERAL

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. The Contract Drawings and the general provisions of the specifications included in Division 0-Contract Provisions and Division 1-General Requirements, are a part of these Specifications. The Contractor shall consult them for instructions pertaining to the work.
- B. This section is comprised of standards of construction and materials for those divisions of these Specifications under which process and service equipment is provided and installed. The Contractor shall refer to the drawings to ascertain which systems he is required to provide. Construction methods and materials for special systems, not described in this section are specified under the detailed section to which they apply. Where more stringent construction methods are required than imposed by this section, they are specified in the detailed sections and shall apply.

1.2 WORK INCLUDED

- A. These specifications and the accompanying drawings are intended to comprise the furnishing and installing of all materials, equipment and supplies as specified herein and required for the satisfactory completion by the Contractor of all work including the installation of Owner furnished equipment.
- B. The drawings and these specifications are complementary to each other in that all apparatus, materials and equipment shown on the drawings and/or specified herein shall be considered essential to the contract requirements.
- C. The Contractor is responsible for all work shown on the drawings and all the systems described herein, unless otherwise shown on the drawings or specified herein.
- D. All apparatus and equipment furnished and installed by the Contractor must be of such dimensions and design as to be adapted to the arrangement of the installation and to fit within the limits of the space available for them.

1.3 SHOP DRAWINGS & OPERATION & MAINTENANCE MANUALS

- A. Shop drawings are required for each item of equipment, apparatus, device and piping furnished in this Division of the specifications. Each shop drawing submittal shall include as a minimum the following information.
  - 1. Identification of the item, i.e., written description, reference to equipment schedule.
  - 2. Assembly drawings which identify each part of the item specified. These should include dimensions and a materials of construction list.
  - 3. Information which verifies that the item meets process specifications, i.e., corrosion resistance, temperature rating, pressure rating, strength.

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4. Electrical and control information, where applicable, for the appropriate equipment, including wiring diagrams in specified form and cut sheets for all components.
5. The location, size and quantity or flow rate of any, compressed air or water service to the equipment.
6. Information on painting systems used for all components.

The Contractor shall furnish for all equipment requiring periodic maintenance four (4) complete sets of loose leaf bound operating and maintenance instruction manuals covering each item of equipment, apparatus, and device furnished or erected, to include, but not limited to:

1. Catalog data or literature
2. Installation instructions
3. Manufacturer's operating instructions
4. Manufacturer's maintenance instructions
5. Wiring diagrams
6. Equipment operating characteristics

For detailed shop drawing and operation and maintenance manual requirements, refer to Section 01730 of the Specifications.

## PART 2 PRODUCTS

Not Used.

## PART 3 EXECUTION

### 3.1 DRAWINGS AND MEASUREMENTS

The drawings show the arrangement, general design and extent of the systems. The equipment, main lines and connections are shown more or less in diagram and in their general locations, except where, in certain cases, the drawings may include details giving the exact location and arrangement.

The drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the Contractor.

Field measurements necessary for getting out materials and fitting in the through the access hatches shall be taken by the Contractor.

Shop drawings and/or equivalent information shall be submitted to the contractor by sub-contractors and will be passed upon by the Owner and returned through the Contractor.

Shop drawings and/or equivalent information shall be processed in accordance with Sections 01300 and 01600 of Division 1 and any additional requirements of the detailed sections.

3.2 LINES AND GRADES

Work shall be constructed in conformity with lines and grades as indicated on drawings. Bench marks outside of the on-site structures shall be used from which lines and grades required for installation of mechanical work may be set.

The Contractor shall lay out his work and be responsible for lines, elevations and measurements required for the installation of his work.

3.3 RECORD "AS BUILT" DRAWINGS

The Contractor shall comply with all requirements of Section 01700 of these Specifications.

3.4 CUTTING AND REPAIRING

All cutting and repairing of existing and completed work, including manholes, which is required for the installation of the Contractor's work shall be done by the respective contractors for the various trades involved, at the Contractor's expense.

The Contractor shall provide openings in the floors, walls, etc., as required for the installation of the piping and equipment.

3.5 APPORTIONMENT OF THE WORK

The Contractor shall classify and apportion all materials and the performance of all labor to the several trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions, etc., insofar as they may apply to and as required to efficiently execute the work involved in this contract, regardless of the classification indicated in these specifications.

3.6 MATERIALS AND EQUIPMENT

All material shall be new and be the standard products of the manufacturer, unless otherwise specified or approved by the Owner. The Owner reserves the right to disapprove and reject any materials, proposed or installed, which in his opinion fail to meet these quality standards. The Contractor shall, at his own expense, remove and replace with approved materials, any materials which in the opinion of the Owner do not comply with these quality standards.

When a specific manufacturer or trade name is mentioned in these specifications, and/or on the drawings, it is used to establish a standard of quality. Substitution of other makes of equal quality may be made, subject to the approval of the Owner, in accordance with the Bid Form General Conditions and Section 01600

Any substitutions so made, shall be deemed to be made for the convenience of the Contractor and any and all additional costs resulting therefrom shall be borne by the contractor making the substitution.

Any items required to complete the work and not specifically mentioned herein, shall conform fully to the quality pattern established by these specifications.

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### 3.7 STORAGE AND HANDLING OF MATERIALS AND EQUIPMENT

The Contractor shall coordinate delivery of equipment with his construction program so that an undue amount of storage space is not required. Space for contractor's use will be designated by the Owner.

The Contractor shall exercise care in the protection of materials and equipment furnished and/or installed under this contract while they are in storage at the site and during and after installation prior to final acceptance.

All materials and equipment shall be handled in a manner to avoid damage or breakage and delay in the completion of the work. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Owner, all items damaged or broken as a result of his operation.

All machined surfaces of the equipment subject to corrosion shall be protected by coating with grease immediately after finishing.

All flanges shall be protected prior to installation by means of wooden flanges bolted in place.

Pump casings shall be thoroughly drained of all water.

Equipment and materials stored outdoors shall be blocked up at least six inches above the ground.

Openings in tanks, valves and pipe shall be kept covered to prevent dirt, rubbish or water from entering, with machined surfaces such as flange faces, pipe threads, machined weld ends of pipe, and fittings protected from corrosion by proper Owner approved compounds.

All materials shall be protected from serious shock, denting, and marring of surfaces.

All unpainted steel surfaces shall be prevented from rusting by an Owner approved method.

Plate and sheet metal work shall be handled and stored with care to prevent permanent deformations or crimps in the material.

Whenever the shop coat of protective paint is damaged, spot coating shall be made immediately to prevent rusting.

All parts of the equipment shall be carefully crated to facilitate shipping and handling. The crates shall be constructed to completely protect the equipment and shall be sufficiently strong to permit lifting and skidding without requiring additional bracing or reinforcement.

All materials shall be so delivered, stored, and handled as to prevent the inclusion of foreign materials and/or damage by water, breakage or other causes. Packaged materials shall be delivered in original unopened containers and shall be stored until ready for use. Packages or materials showing evidence of damage or contamination, regardless of cause, will be rejected. All materials which have been stored shall be subject to retest and shall meet the requirements of these Specifications at the time they are used in the work and at the time of final acceptance of the work.

The Contractor shall obtain a letter from the equipment manufacturer describing the recommended methods of outdoor or indoor storage of the equipment at the site and shall fully comply with such recommendations.

All materials to be incorporated in the work shall be properly arranged, covered, and protected and the Contractor shall be solely responsible for the safety of the same.

Materials may be stored on the site in locations designated by the Owner.

### 3.8 ASBESTOS

No asbestos containing materials shall be allowed on the job site. No asbestos gaskets, packing insulation, etc. shall be furnished as a part of any item provided under these specifications.

### 3.9 MAINTENANCE PRIOR TO FINAL ACCEPTANCE

The Contractor shall be responsible for the maintenance of equipment and systems installed until final acceptance by the Owner, and shall take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage, installation, start up, temporary operation, and shut down.

### 3.10 ADJUSTMENT AND OPERATION OF SYSTEMS

When the work included in these specifications is complete, and at such time as directed by the Owner, the Contractor shall adjust all parts of the systems, advising the Owner when this has been done and the work is ready for final tests.

If it becomes necessary for temporary use of the systems by the Contractor, before all parts are complete, the Contractor shall adjust all parts as far as possible in order to make said temporary use as effective as possible.

If such temporary use is for the Owner's benefit and cleaning or repairing of damage is necessary due to the Owner's actions, such cleaning and repair cost shall be paid by the Owner based on a prior negotiated price.

After temporary use and before acceptance tests, all systems shall be readjusted to meet permanent operational requirements. All systems shall be cleaned internally and externally before placing in operation, and any damaged surfaces shall be restored to as new condition.

### 3.11 EQUIPMENT BASES

All equipment on concrete floors shall be mounted on minimum 6" high concrete pads, unless otherwise noted on the drawings or required by the equipment for proper installation.

All motor driven equipment installed by suspension from building structure shall be so designed and so installed as to effectively isolate all vibration of the equipment from the building structure. The Owner will reject any installations where equipment vibration is not effectively isolated.

Except where otherwise hereinafter specified, the Contractor shall provide structural steel or cast iron bases for all equipment which is to be installed on concrete floor slabs. Unless otherwise shown on the drawings, motors and the equipment they drive, shall be mounted on common bases from the floor.

Where structural bases, integral with floor slabs, are required, these shall be the responsibility of the Contractor. These shall be sized as recommended by the manufacturer of the equipment. The

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Contractor shall arrange for their pouring at the same time as the floor slab. All costs incidental to the pouring of these bases shall be the responsibility of the contractor including modification of the details as shown on the drawings.

All pump bases shall be curbed, as detailed on the drawings.

### 3.12 OIL AND GREASE FITTINGS

The Contractor shall furnish all oil and grease required to place all of the equipment in initial operation. Oil and grease shall be in accordance with the equipment manufacturer's recommendations.

Oil and grease fittings throughout the entire job shall be of one standard type, as approved by the Owner. Where equipment is furnished by the manufacturer with non-approved fittings, the Contractor, at his own expense, shall provide and install standard fittings. All fittings shall be installed in a readily accessible location or provided with extension lines for ease in lubrication.

### 3.13 NAMEPLATES

Each component of equipment, unless otherwise specified, shall have the manufacturer's name and catalog number on a plate securely attached to the item or equipment, or the name and catalog number may be stamped or cast into the body of the item, nameplates shall also give data pertinent to the operation and characteristics of the equipment.

All equipment installed shall be identified in accordance with the following unless otherwise indicated on the drawings.

Individual pieces of equipment shall bear legend plates identifying the equipment numbers as called for on the drawings. Plates shall be white laminated plastic with engraved black letters.

The legend plates shall be 1-1/4" high and 3-1/2" wide and shall be attached to the equipment by means of stainless steel countersunk head machine screws with Phillips slots. The plates shall be approximately 3/32 inch thick with beveled edges and shall have letter sizes and legends as approved by the Owner.

### 3.14 COORDINATION

Before proceeding with installation of piping, ductwork or other system, contractor shall inspect the contract documents and determine that the location of the work does not interfere with other work. In case of interference, the owner shall be notified in writing. The Owner shall then determine the resolution of the interference and shall so inform the Contractor. The Owner's decision shall be binding.

### 3.15 WELDER QUALIFICATIONS AND PROCEDURES

All welding of piping covered by this specification, regardless of conditions of service, shall be performed as follows:

Pipe welding shall comply with the provisions of the latest revision of the following applicable codes, rules or regulations.

- A. Rules for construction of power boilers (Sections I, VI, and appendix, ASME Boiler and Pressure Vessel Code).
- B. Qualification standard for welding procedures, welders, and welding operators (Section IX ASME Boiler and Pressure Vessel Code).
- C. Code for pressure piping ANSI 831.1 with supplement No. 1 ANSI B 31.1A.
- D. State or local requirements as may supersede the above codes.

Standard procedure specifications and welders qualified by the national Certified Pipe Welding Bureau shall be considered as conforming to the requirements of these specifications.

All pipe welding may be by either oxy-acetylene or arc method, and shall be done by approved welders. Welding procedures and joint quality shall strictly conform to above procedures. The Owner reserves the right to require qualifying demonstrations at the Mechanical Contractor's expense, of any welders assigned to the job.

Tee connections in welded piping shall be made with a factory fabricated butt welding tee or with Weld-o-lets. The size of the branch connection shall be one-half the diameter of the main or less. Scarf welding or direct butt welding of side connections shall not be permitted. Tees fabricated from pipe shall not be permitted.

Short radius welding ells shall be used in changing pipe directions of welded pipe lines. Mitered joints shall not be used unless approved by Owner.

### 3.16 ACCEPTANCE TESTS

Upon completion of each installation of each equipment or process system and within 60 days after the date of initial operation of each system, the Contractor shall, at his expense, conduct complete performance tests in the presence of the Owner, to fully demonstrate the capacity and all other characteristics of each system. These tests shall be run for not less than one (1) hour for each point, and shall fully demonstrate the ability of each piece of apparatus to perform as herein required and/or as called for on drawings and/or shown on the catalog of the manufacturer of the specified item and/or shown on the submitted shop drawings.

Upon completion of the work, the Contractor shall conduct a complete inspection of all items of work required by the contract documents, and make whatever corrections and adjustments are necessary to obtain a complete, well functioning system, which meets the requirements of the Owner. All nameplates on equipment shall be kept clean for easy reading.

Pumps, motors and apparatus shall be made to operate at any condition up to full capacity without undue vibration, objectionable noise or overheating. Motors shall be proven not to heat to a temperature exceeding 80 degrees centigrade.

The Contractor shall provide all materials and labor necessary to perform these tests.

This Specification shall apply unless more stringent tests are outlines for a particular item of equipment.

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### 3.17 PRESSURE TESTS

The testing requirements for the respective piping systems shall include all those of the applicable governing codes, such as state, local, and insurance, and those hereinafter specified. All code required inspection certificates shall be furnished by the Contractor, as required.

The Contractor shall make pressure tests on all piping included in the contract. All tests shall be made before piping is painted, covered or concealed. The Contractor shall furnish all pumps, compressors, gauges and other necessary testing equipment and make all connections necessary for the tests.

All tests shall be made in the presence of the Owner and where required, the inspection department having jurisdiction, who shall be notified by the Contractor in sufficient time to enable him to be present. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated. All repair to piping shall be made with new material and to the satisfaction of the authorized inspectors.

All piping systems shall be tested hydrostatically at 50 psi greater than maximum operating pressure but not less than 50 psig for two hours, unless otherwise noted in Section 15100 or Section ?  
Directional Drilling

The Contractor shall provide all materials, equipment and labor necessary to perform these tests.

### 3.18 DISPOSAL OF SALVAGED MATERIAL

Any existing piping, valves and equipment which are required to be removed as part of this project shall be cleaned by the contractor and stored at a location on the site as designated by the Owner.

### 3.19 MAXIMUM PERMISSIBLE NOISE LEVEL

All steady or cyclical noise levels produced by machinery or equipment at the operator's position, and at all other points five feet from the equipment, shall not exceed 85 decibels (unless otherwise specified) when measured by a sound level meter meeting ANSI S1.4-1971, "Specification for General Purpose Sound Level Meters" set to "A" weighting and slow response.

### 3.20 ALIGNMENT

Alignment of all mechanical equipment shall be field checked by the contractor and adjusted as required prior to equipment start-up. This includes drives, couplings and piping connections. Log sheets for each coupling shall be submitted and shall include: date of alignment, gap, end float, angular and offset measurements. Log sheets shall also include the coupling manufacturer's maximum allowable for each measurement. The measured misalignment shall not be greater than 50% of the maximum allowable.

Piping connection to all mechanical equipment shall be disconnected after the installation is complete to verify that no strain is being placed on the equipment by the piping.

### 3.21 VIBRATION

Equipment shall be designed and installed so as to preclude excessive vibration. The Owner will reject any installations where excessive equipment vibration is in evidence.

3.22 INSERTS AND ANCHOR BOLTS

- A. All equipment which must be secured to concrete walls, ceiling slabs, columns and other building masonry (except floors) shall be attached by means of approved inserts embedded in concrete or masonry.
- B. Inserts shall be continuous slotted inserts approximately 1-5/8" wide, 1-3/8" deep by length as required, roll formed not less than 12 gage steel into slotted "U" conformation for 5/8 in. bolt size unless otherwise indicated, with anchors spaced on not more than 6 in. centers, plates and bolts and nuts as required by conditions, shall be provided. Slotted inserts shall be Gateway Erectors, Inc., Type "G", Hohman and Barnard Type CH05, or equal.
- C. Equipment to be secured to floor slabs or concrete bases shall be fastened down with approved cast in place anchors.
- D. Drilled expansive anchor bolts are permissible provided that electric hammers are used, and that the specific hammers have been approved for the purpose by the Owner. Anchor bolts shall be Wejit, Parabolts, Kwikbolt, or equal. All bolts shall be stainless steel coated with anti-seize compound prior to assembly.

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SECTION 15010

ELECTRICAL REQUIREMENTS FOR MECHANICAL WORK

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Electrical equipment shall be furnished and installed where called for in other Sections of Division 15 and in various Sections of other Divisions, as noted therein in accordance with the requirements hereinafter.
- B. Complete information required for wiring and connecting electrically operated or electrically controlled equipment under Division 15 Sections and in other Divisions of these Specifications shall be furnished. Control devices shall be installed in proper time and sequence to meet the Electrical Work schedule.
- C. All motorized equipment shop drawings shall include motor data sheets indicating all nameplate data and motor features, materials, and special construction details.
- D. The size and voltage of all motors furnished under these various Specification Sections, for which starters are to be furnished under Division 16, shall be verified. If starters are to be provided with the equipment under Division 15, or other Division under which the equipment is specified, they shall be of the same manufacturer as those provided under Division 16 and the number of auxiliary contacts required on each motor starter shall be provided. Any conflicts with related equipment furnished under Division 16 of these Specifications shall be coordinated and resolved to make a complete and operable system.
- E. All equipment shall be grounded as specified herein and the number and location of all grounding connections shall be coordinated with the grounding system provided and installed under Division 16.

1.2 WORK NOT INCLUDED

- A. Refer to Division 16.

1.3 ELECTRICAL EQUIPMENT AND WORKMANSHIP

- A. All equipment and workmanship shall be in conformance with the following documents:
  - 1. National Electrical Code, latest approved edition.
  - 2. Any and all Federal, State and/or local codes, ordinances, or regulations.
  - 3. Latest approved standards of IEEE, ANSI, NEMA, ISA, and Underwriters' Laboratories.
  - 4. Division 16 of these Specifications.

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PART 2 PRODUCTS

2.1 PACKAGE EQUIPMENT

- A. All package equipment shall be factory wired where possible from motors to control panels, starters, or to junction boxes. Coordinate all final connections to package equipment with equipment supplier before installation.
- B. Packaged mechanical, process, and service equipment and systems with electric motors and controls and with mechanical, electrical, and other components which may or may not be integrally mounted shall be totally furnished and installed under Division 15 or the Division under which the equipment is specified. Division 16 shall furnish power connections to each "package" and connect alarm signals to specific locations for each "package" as indicated on the Drawings or specified under that particular equipment Specification Section.
- C. All electric solenoid valves and motor operated valves furnished as a part of "package" equipment shall meet the requirements of Sections 15410 through 15428 of these Specifications.
- D. For all Specification Divisions, the equipment manufacturer shall provide power, control interlocking, and alarm connection terminal blocks.
- E. All equipment shall be grounded as specified herein.

2.2 ELECTRICAL CONTROL EQUIPMENT REQUIREMENTS

- A. All controls for equipment furnished as part of a "package" supplied by the equipment manufacturer shall meet the requirements of Division 16 of these Specifications. Control systems shall be complete with a main service switch and minimum NEMA Size 1 combination starters incorporating motor circuit protectors with current limiters where available short circuit current exceeds 15,000 amperes.
- B. Combination molded case circuit breaker and contactor shall be provided for all three phase, non-motor loads. Combination starters and contactors shall be of the same manufacturer and shall match those supplied in the Motor Control Centers specified in Division 16. All single phase motors powered out of control panels supplied with equipment shall be provided with manual motor starters as specified in Division 16.
- C. Control systems shall also include control transformers, heavy duty disconnect switches, industrial control relays, control devices, pilot lights, selector switches, pushbutton switches, alarm contacts, terminal strips, wire numbers, foreign circuit disconnects, and other such devices as may be required. All components shall be heavy duty, industrial type. Panels shall, as a minimum, meet all requirements of the National Electrical Code. Control panels shall be NEMA Type 4, unless otherwise specified, and shall be mounted such that the top of the panel is no higher than 6'-0" above the floor, platform, or slab and such that 3'-6" clear work space is provided in front of the panel. The control panel shall be manufactured by a UL listed industrial control panel manufacturer. Each device shall be permanently identified by a lamicaid nametag, attached to the panel, subpanels or mounted adjacent to the device and engraved with the device's wiring diagram designation and its function.

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- D. Where control panels incorporate failure, lockout, and/or alarm devices, a single pole, double throw, dry and isolated contact indicating equipment "Trouble" shall be provided for remote alarm indication.
- E. Voltage conditioning and surge suppression devices shall be provided as required by the equipment manufacturer for use in a waste treatment plant environment.
- F. All field wiring and wiring connections for field mounted components of packaged equipment systems shall be provided under Division 16 of these Specifications.
- G. A written sequential description of operation under various modes of control shall be provided, describing the complete control circuit and equipment operation and logic.

### 2.3 ELECTRIC MOTORS

- A. Electric motors shall be as specified in Section 15170.

### 2.4 ELECTRICAL WIRING

- A. Electrical wiring shall be installed in heavy wall steel, hot-dip galvanized or sherardized conduit, minimum size to be 3/4", unless otherwise noted. Use of lengths of flexible conduit will be permitted where rigid conduit is not applicable, however, all flexible conduit shall be of the liquidtight type, approved by Underwriters' Laboratories, and length shall not exceed 24", except where specifically directed. All conduit ends shall be provided with O.Z./Gedney Co. Type HBLG insulated bushings, Thomas & Betts Co., or equal, except at couplings or threaded type outlets.
- B. The wire, conduit, and equipment sizes shown on the Contract Drawings are based on estimated ratings. If ratings of equipment, as furnished under the Contract, exceed the estimated ratings, the wire, conduit, and equipment sizes shall be adjusted to meet National Electrical Code requirements at no additional cost to the Owner.
- C. All connections between conduits and general purpose enclosures shall be made with double locknuts. All NEMA Type 3, 3R, 4, and 4X enclosures without integral watertight hubs shall have watertight, threaded, rigid, conduit hubs. NEMA Type 4 enclosures shall be equipped with a drain and a breather, Crouse-Hinds ECD Universal series, or Appleton. The drain shall be mounted on a bolt-on, gasketed hub.
- D. All conduit, fittings, outlets, disconnect switches, gas detectors, receptacles, junction boxes, luminaires, control stations, damper operators, thermostats, and other electric equipment supplied for installation in areas classified as hazardous and/or where called for on the Drawings shall be factory encased in a .040 inch thickness of polyvinyl chloride (PVC).
- E. Wire external to panels shall be stranded copper, Type THWN/THHN or XHHW. Wire within panels shall be Type MTW. Minimum size shall be No. 12 for power and No. 14 for control and alarms, unless otherwise indicated. All work shall conform to the National Electrical Code and local electrical codes. Certificates of inspection approval from authorities having jurisdiction shall be provided. Ground conductors shall be carried in all conduits. All work including wire numbering, color coding of wire, and preparation of ladder diagram format control diagrams shall be in accordance with Division 16 of these Specifications.

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- F. All wires shall be identified and tagged. Identification shall be by number or number-letter combination which shall be the same as that used in the ladder diagram. The identification shall be used only once in the electrical system and shall be marked at each termination. Where systems interconnect and the identification is not continuous, wires shall be tagged twice at each termination, once with the originating number and once with the terminating number.
- G. Equipment ground conductors passing through conduit sleeves with no related circuit conductors therein, shall be bonded to conduit at each end.
- H. Remote instrumentation controllers, transmitters, indicators, relays, converters, ratio stations, recorders, process alarm relays, etc., shall be 120 volt powered, unless noted otherwise on the Drawings.

**PART 3 EXECUTION**

**3.1 EQUIPMENT GROUND CONNECTION REQUIREMENTS**

- A. All electrically powered mechanical equipment shall include provisions for connection of equipment grounding conductor(s). Electrically powered "Package" equipment may have a single ground connection lug, if all electrical components are attached to and in good electrical contact with a common metal frame, enclosure, or base. The grounding of external electrical components shall be by Division 16.
- B. All grounding conductors, lugs, exothermic welds, and other grounding devices shall comply with Division 16 of these Specifications and shall be installed as indicated on the Drawings.

**3.2 SHOP DRAWINGS**

- A. Motor control shop drawings shall be provided for all "Package" equipment. Motor control shop drawings shall meet all of the requirements of Sections 01300 and 16010 of these Specifications.
- B. "Package" equipment control panel shop drawings shall include a "ladder" type diagram of the control logic, panel arrangement showing front and subplate devices, and a complete bill of material. In addition, a written sequential description of operation under various modes of control shall be provided, describing the complete control circuit and equipment operation and logic.

**3.3 FOUNDATION AND SETTING DRAWINGS**

- A. For equipment requiring a foundation, the size, purpose, and location of conduit and incoming lines that must be installed under Division 16, Electrical, shall be shown on the foundation plan furnished by the equipment supplier.
- B. Shop drawings as required in Section 01300 shall be submitted for review prior to being furnished to the electrical trades and before the slab is poured.

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3.4 PAINTING OF ELECTRICAL ENCLOSURES

- A. Exterior of electrical enclosures and cabinets shall be painted to match the finished color of the pre-packaged equipment on which they are mounted or shall be painted ANSI 61 light gray and the interior shall be gloss white.
- B. Exterior of stainless steel and NEMA Type 4X non-metallic electrical enclosures and cabinets shall not be painted and interior steel subplates shall be gloss white.
- C. Refer to Sections 09900 for additional painting requirements for electrical enclosures and raceways.

END OF SECTION

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SECTION 15030

PIPING INSTALLATION, GENERAL

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section of these specifications is intended to outline the basic construction methods and materials to be used for the installation of all piping and equipment systems, and such other work and materials that shall be used to meet the Contract requirements of the mechanical systems for the project to the best accepted level of practice, to meet the requirements of governing codes and as approved by the Owner.

1.2 NOTE

- A. This section is comprised of standards of construction and materials for the Mechanical Division of these specifications. The contractor shall refer to the detailed sections of the Mechanical Division of these specifications and to the drawings to ascertain which systems he is required to provide. Construction methods and materials for special systems, not described in this section are specified under the detailed section to which they apply. Where more stringent construction methods are required than imposed by this Section, they are specified in the particular sections and shall apply.

1.3 COORDINATION

- A. Before proceeding with installation of piping, etc. the contractor shall inspect the contract documents and determine that the location of the work does not interfere with other work. In case of interference, the Owner shall be notified in writing. The Owner will then determine the resolution of the conflict and his decision shall be binding.

PART 2 PRODUCTS

2.1 MATERIALS

- A. All anchors, hardware, supports, and other materials in the wet well must be 316 stainless steel. Pipe flange bolts can be cadmium plated and coated per 09900.
- B. All anchors, hardware, supports, and other materials in the valve vault can be 304 stainless steel. Pipe flange bolts can be cadmium plated and coated per 09900.

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2.2 PIPING

- A. In the description of piping materials, the following abbreviations are used:  
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- stl steel
- M.I. malleable iron
- F.S. forged steel
- C.S. cast steel
- C.I. cast iron
- D.I. ductile iron
- scrd screwed
- thk thick
- galv galvanized
- flgd flanged
- sched. schedule

- B. All ratings in this description of piping materials shall be taken to mean American National Standard Institute ratings.

### 2.3 BOLTS, STUDS AND NUTS

- A. All steel bolts, studs and nuts shall be in conformity with the current Tentative Specifications for Low Carbon Steel Externally and Internally Threaded Standard Fasteners, ASTM Designation: A-307, Grade B.
- B. All carbon steel bolts and nuts used for joining flanged pipe shall be galvanized or cadmium plated unless otherwise called for. All bolts shall be coated with anti-seize compound prior to assembly.
- C. Sleeves for anchor bolts shall be made of Schedule 40 steel pipe and shall be at least 1/2 inch larger in inside diameter than the anchor bolt.

### 2.4 ANCHORS

- A. Anchors shall be provided to rigidly and securely fasten piping to building construction where shown or as required.
- B. Anchors shall be located in such a manner that they will not distort any part of the building as the result of expansion and contraction of piping.
- C. Anchors may be angle iron, inserts, U-bolts and anchor chairs, or a combination of the above. Anchors may also be the screwed coupling type.

### 2.5 PIPE GUIDES AND SPACING

- A. Approved pipe alignment guides shall be provided in the piping adjacent to and on each side of all pipe expansion joints and loops, in order to control the pipe movement in true perpendicular alignment to the expansion joints and loops.
- B. First guides at 4 pipe diameters on each side of device.
- C. Second guides at 14 pipe diameters beyond first guide.
- D. Intermediate guides per standard of Expansion Joint Manufacturers Association (E.J.M.A.).

## PART 3 EXECUTION

### 3.1 EXCAVATION AND BACKFILLING - UNDERGROUND PIPING

- A. The contractor shall perform all necessary excavating, trenching, backfilling, shoring and restoring, in connection with his work as specified herein. Excavations shall conform to the invert dimensions designated on the drawings or as required by field conditions and/or directed by the Owner.
- B. On excavations which occur near and below any foundation footings, the backfilling materials shall consist of concrete poured up to the level of the bottom of footing of the same strength as the concrete in the footings.
- C. Crossing Protection: Adequate temporary crossovers for pedestrian and vehicular traffic shall be provided including guard rails, lamps and flags, as required by agencies having jurisdiction and as directed by the Owner. All items shall be removed when necessity for such protection ceases.
- D. Underpinning: where excavation work is required under existing footings, they shall be underpinned as required to adequately support existing construction in such a manner as to avoid raising or lowering or otherwise damaging existing construction, all as approved by the Owner.
- E. Backfill: Piping, ducts, and other buried mechanical work shall be inspected and tested before backfilling. Particular care shall be exercised to ensure backfilling simultaneously on both sides of piping, sumps, etc.
- F. All trenches under structures, gravel, slag or hard surfaced roads, pavements, hard surfaced parking lots and driveways, sidewalks, curbs, and where the trench edge is within 3 feet of a proposed or existing structure or pavement shall be backfilled with bank run sand meeting the requirements of Granular Material, DOT Class II. 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 percent of maximum unit weight.
- G. Disposals: All excavated material shall be removed from pipe trenches and if, in the opinion of the Owner, it is unsuitable for backfill, it shall be removed from the premises and disposed of off-site legally and immediately.

### 3.2 UNDERGROUND PIPING INSTALLATION

- A. No piping shall be installed in filled or disturbed earth until the earth has been compacted to properly support general construction, as specified in the backfill requirements.
- B. All trenches shall be dry and clean when pipe is being laid.
- C. Pipe and fittings shall be inspected for defects prior to being lowered into the trench and shall be cleaned both inside of the bell and outside of the spigot.
- D. All pipe lines shall be laid straight and in true alignment with the grade and location established on the drawings, or as directed by the Owner.

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- E. Pipes passing through walls below grade and passing through sleeves shall be made watertight by sealing as specified or in an approved manner.
- F. In some cases, pipe shall pass through boxed out areas in slabs or walls, as shown on the Drawings.
- G. Pipes or tubing passing through or under building grade beams shall be installed in a sleeve giving 4 in. clearance to prevent possible damage from settling of the building.

### 3.3 FLUSHING UNDERGROUND SYSTEMS

- A. Before backfilling and before connecting aboveground systems to the underground connections, all pipe, fittings, valves, etc., shall be cleaned of core sand, scale and other foreign matter.
- B. Underground piping shall be flushed with water at a velocity of at least 6 ft. per second for a fifteen (15) minute period, or until all dirt and debris are thoroughly flushed out.

### 3.4 ABOVEGROUND PIPING INSTALLATION-ALL SERVICES

- A. General
  - 1. Pipe lines aboveground shall be run parallel with the lines of the building unless otherwise shown or noted on the drawings. All horizontal runs of piping shall be kept as high as possible so as to provide maximum head room. Vertical lines shall be kept as close to the columns or walls as possible. Pipe lines shall be run so as not to interfere with ducts, conduits or apparatus and with approved offsets around columns, beams and other obstructions, and with necessary expansion joints, pipe bends or fitting offsets, as may be indicated on the drawings or required as essential to an approved installation.
  - 2. All pipe ends shall be reamed. Care shall be taken at all times to prevent foreign material from entering any pipe.
  - 3. All threaded coupling shall be made using an approved teflon tape on the male end. Care shall be taken to prevent the tape from reaching the pipe interior.
  - 4. All horizontal lines shall pitch to low points to provide for complete drainage of each system. Pitch, unless otherwise shown on the drawings shall be not less than 1 inch in 40 feet against direction of flow. Air vents shall be installed at all high points and at locations where air may pocket on all water lines. Air vents shall be drained to sewers or suitable receivers. Hot water heating, gas and air lines shall pitch as stated, but in direction of flow.
  - 5. All gaseous piping connections to equipment shall be valved and where practical shall be taken off the top of the main or sub-main.
- B. Structural steel shall not be cut burned or welded to aid in piping installation except with written approval of the Owner.Placement of Valves:
  - 1. Valves shall be installed at all service connections to equipment, branch lines from main lines, at low points for draining each system and as shown on the drawings.
  - 2. Chain wheel operators shall be provided for all valves located 7'-0" or more above floor surfaces.
- C. Piping Hangers and Supports:

1. All piping shall be adequately supported by means of hangers and supports. Overhead lines shall be carried directly on supports or suspended by clevis hangers from supports. All support steel, hangers, etc., shall be furnished and installed. Piping at all equipment, control valves, etc., shall be supported so that equipment, valves, etc., can be removed without further supporting the piping. Additional support for valves installed in fiberglass and PVC pipe lines shall be provided as required. Piping shall not introduce any strains or distortion to the connected equipment.
2. Spacing of supports for horizontal piping shall be no greater than shown on the following schedule or as detailed on the drawings:

<u>Steel Pipe</u>	<u>Support Spacing</u>	<u>Copper Pipe</u>	<u>Support Bracing</u>
1/2" & smaller	7'-0"	1/2"	6'-0"
3/4" - 1"	8'-0"	3/4" - 1"	8'-0"
1-1/4" - 1-1/2"	9'-0"	1-1/2" - 2"	10'-0"
2"	10'-0"	2-1/2" - 5"	12'-0"
2-1/2" - 3-1/2"	12'-0"	6" & larger	14'-0"
4" - 5"	14'-0"		
6"	16'-0"		
8" - 12"	20'-0"		

<u>Fiberglass Pipe</u>	<u>Support Spacing</u>	<u>PVC &amp; Poly-Propylene Pipe</u>	<u>Support Bracing</u>
2"	7'-0"	1/2" - 3/4"	3'-0"
3"	7'-6"	1" - 1-1/2"	3'-6"
4"	8'-0"	2"	4'-0"
6"	9'-0"	2-1/2" - 3"	4'-6"
8"	10'-0"	4"	5'-0"
10"	11'-0"	6"	6'-0"
12"	12'-0"		
14" and larger	13'-0"		

3. Prior to installing fiberglass pipe the Contractor shall obtain the manufacturer's recommendations in writing for method and location of supports, guides and anchors.
4. Cast iron soil pipe shall be supported close to hubs. A minimum of one support shall be used for each pipe length.
5. Cast iron and ductile iron pipe shall be supported at each joint or at 12'-0" maximum centers, whichever is closer.
6. Hanger rods used in conjunction with clevis hangers shall be sized as indicated in the following schedule. Rods shall be cold rolled steel. Rods installed in below grade galleries, in wet wells, or within retention structure shall be stainless steel.

<u>Pipe Size</u>	<u>Hanger Rod Dia.</u>
1/2" - 2"	3/8"
2-1/2" - 3-1/2"	1/2"
4" - 5" 5/8"	
6" 3/4"	
8" - 12" 7/8"	
14" - 18"	1"

7. Piping installed within the wet well shall be supported using 316 stainless steel embedded inserts, complete with concrete anchors and FRP316 SS pipe clamps, clevis

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- hangers, bolts, nuts and washers. Support system shall be Series "P" as manufactured by Aickin Strut Co. subsidiary of Robroy Industries, Verona, PA, or equal.
8. Trapeze hangers with U-Bolt type fastening may be used in lieu of clevis hangers in congested areas.
  9. "Unistrut" used to support piping shall be Series P1000, 316 SS, as manufactured by the Unistrut Products Co., Super Strut A-1200, Power Strut PS-200, or equal.
  10. Risers shall be supported at intermediate points as required for rigidity.
  11. Vertical piping shall be supported at its base by a hanger placed in the horizontal line near the riser, or by a base fitting set on a pedestal or foundation.
  12. Hanger rods shall be connected to beam clamps, concrete inserts, or expansion shields. These devices shall be Underwriter's Laboratories approved. C-clamps will not be allowed.
  13. Inserts shall be used for suspending hangers from concrete. Cadmium coated or galvanized inserts shall be used where galvanized hangers are required. Other means of setting anchors must be approved by the Owner.
  14. Perforated band iron or wire hangers shall not be used.
  15. Clevis type pipe hangers shall be adjustable wrought steel. Grinnel Figure No. 260, Fee and Mason Fig. 239, Carpenter and Patterson Fig. 100, or equal, complete with bolts, rods and nuts.
  16. Beam clamps shall be malleable iron with bolt, nut and pocket threaded for rod connection. Grinnel Fig. 229, or Elcen Fig. 95.
  17. Pipe protection shields or half pipe saddles shall be supplied at all hangers or supports for all Fiberglass pipe.
  18. Riser clamps shall be wrought steel, with extension lugs and suitable bolts and nuts.
  19. Adjustable roll stands shall be cast iron, Elcen Fig. 18, or Grinnel Fig. 177, for rod supported type or Elcen Fig. 20 or Grinnel Fig. 274 for base supported type.
- D. Unions and Flanges:
1. Unions shall be provided at all valves up to 4" size, and at final connections to equipment, or apparatus. Sufficient joints shall be provided in piping systems to provide means of readily dismantling each system. Joints shall also be provided where shown on the drawings.
  2. Unions shall be of the type, material and pressure rating as herein specified for the services involved. Unions for 4 in. pipe size and larger shall be made with gasketed companion flanges or grooved pipe couplings, as specified.
  3. Unions for copper pipe shall be cast or wrought copper solder type pressure fittings of suitable size and end connections.
  4. Unions and companion flanges shall be installed in the pipe lines at such locations as needed to permit the removal of fixtures, apparatus or equipment without dismantling. Unions and companion flanges shall not be installed in walls, ceilings, partitions or other inaccessible locations.
  5. Wherever flanges with raised faces are joined to companion flanges with a flat face, the raised face shall be machined down to a smooth matching surface and a full face gasket shall be used.
- E. Reducer Fittings:
1. For proper drainage and air elimination eccentric type fittings shall be used when decrease in pipe size is necessary. Bushings shall not be permitted.
  2. For water and other liquid lines top of pipe shall be installed on a continuous straight line.

3. For hot water heating, gas and air lines bottom of the pipe shall be installed on a continuous straight line.

F. Pipe Sleeves, Cover Plates & Flashings:

1. All required sleeves, flashings and plates shall be furnished, located and set for sections of the work where piping passes through floors, walls, ceilings or roof. Where sleeves pass through concrete construction, sleeves shall be located and set before concrete is poured.
2. All sleeves through concrete or masonry walls shall be schedule 40 black steel pipe. Floor sleeves shall be schedule 40 black steel pipe with approved anchoring lugs. Sleeves passing through walls or floors with water, earth or weather on one side shall be provided with 1/4" thick leakplates continuously welded to the sleeves at mid slab. Floor pipe sleeves shall extend 2" above floor surface. Space between pipe and sleeves shall be tightly packed with oakum and sealed with hard pitch or tar compound for sleeves through interior slabs or walls. Space between pipe and exterior sleeves shall be sealed so as to provide air tightness for above ground installations and water tightness for below grade installations. Sealing medium shall consist of synthetic rubber links, corrosion resistant pressure plates and zinc phosphate plated carbon steel bolts. Caulking or other type mastic sealants or lead oakum joints are not acceptable.
3. Sleeves shall be of sufficient diameter to allow for pipe insulation and its jacketing, where insulation is required.
4. Piping extending into finished areas of the building shall have chrome plated floor, wall or ceiling plates, large enough to cover the pipe sleeves.

G. Pipe Welding:

1. All pipe welding may be by either oxy-acetylene or arc method, and shall be done by approved welders, qualified in accordance with the "Welder Qualifications and Procedures" in Section 15050. Welding procedures and joint quality shall strictly conform to above procedures. The Owner reserves the right to require qualifying demonstrations at the mechanical contractor's expense, of any welders assigned to the job.
2. Tee connections in welded piping shall be made with a factory fabricated butt welding tee or with Weld-o-let of butt, socket or threaded type. When Weld-o-lets are used, the size of the branch connection shall be one-half the diameter of the main or less. Scarf welding or direct butt welding of side connections shall not be permitted. Tees fabricated from pipe shall not be permitted.
3. Long radius welding ells, shall, whenever possible, be used in changing pipe directions of welded pipe lines. Mitered joints shall not be used unless approved by Owner.

H. Tags, Charts and Diagrams:

1. All valves shown on the drawings as designated by a valve number shall be provided with a 1" x 1-1/2" x 3/32" thick white laminated plastic valve identification tag attached to the valve with key chain. Valve designations shall be as shown in the "Valve Schedules" shown on the Drawings. Valve Identification numbers shall be 1/2" high. Identification tags shall be white laminated plastic white engraved black letters and bevelled edges.
2. The Contractor shall provide and install at the location designated by the Owner framed and glass covered 24" x 36" flow diagrams, showing piping systems, valves

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and valve numbers, equipment and equipment numbers. Valve numbers and equipment number schedules shall be provided on each diagram in addition to identifying each valve and piece of equipment on the diagram.

3. Diagrams shall be prepared with ink or on mylar and shall be mounted over a white board in an aluminum frame under glass. Frame and glass shall be as manufactured by Seton Name Plate Co., New Haven, Connecticut, Stonehouse Signs, Inc., Arvada, Colorado; or equal.

### 3.5 SOIL, WASTE, STORM AND VENT PIPES

- A. Soil, waste, storm and vent piping shall be of pipe material designated as acceptable for use in the applicable plumbing codes.
- B. Sizes of pipes shall conform to the requirements of the plumbing code unless larger pipe sizes are shown on the drawings. All fixtures shall be vented and re-vented as required to comply with the plumbing code, whether or not so indicated on the drawings.
- C.

### 3.6 MISCELLANEOUS IRON WORK

- A. All structural supports, platforms, braces or tie rods required to support or hang piping and mechanical equipment without vibration shall be furnished and installed as required or directed by the Owner.

### 3.7 SHOP PRIMING PROCEDURES

- A. Unless specified otherwise, ferrous metal items, except items to be encased in concrete and areas adjacent to field welds shall be thoroughly cleaned and prime painted as follows:
- B. Surfaces shall be cleaned free of loose mill scale, loose rust, accessible weld slag or flux deposit, dirt and other foreign matter by sand blasting or by power tool cleaning in accordance with Section 09900 of the Specifications. Oil and grease deposits shall be removed by solvent.
- C. After cleaning, surfaces shall be given one shop coat of prime paint applied thoroughly and evenly to dry surfaces. Surfaces inaccessible after assembly or erection shall be given an additional shop coat of slightly different color than first coat.
- D. After erection, all members where shop coat has been damaged, welds, areas adjacent to welds and field bolts shall be touched up with prime paint.
- E. Primer, unless otherwise specified, shall be as called for in Section 09900 of these specifications.

### 3.8 PROTECTION/CLEANING OF PIPING AND EQUIPMENT SYSTEMS

- A. It shall be the responsibility of this Contractor to install and maintain pipe and equipment which is reasonably clean and free from rust, dirt, scale, etc. Where necessary, this contractor shall provide temporary airtight covers at all pipe and equipment openings.

3.9 MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a factory representative from each equipment manufacturer to inspect and adjust the finished installation of all equipment and to instruct the Owner's personnel in the operation, care and maintenance of the equipment. Additional requirements for certain items of equipment are included in the detailed specifications.

3.10 DIRT POCKETS

- A. Dirt pockets with drain connections and a 3/4 in. gate valve shall be installed in all lines, 3/4 in. and up, carrying gaseous fluids (such as steam, compressed air, gases, etc.).
- B. On gaseous fluid lines up to and including 2 in. diameter, the dirt pockets shall be equal to the line diameter and a minimum of 12 in. deep.
- C. On gaseous fluid lines 2-1/2 in. through 12 in. diameter the dirt pockets shall be equal to 3/4 of the line diameter and a minimum of 18 in. deep.
- D. Dirt pockets in gaseous fluid lines shall be installed at:
  - 1. All low points in the system.
  - 2. Ahead of any rise in the piping.
  - 3. At the end of every primary and secondary main.
  - 4. Every 400 feet (maximum) of level piping with a relatively constant demand during design operation.
  - 5. Every 200 feet (maximum) of level piping with considerable on and off demand during design operation.
  - 6. Ahead of all pressure reducing and control valves unless the branch feeding the valve is taken off the top of the main and is 5 feet or less in length.

END OF SECTION

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**SECTION 15060**

**PIPE AND PIPE FITTINGS**

**PART 1 - GENERAL**

**1.01 SUMMARY OF WORK**

- A. Furnish all labor, materials, tools, equipment, testing, and supervision required to complete all piping systems, as indicated on the drawings and specified herein, and all other work incidental thereto, except as otherwise noted.
- B. The requirements of Section 15000, "General Mechanical Provisions" and Section 15030, Piping Installation, General form a part of this Section and govern work covered in this Section.

**1.02 RELATED WORK**

- A. Shop Drawing submittals are specified in Section 01300.
- B. Section 09900 - Painting.
- C. Section 15000 - General Mechanical Provisions.
- D. Section 15030 – Piping Installation, General.
- E. Section 15100 - Valves.

**1.03 SUBMITTALS**

- A. Shop drawings are required for each item in this section of the specifications, including, but not limited to piping, couplings, gaskets, fittings, layouts, dimensions, etc. in accordance with Section 01300.
- B. Provide layout drawings, showing fittings, valves, supports, coupling, gauges, sample cocks, flushing connections, etc.
- C. Paint Color Charts.
- D. Pressure Test Reports.

**1.04 DELIVERY STORAGE AND PROTECTION**

- A. Properly store, protect, and handle all pipe per manufacturer recommendations.
- B. Store all plastic pipe indoors or cover until installed.

**PART 2 - PRODUCTS**

**2.01 PIPING MATERIALS**

- A. Various types of piping materials are used to meet the specific requirements of the different piping systems as indicated in the "Piping Systems Schedule." This schedule shall be followed except that where a particular piping material is chosen for a piping system that material alone shall be used throughout that entire system of pipe and fittings, except as noted otherwise on the drawings.
- B. Flanges shall be installed at connections to all equipment and valves 3 inches and over.
- C. Unions shall be installed at connections to all equipment and valves 2 inches and below.

**2.02 DUCTILE IRON PIPE (D.I.)**

- A. Ductile iron pipe and fittings shall be standard cement lined and shall meet the requirements of the current ANSI A21.15, (AWWA C115), "Ductile-Iron Pipe, Centrifugal Cast in Metal Molds or Sandlined Molds, for Water or other Liquids," and ANSI A21.10 (AWWA C110) "Ductile Iron and Gray Iron Fittings 3" through 48" for water and other liquids. Cement lining shall conform to ANSI 21.4 (AWWA C104) requirements. Compact Fittings are not acceptable, except as otherwise specified herein. Below grade ductile iron pipe and fittings shall be as specified in <Section 02661>.
- B. The minimum pipe thickness shall be Class 53.
- C. Flanged joints for exposed piping shall be in conformity with the current ANSI B16.1, "Cast Iron Pipe Flanges and Flanged Fittings," Class 125. Non-Threaded mechanical flange fittings are not allowed.
- D. Bolts for all pipe materials shall be cadmium plated or hot-dipped galvanized as specified in Section 15030 unless otherwise specified. All bolts shall be coated with anti-seize compound prior to assembly.
- E. Gaskets for D.I. pipe shall be full face type made of minimum 1/8 inch thick nitrile with a durometer hardness of 55 to 65 and shall conform to ANSI/AWWA A21.11/C 111 requirements unless otherwise specified. Gaskets for blind flanges shall cover the full face of the blind flange. Gaskets shall be as manufactured by Manville, Garlock or equal.
- F. Grooved Pipe Couplings
  - 1. Grooved couplings for ductile iron pipe shall be Victaulic Style 31, or equal, with Grade "S" gaskets and grooves cut for rigid joints.
  - 2. Grooved fittings for ductile iron pipe shall be Victaulic with rigid grooves conforming to ANSI/AWWA C-606.
  - 3. Couplings shall engage the grooved pipe around the entire circumference, and bolt together with two or more track head bolts. All bolts and nuts shall be cadmium or zinc plated except inside the wet well or corrosive areas where they shall be 316 SS.

- G. Joints for above grade piping shall be flanged or grooved pipe couplings. In general pipe connections to valves or equipment shall be flanged unless otherwise indicated on the Drawings.

## 2.10 QUICK DISCONNECT FITTINGS

- A. Quick disconnect fittings for the flushing supply pipes shall be of the cam lock type, aluminum construction, 4" size, male adapter by male NPT, Andrews Model 400-F-AL as manufactured by Dixon Valve and Coupling Co. or Model 633-F as manufactured by Civacon. The quick disconnect fittings shall be connected to a threaded stainless steel flange suitable for bolting to the flanged end of each flushing supply pipe. Each quick disconnect fitting shall be equipped with a cap of the camlock type, aluminum construction, 4" size, Andrews model 400-DC-AL or Civacon Model 634-B.
- B. Quick disconnect fittings for the sodium hypochlorite storage tank fill connection shall be of the cam lock type, polypropylene construction, 4" size, male adapter by male NPT, Model 400F as manufactured by Banjo Corporation. The quick disconnect fitting shall be connected to a threaded PVC flange suitable for bolting to the flanged end of the tank fill pipe. The quick disconnect fitting shall be equipped with a cap of the camlock type, polypropylene construction, 4" size, Banjo Model 400 CAP.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Pipe and Fittings shall be installed according to Section 15000 and per manufacturer recommendations.
- B. Flanges shall be used at connections to all equipment. Where screwed ends are present, a union shall be installed.
- C. Ductile Iron Pipe
  - 1. Flanges shall not be assembled in the field.
  - 2. The flanges shall be power assembled and screwed tight on the pipe until pipe ends project beyond the face line of the flange. The face of the flange and the end of the pipe shall be machine finished to the same plane and normal to the pipe centerline. The flange hub shall completely cover the threaded portion of the pipe so that the machined surface of the pipe is protected against corrosion. After assembly to the pipe, bolt holes shall be drilled. The holes shall accurately straddle pipe and fittings centerline. Drilled holes for flanges shall be spot faced on the back of the flanges. All flange faces shall be machined to a smoothness of not less than 125 rms.

### 3.02 PREVENTION OF ELECTROLYSIS

- A. Insulating couplings shall be provided at all joints between piping systems constructed of dissimilar metals.

**3.03 PRESSURE TESTS**

- A. Piping shall be hydrostatically pressure tested according to Section 15000.

**3.04 PAINTING**

- A. Ductile, Cast Iron, Carbon Steel, Copper and Plastic pipe shall be painted according to Section 09900 of these specifications.
- B. Color to match Owner's color chart.
- C. Stainless Steel Pipe and Tubing shall not be painted.
- D. The following schedule shall be used for painting items specified in the following Piping Sections and Valve Sections:

<b>Item</b>	<b>Painting System No.</b>
Exterior ferrous piping	1
Interior ferrous piping (not specified elsewhere)	2
Submerged and non-submerged ferrous piping in corrosive areas	6

**END OF SECTION 15060**

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SECTION 15100

VALVES

PART 1 GENERAL

1.1 SUMMARY OF WORK

- A. Furnish all labor, materials, tools, equipment, and supervision required to complete all valve installations as indicated on the drawings and specified herein, and all other work incidental thereto, except as otherwise noted.

1.2 RELATED WORK

- A. Section 01300 - Submittals.
- B. Section 09900 - Painting.
- C. Section 15000 - General Mechanical Provisions.
- D. Section 15010 - Electrical Requirements for Mechanical Work.
- E. Section 15030 – Piping Installation, General.
- F. Section 15060 - Pipe & Pipe Fittings.

1.3 SYSTEM DESCRIPTION

- A. Valves and operators shall be of the type and size indicated on the Valve Schedule shown on the Drawings.

1.4 SUBMITTALS

- A. Shop drawings and Operation and Maintenance Manuals are required for each item in this section of the specifications, including, but not limited to valves, actuators, manual operators, pneumatic cylinders, couplings, gaskets, etc.

1.5 WARRANTY

- A. The warranty period for all items covered by this Section of the Specifications, shall be one year from the date of equipment acceptance as specified in the General Conditions.

1.6 INSPECTION & TRAINING REQUIREMENTS

- A. A factory representative employed by the manufacturer shall visit the site prior to equipment start-up to verify the proper installation of the equipment and to instruct the Owner's operating personnel in the maintenance and operation of these units. The scheduling of this service shall

be coordinated with the Owner and the cost of this service shall be included in the Contractor's bid price.

## PART 2 PRODUCTS

### 2.1 GATE VALVES

#### A. TYPE G-3

1. Gate valves for sewage service shall be of the non-rising stem, ductile iron body, resilient wedge type, minimum 150 psi water working pressure and shall conform to AWWA C-509. Valves shall include flanged ends, a ductile iron wedge encapsulated with a resilient elastomer material, cast bronze stem and nut, and Delrin thrust bearing. The stem seal plate shall include an O-ring gasket to seal against the bonnet. The stem seal shall be replaceable with the valve under pressure and full open. The body, bonnet, and seal plate shall have a factory applied thermoplastic epoxy coating on all interior and exterior surfaces. The coating shall comply with AWWA C-550-81. The valve body shall be free of pockets or ledges where sediment or debris can collect.
2. Valve actuators shall be as indicated in the valve schedule included with the Drawings. Motorized valves shall be equipped with a mounting yoke and stem coupling suitable for connection of the motor actuator. Valves and actuators shall be factory assembled by the valve manufacturer.
3. Valves shall be M & H Style 4067-02, Clow Figure No. F-6102 or US Pipe Metroseal.

### 2.2 PLUG VALVES

#### A. TYPE P-1F

1. Plug valves 4" dia. and larger shall be flanged, plug valves smaller than 4" in dia. shall have screwed joints. All plug valves shall be eccentric type, non lubricated valves with resilient faced plugs and 100% flow area equivalent to adjoining pipe. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard.
2. Valve bodies and plugs shall be ductile iron. All exposed nuts, bolts, springs, washers, etc., shall be zinc plated. Resilient plug facings shall be Buna-N or other elastomer as required by the application.
3. The valve packing shall be adjustable and replaceable, consisting of multiple vee-rings and shall be visible, allowing service without removing the actuator.
4. The valve seat shall be welded nickel with a nominal thickness of 1/8". The valve shall incorporate upper and lower stainless steel bushings with grit excluders.
5. Valve pressure rating shall be 150 psi and shall be established by hydrostatic tests as specified by the current edition of ANSI Standard B16 1. Valves shall provide drip tight shutoff up to the full pressure rating with pressure in either direction.
6. Valve operators, regardless of the type, shall be mounted by the valve manufacturer and tested as an assembly at the factory of origin. Test documents shall be furnished upon request.
7. Valves shall be Dezurik Style PEF, ValMatic Series 5800R or Henry Pratt Ballcentric.

## 2.3 CHECK VALVES

### A. TYPE C-1

1. Check valves 6" and larger shall be flanged, 125 psig, swing type. Valves shall have cast iron bodies and discs, stainless steel disc shaft and Buna-N disc seat. Valves shall be complete with outside lever and spring. Valves shall be suitable for vertical or horizontal service and shall be M & H Style 259-02, Clow Figure F-5381/5340, or Golden Anderson Figure 230.
2. Check valves 2" to 6" in size shall be flanged, 125 psig, swing type, cast iron body and disc complete with outside lever and weight. Discs shall be Buna-N faced. Valves shall be suitable for vertical or horizontal service. Valves shall be M & H Style 159-02, Clow Figure F-5382, or Golden Anderson Figure 220.

## 2.4 BALL VALVES

### A. TYPE B-3

1. Valves 2" and below shall be 316 S.S. body, ball and stem with Teflon seats and seals. The ball shall be full port, self-aligning with seats on both sides to provide a positive seal in either direction. The valve shall have a three-piece body with stainless steel body bolts, screwed ends. Valves shall be Model T-595-S6-R-66 as manufactured by Nibco or equal as manufactured by Watts of Nelles-Jamesbury.
2. Valves larger than 2" shall be 316 S.S. body, ball and stem with Teflon seats and seals. Valves shall be split body, full bore, class 150 design with flanged ends. Valves shall be Model F515-S6-Y-66/FS as manufactured by Nibco or equal as manufactured by Watts or Nelles-Jamesbury.

## 2.5 OPERATORS

### A. GEAR OPERATORS (G)

1. Gear operators shall be provided, as indicated in the Valve Schedule. The gear mechanism shall be the totally enclosed type. The gear operator shall be selected to operate the valve at the indicated test pressure on the Piping Schedule with an operator pull of no more than 40 lbs. Gear operators for buried or submerged valves shall be sealed and specifically designed for buried/submersed service as indicated on the Drawings.

### B. HANDWHEEL OPERATORS (HW)

1. Handwheel operators shall be provided as indicated in the Valve Schedule and shall be of the valve manufacturer's standard design. Handwheels shall operate with 40 lbs. maximum applied force, with the test pressure indicated on the Piping Schedule applied across the valve.

### C. VALVE OPERATOR ACCESSORIES

1. General
  - a. Where indicated in the valve schedule and/or on the Drawings, extension stems with bronze bushed stem guides spaced as required, floorstands, valve boxes, gearing, handwheel, chainwheels and chains, lever, etc., shall be provided. Valve operator accessories shall be as follows:
    - Extension Stems - Type 304 S.S.
    - Couplings - Bronze or Stainless Steel

- Chains - Galvanized Steel
- Valve Boxes - C.I. with 8" clear opening and removable cover
- Operating Nuts - 2" square cast iron

PART 3 EXECUTION

3.1 INSTALLATION

- A. Piping and valve installation shall be as specified in Sections 15000 and 15030 and as specified in other applicable sections of these specifications.

3.2 TESTS

- A. All motor, pneumatic, hydraulic and solenoid operated valves shall be field tested. Field testing shall include local and remote operation and all alarm functions (if applicable).
- B. All automatically operating valves shall be adjusted to the set points specified or those identified by the Engineer. Testing shall then be conducted to verify operation including any alarm functions.

3.3 PAINTING

- A. The following schedule shall be used for painting items specified in the following Piping Sections and Valve Sections

<u>Painting Item</u>	<u>System No.</u>
- Exterior, valves & operators	1
- Interior, valves & operators (not specified elsewhere)	2
- Submerged and non-submerged valves & operators in retention basin or wet well	6
- Buried Valves	6

- B. For detailed painting requirements and system descriptions refer to Section 09900 of the Specifications.

3.4 STORAGE OF MATERIAL

- A. All material shall be stored prior to installation in accordance with Sections 01600, and the manufacturer's instructions. Valve actuators shall be stored in a manner to prevent damage due to moisture or water intrusion.
- B. Conduits connected to valve actuators shall be temporarily sealed during construction to prevent water entrance through open conduit systems.

END OF SECTION

## SECTION 16010

### GENERAL ELECTRICAL, INSTRUMENT, AND CONTROL REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General requirements for electrical power, instrumentation, and controls systems.

##### 1.2 RELATED SECTIONS

- A. Section 16050 – Basic Electrical Materials and Methods.

##### 1.3 REFERENCES

- A. All equipment and workmanship shall be in conformance with the following documents:
  1. National Electrical Code, latest approved edition.
  2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
  3. Latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.
- B. All equipment shall be designed, constructed, installed, and tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, and OSHA, except as modified herein.

##### 1.4 GENERAL REQUIREMENTS

- A. Unless otherwise specified, provide tools, equipment, apparatus, transportation, labor, and supervision to complete and place in satisfactory operation the work indicated on the Drawings and specified herein. Where permits or inspection fees are required in connection to the work under this Specification, the Contractor shall secure such permits and pay all fees.
- B. Where any public or private utilities are encountered, the Contractor shall be responsible for any damages thereto resulting from his operations. Any existing lines or utilities damaged during the construction and which are not to be abandoned or removed, shall be replaced or repaired. The Contractor shall be responsible for determining the exact location of all underground or otherwise concealed utilities, conduit runs, piping, etc. which may interfere with construction or which require modifications.
- C. All work shall be done in conformity with the applicable requirements of the codes, rules, and regulations of public utilities and all others having jurisdiction.
- D. Where the Specifications describe or the Drawings show materials of higher quality than required by the above rulings and codes, the Drawings and Specifications shall govern the quality of materials which shall be furnished.

- E. The wire, conduit, and equipment sizes shown on the Contract Drawings are based on estimated ratings. If ratings of equipment as furnished under the Contract exceed the estimated ratings, the wire, conduit, and equipment sizes shall be adjusted to meet NEC requirements at no additional cost to the Owner.
- F. The phrase "below grade," when used in reference to the interior of buildings, rooms, or other structures in these Specifications and on the Drawings, shall apply to the entire internal volume of the room, area, or structure where 50% or more of the volume is actually below the average of the exterior finished grade elevations. In all other cases, the phrase shall only apply to the volume of space actually below finished grade.
- G. Dry locations are defined as interior; above grade; heated rooms, structures, buildings, cabinets, enclosures, etc. not normally subject to dampness or wetness. Damp locations are defined as interior; above grade; unheated rooms, structures, and buildings. Wet locations are defined as all outdoor areas; all underground rooms, structures, building areas, vaults, etc.; whether heated or unheated. Refer to National Electrical Code Article 100, "Location:" for additional definitions.

#### 1.5 PROJECT CONDITIONS

- A. Before submitting his proposal, this Contractor shall be held to have examined the site and satisfied himself as to the existing conditions under which he will be obliged to work. The Contractor will be allowed no claim(s) for extra(s) due to his failure to make the above examination.

#### 1.6 INSPECTION

- A. At the proper time, the Contractor shall file application for inspection of his work with the local, State, or National authority having jurisdiction and shall deliver to the Owner all required certificates attesting to approval by such authorities.

#### 1.7 GUARANTEE

- A. Repair and maintenance for the guarantee period is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine. (This is replacement of lamps, oiling, greasing, etc.) The Owner shall be the judge of what shall be considered as routine maintenance.

#### 1.8 SUBSTANTIAL COMPLETION

- A. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete, in accordance with the Contract Documents, such that the Owner can occupy the facilities and/or utilize the system for its intended use.
- B. Substantial Completion shall be determined by the Owner and/or the Engineer based on completion of Testing, Start-up, and Demonstration requirements as specified in Sections 16960 and 16980. See Section 01700, Contract Closeout for additional requirements.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. All materials and equipment shall be new, except where specifically identified otherwise.
- B. All materials and equipment shall be listed or labeled by Underwriters' Laboratories, Inc., except for materials and equipment not available from any source with such listing and/or labeling, or as specifically required by the Division 16 Sections.
- C. All conductor terminations, lugs, and connectors on all equipment supplied under this Contract shall be 75°C rated for copper conductors.
- D. Concrete for electrical work shall be as specified in Div 03.

### 2.2 LOOSE AND DETACHABLE PARTS

- A. The Contractor shall retain all loose and small detachable parts of the apparatus and equipment furnished under his Contract, until the completion of his work, and shall then turn same over to the Owner or his representative delegated to receive them and obtain from the Owner an itemized receipt, therefore, in triplicate, the Owner retaining the original. The Contractor shall retain one copy of this receipt for his files and shall attach the other two to any request for final payment for the work.

### 2.3 STANDARDS

- A. All materials shall be new and shall conform as a minimum with NEMA, ANSI, and Underwriters' Laboratories, Inc. (UL) in every case where such a standard has been established for the particular type of material in question.

### 2.4 SPARE PARTS

- A. Spare parts shall be provided for electrical equipment supplied under this Contract, as specified in individual Specification Sections, and shall be furnished and delivered to the Owner. Spare fuses are specified under Section 16477.
- B. Spare parts shall be packed and individually boxed for storing with each box labeled with the part's description including its part or catalog number, its use, and the equipment for which it is a part. Parts used during startup shall be replaced prior to acceptance.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. All floor mounted equipment shall be provided with a minimum 4 inch high concrete pad, unless a higher dimension is shown (or called for) on the Drawings.

- B. Material and equipment furnished and installed by the Contractor shall be completely protected against damage, pilferage, dampness, or abuse until turned over and accepted by the Owner.
- C. Concrete shall be maintained in moist condition for at least five (5) days after placement, by means approved by the Owner.
- D. The installation of all electrical, instrumentation, and control equipment shall meet the requirements of the State and Federal Occupational Safety and Health Statutes.

### 3.2 DRAWINGS AND MEASUREMENTS

- A. Drawings shall be submitted in accordance with Sections 01300 and 01700 of these Specifications and as specified hereinafter. No work shall be undertaken until the Engineer has reviewed and approved the shop drawings. Only approved materials shall be installed and only approved installation methods shall be used.
- B. The Drawings show the arrangement, general design, and extent of the systems. The work is shown on the Drawings by symbols, as shown in a legend on the Drawings. Equipment is shown in its general location, except where in certain cases the Drawings may include details giving the exact location and arrangement. Existing, underground or otherwise concealed utilities, piping, conduit runs, etc. indicated on the Drawings are shown in approximate locations and orientations only; the Contractor shall field verify exact locations.
- C. The Drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the Contractor. Field measurements necessary to determine the required quantities of materials and fitting the installation of all materials and equipment into the building construction shall be taken by the Contractor.
- D. Installation drawings and manufacturer's shop drawings are required for all electrical, instrumentation, and control work. Installation drawings shall show panel layout, conduit connection sizes, and location and equipment foundations, details, and locations, accurately dimensioned. Exposed runs of conduit need not be dimensioned. Conduit layout and installation drawings shall be submitted for approval and shall show all conduit runs, complete from origination to termination, and shall indicate conduit sizes and fills, raceway system components, methods and spacing of supports, etc.
- E. Control schematics shall be provided for all new control circuits. Control schematics shall use the ladder diagram type format incorporating line numbers, operation function statements, contact location line numbers with underlines indicating normally closed contacts. A description of operation of each device and complete written sequence of operation shall be provided with all control schematics. Format and symbols shall be as approved by the Owner. Wire and terminal numbers shall be clearly shown.
- F. Upon completion of the work, complete "As-Built" drawings shall be provided. For additional requirements see Section 01700, Contract Closeout, Project Record Documents.

### 3.3 STORING OF EQUIPMENT

- A. All equipment shall be stored in accordance with the manufacturer's recommendations. A letter from the manufacturer shall be provided stating those recommendations.
- B. All equipment which has been set in place but not in operation shall be protected from damage or deterioration from whatever causes in accordance with the manufacturer's recommendations until the equipment has been accepted by the Owner.
- C. All wire and cable shall be stored on the original, manufacturer's reels, protected from the weather, and all cable end seals shall be maintained intact until the cable is installed.
- D. During construction, all electrical equipment insulation shall be protected against absorption of moisture and metallic components shall be protected against corrosion by strip heaters, lamps, or other acceptable means. This protection shall be provided immediately upon receipt of the equipment and maintained continuously.

### 3.4 CLEANUP

- A. After substantial completion and prior to final acceptance, all electrical equipment shall be cleaned up, interior and exterior, to be free of dust and other foreign matter. Internal components shall be vacuumed, including windings of dry type transformers, and wiped free of dust.
- B. De-energization of equipment to accomplish the cleaning work shall be done at a time as approved by the Owner.

### 3.5 PAINTING

- A. The exterior of all enclosures shall be cleaned and touched up with matching paint where scratched or marred so that the exterior presents an "as new" appearance.
- B. All factory finished equipment shall be protected from damage during erection, thoroughly cleaned after erection, and touched up as required. If the factory finish has, in the opinion of the Owner, been seriously damaged, the equipment shall be refinished.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General electrical equipment and installation requirements.

1.2 RELATED SECTIONS

- A. Section 00700 – General Conditions.
- B. Section 00800 – General Supplementary Conditions.
- C. Section 01000 – General Specifications.
- D. Section 16010 – General Electrical, Instrument, and Control Requirements.

1.3 WORK INCLUDED

- A. The Contractor shall furnish all labor, material, and equipment required for the installation of the electrical systems, modifications to existing electrical systems, and the completion of the work as herein specified and/or indicated on the Drawings. It is the intent that the Drawings and Specifications, which are general only, shall provide for finished, first-class work, and that the equipment and appurtenances thereto shall be of such construction and details, and of such materials, as to function completely and properly, and so as to be of long life; and such as not to require excessive upkeep or maintenance; and that operation shall be simple and control convenient. Any items omitted therefrom which are clearly necessary for the completion of the work or its appurtenances shall be considered a portion of the work though not directly specified or shown. All work shall conform with NECA 1-2010, Good Workmanship in Electrical Contracting.
- B. The Contractor shall make all necessary arrangements and pay all costs and fees of the DTE Energy Co. for the modification of the secondary service(s) and any assistance during construction.
- C. The Contractor shall provide and install all conduit and wire connections required between components of equipment and systems supplied under other Sections of these Specifications, where shown or indicated on the Drawings.
- D. The Contractor shall furnish and install complete modifications to the existing secondary power distribution systems.

1.4 DESCRIPTION OF SYSTEMS

- A. Secondary power is 240/120 volts, 3 phase, 4 wire plus ground, 60 Hertz.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

- A. The Contractor shall furnish and install complete modifications to the existing secondary power supply system, together with all necessary supports, framing, hangers, and all other appurtenances. He shall furnish and arrange for the setting of anchor bolts, channels, etc. which are to be set in the concrete or in masonry walls. The work shall include all items in the Drawings and Division 16 Specifications.

## PART 3 EXECUTION

### 3.1 TEMPORARY POWER FOR CONSTRUCTION

- A. The Contractor shall be responsible for providing temporary electrical power as required during the course of construction and shall remove temporary service equipment when no longer required. The Contractor shall coordinate with the DTE Energy Company sources of required temporary power. Temporary power sources shall be installed per NECA 200-2010, Temporary Electric Power at Construction Sites, Standards.
- B. Portable, diesel, engine-generator sets may be utilized for temporary power to maintain loads during construction. Each engine-generator set shall be sized to adequately handle the intended load, including largest motor starting with all other loads running. The following shall be submitted for each engine-generator set and approved prior to use:
1. A schedule indicating loads served, starting date, ending date, set size, and location on the site; coordinate with the Sequence of Construction and Demolition hereinafter.
  2. Generator sizing calculations including load tabulation and motor starting sequence.
  3. Engine-generator set data including size, manufacturer, catalog number, load cable size and type, and load connection location.

Each engine-generator set shall be secure during use and shall be maintained for efficient and continuous operation. The Contractor shall provide all necessary fuel, replenished to ensure continuous operation, and maintenance required during use.

Load cables shall be routed and protected to prevent damage and to prevent exposing personnel to hazards. Cables shall be of the heavy-duty jacketed type, Bronco/66 Type G cable as manufactured by Teledyne Western Wire Co., Essex Type G, or equal.

Engine-generator sets shall be as manufactured by Kohler Power Systems, Cummins Power Generation, Caterpillar, Inc., or equal.

### 3.2 DRAWINGS AND MEASUREMENTS

- A. Outlets connected by lines show switch control or circuiting only and are not actual runs of conduit. All light and receptacle outlets are lettered and numbered; the letter indicates the panelboard from which the circuit is to be powered. All outlets bearing the same letter and number shall be connected to the same circuit.

- B. Power feeders shall be run in individual conduits, from source to load, as indicated in schedules, wiring diagrams, or by home runs on the Drawings.

END OF SECTION

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SECTION 16110

RACEWAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal conduit.
- B. Flexible metal conduit.
- C. Liquidtight flexible metal conduit.
- D. Fittings and conduit bodies.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16050 – Basic Electrical Materials and Methods.
- C. Section 16118 – Underground Conduit System.
- D. Section 16130 – Boxes.
- E. Section 16170 – Grounding and Bonding.
- F. Section 16190 – Supporting Devices.
- G. Section 16195 – Electrical Identification.

1.3 REFERENCES

- A. ANSI C80.1 – Rigid Steel Conduit, Zinc Coated.
- B. ANSI C80.3 – Electrical Metallic Tubing, Zinc Coated.
- C. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- D. ANSI/NFPA 70 – National Electrical Code.
- E. NECA 101-2013, Steel Conduits (Rigid, IMC, EMT).
- F. NECA 111-2003, Standard for Installing Non-metallic Raceways.
- G. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

- H. NEMA TC 2 – Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- I. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- J. UL 6 Standard for Rigid Metal Conduit.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate materials, finishes, dimensions, listings, and standards compliance.
- C. Product Data: Provide data for conduit, tubing, duct, fittings, and accessories.
- D. Manufacturer’s Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 01600.
- B. Accept conduit on site. Inspect for damage.
- C. Conduit shall be delivered at the construction site in not less than ten foot lengths; each length of conduit to have approval label of the Underwriters.
- D. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- E. Protect PVC conduit from sunlight.

#### 1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Verify routing and termination locations of conduit prior to rough-in.
- C. Conduit routing is shown on Drawings in approximate locations, unless dimensioned. Route as required to complete the raceway system.

### PART 2 PRODUCTS

#### 2.1 CONDUIT AND FITTINGS

- A. Provide all conduit, conduit fittings, outlet boxes, pull boxes, supports, hangers, plates, and such other items as are incidental to or required for a complete installation, all of which shall be made of cast iron, malleable iron, or galvanized steel, unless indicated otherwise.
- B. No threadless couplings or running threads will be permitted on rigid conduits.

- C. No conduit smaller than 3/4 inch shall be used, unless otherwise indicated or specified.
- D. All raceways shall be marked with the manufacturer's name or trademark as well as type of raceway and size. This marking shall appear at least once every 10 feet and shall be of sufficient durability to withstand the environment involved.
- E. Wherever conduits cross building, tank, or other structural expansion joints, the Contractor shall provide and install conduit expansion/deflection fittings as manufactured by O.Z./Gedney Type DX, Crouse-Hinds, Thomas & Betts, or equal, unless indicated on the Drawings as requiring an expansion fitting.
- F. Expansion fittings with copper, ground bonding jumpers shall be installed where indicated on the Drawings and shall be O.Z./Gedney Type AX with Type BJ bonding jumper, Crouse-Hinds, or equal.

## 2.2 RIGID METAL CONDUIT

- A. Rigid steel conduits shall consist of heavy wall, mild steel tube, hot-dipped galvanized with threads electrogalvanized after cutting, and especially selected with reference to uniformity of thickness and freedom from defects. All fittings shall be suitable and approved for use in rigid steel conduit systems.
- B. Manufacturers:
  - 1. Wheatland Tube Company
  - 2. Allied Tube & Conduit Corporation
- C. Rigid Steel Conduit: ANSI C80.1, UL 6.
- D. Fittings and Conduit Bodies: ANSI/NEMA FB 1; UL Standard 514B; all steel fittings.

## 2.3 PVC COATED METAL CONDUIT AND FITTINGS

- A. Manufacturers:
  - 1. Thomas & Betts Ocal Blue
  - 2. Robroy Industries Plasti-Bond Red H<sub>2</sub>OT
- B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick. UL listed with the PVC coating as the primary corrosion protection.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit. UL listed with the PVC coating as the primary corrosion protection.
- D. PVC coated conduit, fittings, and fasteners shall all be supplied from the same manufacturer.
- E. PVC coated conduit shall be rigid metal conduit factory encased with polyvinyl chloride of .040 inch (40 mil) thickness minimum on the exterior and a urethane coating of .002 inch (2 mil) thickness nominal or a phenolic coating of .003 inch (3 mil) thickness nominal on the interior. The adhesion of the coating shall be greater than the tensile strength of the coating (NEMA RN1 requires a minimum tensile strength of 2000 psi for PVC).

- F. All fittings and fasteners shall have the same PVC coating on the exterior as the conduit. All hollow fittings shall also have the same interior coating as the conduit. Couplings, fittings, and conduit bodies shall have PVC sleeves at threaded joints with length equal to the outside diameter of the associated conduit or 2 inches. Conduit body covers shall be provided with stainless steel screws with PVC coated, hex heads.

#### 2.4 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
  - 1. AFC
  - 2. Southwire - Alflex
- B. Description: Interlocked steel construction.
- C. Fittings: ANSI/NEMA FB 1.
- D. Flexible metallic conduit shall be 3/4 inch nominal trade size (minimum) flexible steel conduit tubing, hot-dipped galvanized, meeting Underwriters' Laboratories Standard for flexible steel conduit (UL 1).

#### 2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
  - 1. Anaconda "Sealtite" Type LA
  - 2. Electriflex
  - 3. AFC
  - 4. Thomas & Betts Corp.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: ANSI/NEMA FB 1.
- D. All fittings used with this conduit shall be of the liquidtight type and shall be equipped with approved type grounding devices to insure continuity between the conduit and the connection. The fittings shall seal out vapors, coolants, oil, water, dust, and other foreign matter and shall be installed with a sealing O-ring between the fitting and the box. The fittings shall be "ST" series connections as manufactured by Appleton Electric Co., Ideal Industries 75-000 Series, or equal.

#### 2.6 MISCELLANEOUS FITTINGS AND MATERIALS

- A. Insulated grounding bushings shall be Type HBLG as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.
- B. Insulating bushings shall be high impact resistant, thermoset plastic, 150°C rated, Type A as manufactured by O.Z./Gedney, American Fittings Corp., Thomas & Betts, or equal.
- C. All locknuts shall be of the sealing type, O.Z./Gedney Type SLG, Appleton, American Fittings Corp., Thomas & Betts, or equal.

- D. Liquidtight hubs shall have a sealing ring between the fitting and the box and an insulated throat to insure protection of the wires as pulled. Hubs shall be made of nodular or malleable iron steel, zinc plated for corrosion resistance, UL listed, and shall meet or exceed the requirements of UL test 514B. Liquidtight hubs shall be Bridgeport, O.Z./Gedney Type CHM, Ideal Industries 75-000 Series, American Fittings Corp., Thomas & Betts, or equal.
- E. Sealing fittings shall be Crouse-Hinds Co. Type EYS, Appleton, or equal. Sealing fittings used as water stops shall have an integral drain and shall be Crouse-Hinds Type EYD, Appleton, Thomas & Betts, or equal. Sealing fittings in hazardous or corrosive areas shall be PVC coated.
- F. Explosion proof, flexible conduit couplings shall consist of a braid cover over a flexible inner core with suitable end fittings. Flexible couplings shall be all stainless steel construction, Crouse-Hinds Type EC-S516, Appleton, or equal.
- G. Conduit sealing compound shall be Waterguard Desiccants Industrial Encapsulant, Polywater FST-250, or equal.
- H. Link seal for sealing conduits into sleeves and cored openings shall be GPT Industries - Thunderline, Metraflex Co. Metraseal, Calpico, or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF RACEWAYS

- A. Install conduit in accordance with NECA 101-2013, Steel Conduits (Rigid, IMC, EMT).
- B. Arrange supports to prevent misalignment during wiring installation.
- C. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- D. Do not attach conduit to ceiling support wires.
- E. Arrange conduit to maintain headroom and present neat appearance.
- F. Identify raceway systems under provisions of Section 16195.
- G. Joints shall be made tight with standard couplings and corners turned with elbows or long radius bends in pipe.
- H. Exposed multiple runs of conduit indoors shall be supported on hangers suspended from concrete inserts or structural steel. Single runs of conduit may be attached to ceilings or walls by means of approved type anchors. Conduit and other equipment may be attached to structural steel only where approved by the Owner. All conduit shall be secured to the supports by means of galvanized malleable iron clamps using two bolts or machine screws. Conduit supports, hangers, and anchors shall be as specified under Section 16190.
- I. The use of wood plugs for anchoring raceways to concrete or masonry will not be permitted.

- J. All conduits installed exposed shall be run vertically or horizontally and shall be parallel or at right angles to the building or structure walls.
- K. The Contractor shall provide and install, where required, the additional steel to adequately support all conduits, boxes, and all other electrical equipment.
- L. All conduit shall be dry, clean, and free of obstructions before conductors are pulled in. If there is evidence of moisture, obstructions, or foreign matter in the conduit when the conductors are installed, the wiring shall be removed and the conduit cleaned to the satisfaction of the Owner. All wiring showing evidence of damaged insulation shall be replaced.
- M. Concealed conduit shall be placed in floors, ceilings, and walls before concrete is poured and in masonry walls as the walls are laid up. The conduit shall be blocked and fastened in place to prevent any displacement during construction. Conduits shall be separated by at least one conduit diameter, unless specifically authorized by the Owner to do otherwise. All conduit joints shall be made tight with galvanized couplings or approved unions.
- N. All steel conduit run exposed shall be supported at intervals not exceeding 8 feet, unless shown otherwise on the Drawings. Multiple runs of conduit shall be mounted with steel supports so arranged that each individual conduit is clamped in place.
- O. Conduit installed on walls shall be mounted on spacers to provide not less than 1/4 inch space between the conduit and the wall.
- P. Conduit installed exposed outdoors shall be supported by structural steel members.
- Q. All conduit entrances through below grade walls and poured-in-place concrete roofs shall be installed through sleeves poured in place or through core drilled opening, unless poured in place.
- R. Sleeves for passage of conduits through poured concrete roofs and below grade walls shall be constructed of heavy wall steel pipe with full circle continuously welded water stop plate. Sleeves shall be sized to accommodate the conduit and link seal combination as specified hereinbefore.
- S. All conduits passing through openings or sleeves in roofs, below grade walls, or floors shall be sealed in place and made watertight with link seal.
- T. All conduit stubs for future use shall be terminated with pipe caps.
- U. Conduit runs installed horizontally overhead shall allow a minimum of 7 feet of headroom, except where installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.
- V. Wherever a conduit emerges from the underside of a slab or roof or enters an area from above and that slab or area or conduit is exposed to the weather, then that conduit shall be provided with a pull box or fitting and filled to a length of 12 inches minimum with conduit sealing compound where the conduit emerges indoors to prevent water from following the conduit

interior. The sealing compound shall be as specified hereinbefore under Miscellaneous Fittings and Materials.

- W. Wherever a conduit enters an electrical equipment enclosure from an underground or outdoor location and other locations where indicated on the Drawings, the conduit opening shall be sealed after the wires and/or cables are pulled. One and one half (1½) inch and smaller conduits with more than 20 percent wire fill may be sealed with conduit sealing compound; all other conduits, where required, shall be provided with conduit sealing bushings or compound bushings with ground conductor connectors, as manufactured by O.Z./Gedney or equal. Conduit sealing compound shall be forced into conduits to a minimum depth of 12 inches.
- X. Field bends in conduit shall not be of a lesser radius than that of manufactured elbows of the same trade size and shall show no flattening of the conduit. Conduit bends shall be held to as large a radius as possible for ease in pulling of conductors and to provide a neatly installed appearance. Generally, conduits 1" and smaller shall be bent in the field. Other conduit bends shall conform to the following: 2" and 2½" conduit, 24" radius, 3" and larger with a minimum radius of 36". Except where conduit runs are shown in exact detail on Drawings, the maximum length of straight conduit runs shall be 200 ft. between pull boxes, with 50 ft. deducted for each 90 degree bend and 25 ft. deducted for each 45 degree bend, reduction in length for all other angle bends shall be figured on a similar basis.
- Y. Conduit parallel to or crossing uninsulated hot water or steam pipes shall be separated from same by 12", if parallel, or 7", if crossing. Where hot water or steam pipe lines are insulated, conduit shall clear the insulation surface by 2". Conduit shall not run directly under cold water lines.
- Z. Conduit stub-ups into the bottom of NEMA Type 12, floor mounted enclosures, including motor control centers, shall enter the enclosure through individual holes in the bottom plate or sheet steel bottom and the openings shall be sealed around each conduit to maintain the enclosure's NEMA Type 12 rating.
- AA. All conduits and sleeves passing through openings in walls above grade or floors shall be sealed in place and made watertight with non-shrink grout or other Owner approved sealant. Non-shrink grout used in floor or wall openings, shall be of the non-metallic type. All openings in fire rated walls and floors shall also be sealed with a fire barrier sealing system capable of maintaining the designed fire rating of the wall or floor and suitable for sealing out smoke and fumes. The fire barrier sealing system shall be capable of passing the ASTM E-814 (UL 1479) fire test and shall be subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory; provide products by Hilti Construction Chemicals, Inc.; 3M™ Fire Protection Products; or equal.
- BB. Openings in boxouts through floors or walls or in the bottom of electrical equipment shall be closed using split insulating blocks or non-shrink grout in a manner as approved by the Owner. All unused sleeves shall be capped or plugged at both ends with approved fittings.
- CC. Metallic sleeves containing a ground conductor shall be bonded at each end to the ground conductor.
- DD. The ends of all metallic conduits or elbows shall be cut square, reamed, and threaded.

- EE. The threads of all steel conduit connections concealed in concrete shall be coated at the time of installation with No. B69A45 Zinc clad primary coating, as manufactured by Sherwin William's Corp., Ideal Industries No. 40-630, CRC Chemicals Zinc-It, or equal.
- FF. The threads (metallic) of all corrosive area, outdoor, below grade, and hazardous area equipment connections including conduit, conduit fittings, pull and junction box covers, lighting fixture reflector, guard, and outlet box connections, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly. Coating compound shall be NO-OX-ID "A Special" by Sanchem, Inc., Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, or equal.
- GG. Ground and bond metallic raceway systems under provisions of Section 16170.
- HH. All metallic conduits, except those terminated in metal boxes or enclosures without knockouts and secured with double locknuts, integral hubs, or liquidtight hubs, shall be terminated with insulated grounding bushings. Conduits terminated in metal boxes or enclosures without knockouts and secured with double locknuts shall be terminated with an insulating bushing.
- II. All conduits and sleeves, metallic and non-metallic, intended for the passage of wire or cable and not terminated with a fitting, shall be terminated with a bushing or end bell.
- JJ. All connections between metallic conduits and NEMA Type 1 or NEMA Type 12 steel boxes shall be made with double locknuts. All connections between conduits and NEMA Type 3, 3R, 4, and 4X boxes shall be made with watertight connections. Watertight connections shall consist of integral hubs or liquidtight hubs.
- KK. Sealing fittings and all other fittings for conduit in hazardous locations shall be explosion proof, Class I, Division 1, Group D.
- LL. Electrical metal tubing or so called "Thin Wall" conduit and fittings shall not be used.
- MM. Raceway systems, in general, shall consist of Rigid Metal Conduit and fittings or Non-metallic, FRP Conduit and fittings.
- NN. Conduit and fittings in areas classified as corrosive, hazardous, and other areas indicated on the Drawings, shall be PVC coated metal conduit and fittings, unless constructed of stainless steel. The installation of such conduit and fittings shall be in strict accordance with the manufacturer's printed instructions and using the manufacturer's recommended tools and touch-up procedures.
- OO. To guarantee proper installation procedures and insure the validation of the manufacturer's warranty, the Contractor must request installation training from the manufacturer, or his appointed representative, prior to installing any PVC Coated Conduit and Fittings on the project. The manufacturer shall provide installation training at no cost to the Contractor. The Contractor shall provide the time and place, preferably at the job site, and the manufacturer shall certify every Contractor's employee completing the installation training.
- PP. All metallic conduit, conduit fittings, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in

polyvinyl chloride of minimum .040 inch (40 mil) thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

- QQ. Flexible conduit may be used only where rigid conduit is impracticable or where indicated on the Drawings.
- RR. Liquidtight, PVC coated, flexible metal conduit and associated fittings shall be installed as follows:
1. All sections of flexible conduit larger than 1¼ inches in diameter shall be paralleled with a braided copper bonding strap connected between the last section of rigid conduit and the frame of the equipment to ensure a continuous ground.
  2. Liquidtight, PVC coated, flexible metal conduit shall be installed with watertight connectors and in minimum lengths without sharp bends.
- SS. All final conduit connections to motors and other machinery, equipment, and devices which may be subject to movement or vibration shall be made with 15" to 18" of flexible, liquidtight, metallic conduit.
- TT. Final conduit connections to motors and other machinery, equipment and devices in hazardous areas which may be subject to movement or vibration shall be made with explosion proof, Class I, Division 1, Group D, flexible conduit couplings.

END OF SECTION



SECTION 16118

UNDERGROUND CONDUIT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Direct buried conduit.
- B. Directional Bored Electrical Conduit.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16050 – Basic Electrical Materials and Methods.
- C. Section 16110 – Raceways.

1.3 REFERENCES

- A. ANSI C80.1 – Rigid Steel Conduit, Zinc-Coated.
- B. UL 6 Standard for Rigid Metal Conduit.
- C. ANSI/ASTM A153 – Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- D. ANSI/ASTM A569 – Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.
- E. ANSI/IEEE C2 – National Electrical Safety Code.
- F. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- G. ANSI/NFPA 70 – National Electrical Code.
- H. ASTM A48 – Gray Iron Castings.
- I. ASTM A123 – Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.
- J. NEMA TC 7 – Smooth Wall Coilable Polyethylene Electrical Plastic Duct.
- K. NEMA TC 14 – Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes and handholes.
- C. Shop Drawings: Indicate dimensions, reinforcement, size, and routings of all underground ducts and duct banks.
- D. Product Data: Provide for metallic conduit; non-metallic duct, conduit, and duct fittings; manhole and handhole accessories, frames, and covers.
- E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual locations of exact routing of all duct banks and underground conduit runs.
- C. Accurately record actual locations of each manhole and handhole.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 01600.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.

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PART 2 PRODUCTS

2.1 RIGID STEEL CONDUIT

- A. Manufacturers: As specified under Section 16110, Raceways.
- B. Rigid Steel Conduit: ANSI C80.1, UL6.
- C. Fittings: ANSI/NEMA FB 1; UL Standard 514B; steel.

2.2 NON-METALLIC CONDUIT

- A. Manufacturers:
  - 1. Carlon
  - 2. JM Eagle
  - 3. Osburn Associates, Inc.
  - 4. Scepter
  - 5. Cantex
- B. Description: NEMA TC 2; Schedule 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3. All fittings and adapters shall be as supplied by the conduit manufacturer.

2.3 NON-METALLIC, PVC DUCT

- A. Manufacturers:
  - 1. Carlon
  - 2. JM Eagle
  - 3. Robintech
  - 4. Osburn Associates, Inc.
- B. Plastic Utilities Duct: NEMA TC 8; PVC, Type EB or DB.
- C. Plastic Utility Duct Fittings: NEMA TC 9.
- D. Plastic Communications Duct and Fittings: NEMA TC 10, Type EB or DB.
- E. All fittings and adapters shall be as supplied by the duct manufacturer.

2.4 NON-METALLIC, FRP DUCT

- A. Manufacturers:
  - 1. FRE Composites, Inc.
  - 2. A. O. Smith/Inland
  - 3. Champion Fiberglass
- B. Conduit and Fittings: NEMA TC 14; Type SW or HW. All fittings and adapters shall be as supplied by the duct manufacturer.

- C. Joining Method: Tapered bell and spigot joints.

2.5 HIGH DENSITY POLYETHYLENE (HDPE) CONDUIT

- A. Manufacturers:
  - 1. Dura-line
  - 2. Carlon
- B. All fittings and adapters shall be as supplied by the duct manufacturer.

2.6 DIRECTIONAL BORED ELECTRICAL CONDUIT

- A. The Contractor shall install directional bored underground conduits where shown on the Plans, and in accordance with the requirements of these Specifications. Conduit used for Directional Boring shall be of the size, type and quantity as shown in the Plans and shall meet the material specifications as stated herein.
- B. Conduit for Directional Boring shall be coilable High-Density Polyethylene. Smooth-Wall, coilable, polyethylene plastic conduit shall meet NEMA TC2, TC7 and UL651 and 651A applicable sections. Conduit shall be High-Density Polyethylene Type III, Grade P-33, Category 5, Class C, per ASTM-D3485.
- C. A mixture of Bentonite clay and potable water shall be used as the cutting fluid for the Drilling system. The Bentonite mixture used shall have the minimum viscosities as measured by a marsh funnel.

Rocky Clay	60 Sec.
Hard Clay	40 Sec.
Soft Clay	45 Sec.
Sandy Clay	90 Sec.
Stable Sand	120 Sec.
Loose Sand	150 Sec.
Wet Sand	150 Sec.

These viscosities may be varied to best fit the soil conditions encountered.

No other chemicals or polymers/ufacants shall be used in the drilling fluid without the written consent of the Owner, after a determination is made that the chemicals to be added are not harmful or corrosive to the conduit being installed.

2.7 ACCESSORIES

- A. Polypropylene fish line: 240 pounds (minimum) tensile strength.
- B. Warning tape shall be as manufactured by Brady, Panduit, or equal.

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PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavation, base material installation, and compaction is completed.

3.2 PREPARATION

- A. Prepare excavation in accordance with precast manhole or handhole manufacturer's instructions.

3.3 DIRECT BURIED CONDUIT INSTALLATION

- A. Underground conduits for direct burial shall be rigid steel conduit or non-metallic conduit.
- B. Install rigid steel conduit according to NECA 101-2006.
- C. Plastic fittings shall be of the type recommended for the type of conduit used. All conduits shall be coupled together to make a water-tight connection.
- D. Install non-metallic conduit in accordance with manufacturer's instructions.
- E. Join non-metallic conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full, even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. The Contractor shall allow 24 hours, minimum, for all solvents to evaporate after cementing the last joint in the raceway system before pulling in any wires or cables.
- F. All direct buried conduits shall be installed 30" minimum below grade (unless otherwise shown on Plans) and shall slope (minimum 3" per 100 feet) to handholes, manholes, cable vaults, or other structures.
- G. All changes in conduit elevation such as ells, stubs, bends, etc., shall be galvanized rigid steel. All conduit risers above grade shall be rigid steel. Conduits shall be rigid steel within 10'-0" of all structures. All conduits under buildings shall be rigid steel.
- H. Provide suitable fish line in each spare or empty duct, except sleeves and nipples.
- I. Excavate and backfill trenches under provisions of Section 02200. Install warning tape above all duct runs, as indicated on the Drawings.

END OF SECTION



SECTION 16123

WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire.
- B. Underground feeder and branch circuit cable.
- C. VFD load wire.
- D. Service entrance cable.
- E. Instrumentation cable.
- F. Communications cables.
- G. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Section 16050 – Basic Electrical Materials and Methods.
- B. Section 16110 – Raceways.
- C. Section 16130 – Boxes.
- D. Section 16190 – Supporting Devices.
- E. Section 16195 – Electrical Identification.

1.3 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code.
- B. Underwriters' Laboratories Standard UL-83.
- C. Underwriters' Laboratories Standard UL-44.
- D. Federal Specification A-A-59544.
- E. ANSI Standard C33.80.
- F. ICEA – Insulated Cable Engineers Association.

- G. ASTM – American Society for Testing and Materials.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide for all wire and cable.
- C. Test Reports: Indicate procedures and values obtained.
- D. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.

#### 1.5 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate. Route wire and cable as required to meet Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

#### 1.6 COORDINATION

- A. Coordinate Work under provisions of Section 01039.
- B. Determine required separation between cable and other work.
- C. Determine cable routing to avoid interference with other work.

### PART 2 PRODUCTS

#### 2.1 GENERAL

- A. All wires and cables shall be permanently identified, at intervals not exceeding 3 feet, indicating type, size, voltage rating, and manufacturer’s name.
- B. All wires and cables shall be continuous and shall be delivered in reels or in coils. Reels and coils shall be plainly marked for complete identification, including the wire or cable size, the number of conductors, the type of wire or cable, length, weight, thickness and character of the insulation, and the name of the manufacturer.
- C. All coils and reels of wires or cables shall carry original date perforated inspection labels of the Underwriter’s laboratories, Inc. showing the number of feet and type of wire contained.

#### 2.2 MANUFACTURERS – BUILDING WIRE

- A. General Cable

- B. Southwire Corporation

### 2.3 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor: Annealed, uncoated copper. All conductors shall be stranded. ASTM designation B-3.
- C. Conductor Temperature Rating: 90°C in wet locations; 90°C in dry locations.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation: ANSI/NFPA 70, Type THWN; high temperature polyvinyl chloride with nylon jacket or Type XHHW-2, high temperature cross-linked polyethylene.

### 2.4 MANUFACTURERS – UNDERGROUND FEEDER AND BRANCH-CIRCUIT WIRE

- A. General Cable
- B. Southwire Corporation

### 2.5 UNDERGROUND FEEDER AND BRANCH-CIRCUIT WIRE

- A. Description: Single conductor, ANSI/NFPA 70, Type USE-2.
- B. Conductor: Annealed copper. All conductors shall be stranded. ASTM designation B-3.
- C. Conductor temperature rating: 90°C in wet locations; 90°C in dry locations.
- D. Insulation voltage rating: 600 volts.
- E. Insulation: Type RHW-2.

### 2.6 MANUFACTURERS-VFD LOAD WIRE

- A. Southwire Corp.
- B. Belden
- C. General Cable
- D. Okonite Okoguard-Okolon
- E. Prysmian Cables & Systems

### 2.7 VFD LOAD WIRE

- A. Description: Single conductor, ANSI/NFPA 70 Type XHHW-2 or Type RHW-2.

- B. Conductor: Annealed copper. All conductors shall be stranded. ASTM designation B-8, B-33, B-172 or B-174.
- C. Conductor temperature rating: 90°C in wet or dry locations; 130°C emergency overload rating.
- D. Insulation voltage rating: 2000 volts minimum.
- E. Insulation: Type XHHW-2 or Type RHW-2, Cross-linked Polyethylene (XLPE).
- F. Shield: Overall copper tape shield with suitable overlap to prevent separation during installation.
- G. Jacket: Sunlight resistant, black overall PVC in accordance with S-95-658/NEMA WC70.
- H. Installation: If unshielded cable is provided, input line reactors must be provided and installed in VFD.

## 2.8 MANUFACTURERS – SERVICE ENTRANCE CABLE

- A. Southwire Corporation
- B. General Cable

## 2.9 SERVICE ENTRANCE CABLE

- A. Description: Single conductor, ANSI/NFPA 70, Type USE-2.
- B. Conductor: Annealed, uncoated copper. All conductors shall be stranded. ASTM designation B-3.
- C. Conductor temperature rating: 90°C in wet locations; 90°C in dry locations.
- D. Insulation voltage rating: 600 volts.
- E. Insulation: Type RHW-2; Crosslinked Polyethylene (XLP).

## 2.10 MANUFACTURERS – INSTRUMENTATION CABLE

- A. Single Pair Cable:
  - 1. Belden No. 8760
  - 2. Southwire Corporation
  - 3. General Cable/Carol Brand No. C2534.
- B. Multiple Pair Cable:
  - 1. Belden No. 9773 through No. 9777
  - 2. Southwire Corporation
  - 3. General Cable/Carol Brand No. C6047-C6051.
- C. Three Conductor Cable:

1. Belden No. 8770.
2. Southwire Corporation
3. General Cable/Carol Brand No. C2535.

## 2.11 INSTRUMENTATION CABLE

- A. Description, general:
1. Single pair cable shall be a single twisted pair, No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.
  2. Multiple pair cable shall be two or more individual twisted pair, No. 18 gauge, stranded conductors, each pair with shield and drain wire, and an overall jacket.
  3. Three conductor cable shall be three No. 18 gauge, stranded conductors with shield, drain wire, and overall jacket.
- B. Underground and General Use Cables:
1. Conductors: Tinned copper.
  2. Insulation voltage rating: 300 volts.
  3. Insulation material:
    - a. Single pair cable – polyethylene.
    - b. Multiple pair cable – polyethylene or polypropylene.
    - c. Three conductor cable – polyethylene.
  4. Shield material: 100 percent aluminum polyester.
  5. Drain wire: Stranded, tinned copper.
  6. Jacket: Chrome vinyl (PVC).
- C. Riser and Plenum Use Cables:
1. These cables shall be similar to the underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF.

## 2.12 MANUFACTURERS – COMMUNICATIONS CABLE

- A. RS-232/422, RS-485/DH-485, Ethernet (Category 5), DH+ (Twinaxial), Unshielded twisted pair (UTP), and telephone cables shall be as manufactured by: Belden; Alpha; or Manhattan.

## 2.13 COMMUNICATIONS CABLE

- A. Wire type communications cables shall meet all applicable standards of EIA/TIA, IEEE, and the NEC.
- B. Riser and Plenum Use Cables:
1. These cables shall be similar to the underground and general use cables specified above, except that the insulation and the overall jacket materials shall be either FEP or PVDF.

## 2.14 MANUFACTURERS – ANTENNA CABLE

- A. Heliac antenna cables shall be ½”O.D. (nominal) as manufactured by: Andrew. Connectors shall be Andrew L44P UHF male, and L4PNF-C N female, as required.

- B. Coax antenna cables between lightning arrestor and radio shall be shall be 8240 RG-58/U as manufactured by Belden cable. Cable shall be supplied with UHF and SMA connectors as required.

#### 2.15 ANTENNA CABLE

- A. Heliax antenna cables and connectors shall meet all applicable standards of EIA/TIA, IEEE, and the NEC.
- B. Coax antenna cables and connectors shall meet all applicable standards of EIA/TIA, IEEE, and the NEC.

#### 2.16 MANUFACTURERS – WIRING CONNECTORS AND ASSOCIATED MATERIALS

- A. Solderless Pressure Connectors:
  - 1. 3M™ Company Model Scotchlok
  - 2. Thomas & Betts Model Sta-Kon
  - 3. Burndy Model Insulug Type TN
- B. Spring Wire Connectors:
  - 1. 3M™ Company Model Scotchlok
  - 2. Ideal Model Wing-Nut
- C. Compression Connectors:
  - 1. 3M™ Company Model Scotchlok
  - 2. Thomas & Betts Model Color-Keyed
  - 3. Burndy Model Hylug
- D. Tap Connectors:
  - 1. Thomas & Betts Model Color-Keyed
  - 2. Burndy Model Crimpit
  - 3. Anderson Model Crimptaps
- E. Watertight, Twist-On Connectors:
  - 1. 3M™ Company Direct Bury Splice Kits
  - 2. King Innovation “DryConn”
  - 3. Ideal Industries, Inc. Twister DB Plus
- F. Watertight, Insulated Connector Blocks:
  - 1. Utilco Type USPA-SS, Type PSA-SS, or Type PED-SS
  - 2. IlSCO Type USPA-SS
- G. Electrical Insulating Tape:
  - 1. 3M™ Company “Scotch” No. 33+
  - 2. Plymouth “Premium Black”
- H. High Temperature Tape:
  - 1. 3M™ Company “Scotch” No. 70
  - 2. Plymouth “Plysil”

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- I. Fireproofing Tape:
  - 1. 3M™ Company “Scotch” No. 77
  - 2. Plymouth No. 50
- J. Woven Fiberglass Tape:
  - 1. 3M™ Company “Scotch” No. 69
  - 2. Plymouth “Plyglas”
- K. Color Coding Tape:
  - 1. 3M™ Company “Scotch” No. 35
  - 2. Plymouth “Slipknot” No. 45
- L. Insulating and Watertight Sealing Materials:
  - 1. 3M™ Company “Scotchcast” kits
  - 2. Raychem WCS Series heat shrinkable sleeves
  - 3. 3M™ Company 8400 Series cold shrink materials
  - 4. 3M™ Company “Scotchkote” sealant
- M. Metal Clad Cable Fittings:
  - 1. PLM Products JAG Series and TFA Series
- N. Watertight Cord Grip Fittings:
  - 1. Crouse-Hinds CGB-SG Series
  - 2. Appleton Electric Co.
  - 3. Thomas & Betts
- O. Cable or Cord Strain Relief:
  - 1. Hubbell-Kellems
  - 2. Daniel Woodhead Co.
- P. Cable Pulling Lubricant:
  - 1. American Polywater “Dyna-Blue”
  - 2. Ideal “Aqua Gel”
  - 3. Minerallac “Golden Glide”
  - 4. 3M™ Company “GEL”

## 2.17 WIRING CONNECTORS AND ASSOCIATED MATERIALS

- A. All wiring connectors shall be 75°C rated and suitable for use on copper conductors.
- B. Metal Clad Cable Fittings:
  - 1. Fittings for terminating cables shall conform to NEMA Standards.
  - 2. Individual items shall be the coordinate design of one manufacturer and shall be constructed from quality materials with smooth surfaces; clean, close-fitting threads; and free of sharp edges, burrs, or other defects. Fittings shall be furnished complete with locknuts, bushings, or other required accessories.
  - 3. When installed, the cable clamping element shall provide secure mechanical strength against cable pullout or rotation and provide permanent electrical contact between

- fitting and metal armor without crushing or distorting either the armor or the cable insulation.
4. Fittings shall be made from steel, with a corrosion resistance coating.
  5. The clamping element shall consist of a fixed base with an adjustable clamp containing a contoured lip for close engagement with the armor convolutions. Clamping fasteners shall be accessible from one side and shall be limited to slotted head for screwdriver installation. Clamp range shall not exceed 200 mils per fitting.
  6. Gasketed fittings shall provide permanent, watertight seals, unless otherwise noted. All gaskets shall be neoprene. The gasket clamping surfaces shall be smooth and tapered to provide uniform pressure on the gasket.
  7. Fittings for jacketed armor cable shall provide a closed neoprene gasket seal to the outer cable jacket, contain a stop to prevent the metal armor from passing through the fitting, and provide a permanent, secure method of grounding the metal armor to the fitting.
- C. VFD Cable Fittings:
1. Fittings for terminating at VFDs shall conform to NEMA Standards.
  2. VFD fittings shall be designed to provide termination of armor and shield, if provided.
  3. When installed, VFD fittings shall include set-screws to limit vibrational loosening.
  4. All VFD fittings shall be suitable protected from corrosion and shall be UL listed for use in Type 3R enclosures.
  5. All fittings shall form a water-tight seal to the outer jacket of the cable.
- D. Cable or cord strain reliefs shall consist of stainless steel wire mesh with support bale. Strain reliefs shall be of the split rod type where required or indicated on the Drawings.
- E. Cable Pulling Lubricant:
1. Lubricant shall be UL listed and approved for use on the cable jacket or insulation.
  2. Lubricant shall be polymer based and shall dry completely when exposed to air.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.

### 3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

### 3.3 WIRING METHODS

- A. Interior Locations:
  1. Wire for general power, light, and control shall be building wire, Type THWN or Type XHHW-2 insulation, in raceway or metal sheathed or metal clad cable, where indicated.

2. Cables for instrumentation signals shall be single or multiple pair Instrumentation Cable.
  3. All wire for connections between Variable Frequency Controllers and associated motors shall be shielded and shall be VFD Load Wire.
- B. Exterior Locations:
1. Wire and cable for general power, light, and control for use in raceways exterior to buildings and in underground raceways shall be underground feeder and branch circuit wire.
  2. Cables for instrumentation signals shall be three or more pair Instrumentation Cable.
  3. All wire for connections between Variable Frequency Controllers and associated motors shall be shielded and shall be VFD Load Wire.
- C. Use wiring methods indicated on Drawings.
- D. Color Coding:  
The color schedule for the conductor insulation of wire and cable shall conform to the following:
1. Three phase lighting and power, 208Y/120 VAC-Black, Red, Dark Blue, White or Gray, and Green ground.
  2. Three phase lighting and power, 120/240 VAC-Black, Red, Orange (high leg to ground), White or Gray, and Green ground.
  3. Single phase lighting and power, 120/240 VAC-Black, Red, White or Gray, and Green ground.
  4. Three phase lighting and power, 480 VAC-Brown, Orange, Yellow, and Green ground.
  5. Three phase lighting and power, 480Y/277 VAC-Brown, Orange, Yellow, Gray, and Green ground.
  6. DC power – Red with White stripe (+) and Light Blue with White stripe (-).
  7. Single conductor control, AC voltage – Red.
  8. Multi-conductor control cables – ICEA Method 1.
  9. Alarm, annunciator, instrumentation, graphic, and telemetering (if not shielded), AC voltage – Pink.
  10. Alarm, annunciator, instrumentation, graphic, and telemetering (if not shielded), DC voltage – Light Blue.
  11. Intrinsically safe circuits – Purple.
  12. On wire sizes larger than Number 8 AWG and/or where authorized by the Owner, coding may be identified by taping with the appropriate colored self-adhesive vinyl color coding tape.
  13. Grounding conductors shall be continuous green or bare for all systems.
  14. Neutral conductors shall be continuous white or gray for all systems.
- E. The installation of intrinsically safe circuits shall meet all requirements of the NEC.
- F. Wiring Connections:
1. Dry location splices and tap connections shall consist of compression connectors or tap connectors, taped to 150 percent of insulation rating of the conductors.

2. Final connections to equipment wire leads for No. 8 AWG and smaller wire in dry locations only, except 480 volt motor leads, may be made with spring wire connectors.
3. Wet and damp location splices and tap connections shall consist of compression connectors or tap connectors with insulating and watertight sealing materials; water tight, twist-on connectors for wire sizes up to three No. 10 AWG; or watertight, insulated connector blocks; providing watertight connections suitable for direct burial.
4. All conductor terminations at screw terminals shall consist of solderless pressure connectors, except where conductor terminations are included with the equipment being connected.
5. Insulation of connections in lighting fixture and high temperature equipment shall consist of silicone rubber type high temperature tape with a woven fiberglass tape over-wrap.
6. Electrical insulating tape (plastic type) shall be used on all splice and tap connections, unless wire manufacturer's recommendations require otherwise.

### 3.4 INSTALLATION

- A. All wiring shall be run in rigid metal raceway systems or underground conduit systems, unless noted otherwise.
- B. Install products in accordance with manufacturer's instructions.
- C. The minimum size of conductors shall be No. 12 AWG, unless specifically approved and/or shown otherwise on the Drawings.
- D. Use stranded conductors for control circuits, No. 14 AWG minimum, unless shown otherwise on the Drawings.
- E. Multi-conductor underground feeder, branch-circuit, and control cable shall meet the requirements of Article 340 of the National Electrical Code.
- F. Use No. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 60 feet.
- G. Use No. 8 AWG conductors for 20 ampere, 120 volt branch circuits longer than 100 feet.
- H. Use No. 6 AWG conductors for 20 ampere, 120 volt branch circuits longer than 170 feet.
- I. Use No. 4 AWG conductors for 20 ampere, 120 volt branch circuits longer than 270 feet.
- J. Use No. 3 AWG conductors for 20 ampere, 120 volt branch circuits longer than 420 feet.
- K. Where conductors or cables are to be installed in non-metallic raceway systems, the Contractor shall allow 24 hours, minimum, for all solvents to evaporate after cementing the last joint before pulling wires or cables.
- L. Pull all conductors into raceway at same time. Cable pulling tensions shall not exceed manufacturer's recommended values.

- M. Use suitable wire pulling lubricant for wire, No. 4 AWG and larger, and for all cables. No soap flakes, vegetable oils, clays, or grease shall be permitted in raceways.
- N. Use suitable cable fittings and connectors.
- O. Neatly train and lace wiring inside boxes, equipment, and panelboards. Wires and cables shall be bundled and laced as specified in Section 16190.
- P. All wires and cables routed through large pull boxes and terminal cabinets shall be looped to provide two to three feet (minimum) of slack within the enclosure, where practical.
- Q. Clean conductor surfaces before installing lugs and connectors.
- R. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- S. Wire and cable shall be supported in vertical runs by insulated clamps so that wire or cable weight will not be unduly supported from conductor terminations.
- T. Spade or fork tongue lugs shall not be used, except where approved by the Owner.
- U. Conductor terminations and tap splices within lighting fixture pole/transformer bases shall be suitable for wet or damp locations.
- V. Wires and cables shall, in general, be run continuously, without splicing, from origination to termination. No splices shall be permitted in any feeder circuit, except in outlet, junction, and/or pull boxes, or where specifically noted on the Drawings. Use sufficient length of wire for connecting to equipment without straining. All methods of splicing shall meet cable manufacturer's recommendations. All splices shall be carefully placed in outlet boxes, etc. without crowding. No splicing shall be permitted in signal cables.
- W. Splices and tap connections shall be made in junction boxes only; conduit type fittings shall not be used as junction boxes.
- X. Wires and cables shall be installed in raceways, as indicated on the Drawings or required, and shall provide a complete and operating system.
- Y. All wires and cables shall be tagged as specified in Section 16195.
- Z. Motor control center feeder circuits and distribution panelboard branch circuits shall each be run in individual raceways from source to motor or other load.
- AA. Vertical lengths of wire and cable shall be supported as required by Article 300.19 of the National Electrical Code. Cable weight shall not be unduly supported from conductor terminations.
- BB. Vertical lengths of exposed cable or cord runs over ten feet long shall be supported with a strain relief.

- CC. Where an exposed run of cable or cord enters a box or enclosure, provide a watertight cord grip fitting suitable for the cable or cord diameter.
- DD. All 120 VAC, single phase loads shall be connected to provide a balanced load on the lighting transformers. All 480 VAC, single phase loads shall be connected to provide a balanced load on the 480 VAC, three phase system.
- EE. Make conductor length for parallel feeders identical on each phase leg.
- FF. Feeders shall be connected for correct phase rotation. Where possible, busses shall be connected to result in the "A" or "X" phase being in the north, east, or top position with the other phases following in sequence. The terminals H1, H2, and H3 of transformers shall be connected to A, B, and C; 1, 2, and 3; or X, Y, and Z conductors, respectively, of incoming feeders.
- GG. Final connections to motors and other machinery, equipment and devices in hazardous areas which may be subject to movement or vibration may consist of a loop of mineral-insulated, metal-sheathed cable (Type MI) with UL listed fittings.

### 3.5 INTERFACE WITH OTHER PRODUCTS

- A. Identify wire and cable under provisions of Section 16195.
- B. Identify each conductor with its circuit number or other designation indicated on Drawings.

### 3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Sections 01400 and 16960.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Verify continuity of each feeder conductor.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pull and junction boxes.
- B. Wireways.

1.2 RELATED SECTIONS

- A. Section 07270 - Firestopping.
- B. Section 16010 - General Electrical, Instrument, and Control Requirements.
- C. Section 16050 - Basic Electrical Materials and Methods.
- D. Section 16110 - Raceways.
- E. Section 16140 - Wiring Devices.
- F. Section 16160 - Cabinets and Enclosures.
- G. Section 16190 - Supporting Devices.
- H. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- C. NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- D. NEMA OS 2 - Non-metallic Outlet Boxes, Device Boxes, Covers and Box Supports.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate materials, finishes, dimensions, listings, and standards compliance.

- C. Product Data: Provide data for boxes, wireways, and accessories.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

#### 1.5 SUBMITTALS FOR CLOSEOUT

- A. Section 01700 - Contract Closeout: Submittals for Project closeout.
- B. Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70, National Electrical Code.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.
- C. All boxes shall be sized per Article 314 of the National Electrical Code as a minimum.

### PART 2 PRODUCTS

#### 2.1 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
  - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
  - 2. Concrete Ceiling Boxes: Concrete type.
- B. Non-metallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, cast ferrous alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- D. Covers for boxes containing wiring devices shall be as specified in Section 16140.

#### 2.2 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 16160.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
  - 1. Material: Galvanized cast iron.
  - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

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- D. Pull and junction boxes for hazardous areas shall be cast iron alloy, explosion proof, Class I, Division 1, Group D as manufactured by Curlee, Appleton, or equal, except boxes for intrinsically safe circuits may be NEMA Type 4 or non-metallic NEMA Type 4X rated.
- E. Single and two gang pull boxes and junction boxes shall be rust proof, cast metal, Type FD boxes with gasketed covers.
- F. Larger boxes and raceways shall be NEMA Type 12, in indoor, above grade locations, or stainless steel NEMA Type 4 or non-metallic NEMA Type 4X with stainless steel hardware in all other locations or where indicated on the Drawings, built of Code gauge steel, with angle iron supports and braces. Cable support racks shall be provided where required. Access shall be by means of removable, gasketed screw covers fastened with machine screws.
- G. NEMA Type 4X boxes shall be of corrosion resistant, high impact strength, fiberglass reinforced polyester material suitable for surface mounting. Barriers shall be provided where indicated on the Drawings or required.
- H. All pull boxes installed below grade within the structures shall be provided with a drain, Crouse-Hinds ECD Universal Series, Appleton, or equal mounted on a bolt-on, gasketed hub or Stahlin Drain Vent on NEMA Type 4X boxes.
- I. In-line pull boxes, where shown on the Drawings, shall be Appleton Type PTC with solid gasket or equal.
- J. Threaded conduit fittings with gasketed covers shall be used for all exposed conduit outlets and boxes.
- K. Conduit bodies and fittings shall be of cast iron, malleable iron, and/or galvanized steel.

### 2.3 WIREWAYS

- A. Wiring ducts shall be NEMA Type 12 galvanized steel in indoor, above grade locations; non-metallic, NEMA Type 4X in corrosive locations; or stainless steel, NEMA Type 4 in all other locations or where indicated on the Drawings. Metallic wireways shall be 14 gauge steel raceways and all wireways shall be provided with removable covers held with captive screws. All fittings shall be designed to be used with the ducts to result in an unobstructed system. The ducts and fittings shall be sized as shown on the Drawings. All hardware on stainless steel and non-metallic wiring ducts shall be made of stainless steel.
- B. The wiring ducts shall be as manufactured by Keystone, Hoffman Engineering Co., B-Line, or equal.

### 2.4 MISCELLANEOUS COMPONENTS

- A. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Verify locations of floor boxes and outlets in all work areas prior to rough-in.

#### 3.2 INSTALLATION

- A. Install boxes in accordance with NECA "Standard of Installation."
- B. Install pull boxes and junction boxes in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- C. Pull boxes and/or junction boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet after 90 degrees of bends, every 100 feet after 180 degrees of bends, and every 50 feet after 270 degrees of bends. More than 270 degrees worth of bends shall not be installed between pulling points in any conduit run.
- D. Pull boxes, auxiliary pull fittings (slip joints), and cable raceways for the pulling, nesting, or concealment of wires or cables shall be provided where indicated on the Drawings and also where required, though not indicated, as specified above.
- E. Mark or label all boxes as specified in Section 16195.
- F. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- G. Enough room shall be supplied in boxes for insulating joints, wires, and bushings, and deep boxes shall be installed where required by the type of fixture or outlet called for on the Drawings.
- H. Wire and cable splices and tap connections shall be made in junction boxes only; conduit type fittings shall not be used as junction boxes.
- I. Electrical boxes are shown on Drawings in approximate locations, unless dimensioned. Adjust box location up to 8 feet, if required to accommodate intended purpose.
- J. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.
- K. Maintain headroom and present neat mechanical appearance.
- L. Use flush mounting outlet box in finished areas.
- M. Support boxes independently of conduit.
- N. Use gang box where more than one device is mounted together. Do not use sectional box.
- O. Use cast outlet box in exterior locations and wet locations.
- P. Large Pull Boxes: Use surface-mounted cast metal boxes outdoors.

- Q. The threads of all corrosive area, hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, lighting fixture reflector, guard, and outlet box connections, wiring device boxes, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.
- R. All metallic, except stainless steel, pull boxes, junction boxes, outlet boxes, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum .040 inch (40 mil) thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

### 3.3 ADJUSTING

- A. Section 01700 - Contract Closeout: Adjusting installed work.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

### 3.4 CLEANING

- A. Section 01700 - Contract Closeout: Cleaning installed work.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION



SECTION 16140  
WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Receptacles.
- B. Device plates and box covers.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16130 - Boxes.

1.3 REFERENCES

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01300 - Submittals: Procedures for submittals.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, materials, finishes, and configurations.
- C. Submit manufacturer's installation instructions.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc., or other testing firm acceptable to the authority having jurisdiction, as suitable for the purpose specified and indicated.

## PART 2 PRODUCTS

### 2.1 RECEPTACLES

- A. Duplex receptacles shall be 20 amp, 125 volt, 3 wire, grounding type, Hubbell Cat. No. HBL5362, General Electric GE5362, Cooper Wiring Devices No.5362B, or equal. Covers for general use receptacles shall be Crouse-Hinds Co. No. DS23G, Leviton 5362, Appleton Electric Co., or equal.
- B. Duplex receptacles installed in corrosive areas shall consist of a 20 amp, 125 volt, 3 wire, grounding type, corrosion resistant receptacle; Hubbell Cat. No. HBL53CM62, Leviton 53CM-62, General Electric GE0526C, Cooper Wiring Devices No. 5362CRY, or equal mounted in a non-metallic, corrosion resistant box with a corrosion resistant, weatherproof cover; Carlon, TayMac Corp., or equal.

### 2.2 EMERGENCY POWER RECEPTACLES

- A. Emergency power receptacle shall match the plug on the City portable generator set cord. The receptacle assembly shall be weatherproof with a spring door cover and reversed contacts or a receptacle with plug interior (exposed contacts). The receptacle shall be made of corrosion resistant, copper free, cast aluminum.
- B. The receptacle shall be rated 200 amp, 600 volt, 4 pole plus ground. All wire connectors on the receptacle shall be 75°C rated.

### 2.3 COVER PLATES

- A. Where switches are installed surface mounted, they shall be installed in Type FD boxes with mounting lugs and provided with surface mounting covers. Covers shall be weatherproof where required, Crouse-Hinds No. DS181 or equal.
- B. Weatherproof receptacle covers shall be raintight while in use, NEMA Type 3R rated, UL listed and marked for use in Wet Locations with plug-cap inserted, and shall be made of impact resistant, ultraviolet inhibiting polycarbonate; TayMac Corp. with deep cover, Thomas & Betts WT Series with deep lid, Intermatic Flexi-Guard Series, Carlon E9U In-Use Series, or equal.
- C. Padlockable cover plates for switches and/or receptacles shall be weatherproof, die-cast aluminum with gasket, Killark WCV Series or equal.

### 2.4 MISCELLANEOUS

- A. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.
- B. All metallic, except stainless steel, device boxes, outlet boxes, cover plates, fittings, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum .040 inch (40 mil)

thickness. Where factory PVC coating is not available or where PVC coating would void UL listing or labeling, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Section 01039 - Coordination and Meetings: Verification of existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

#### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

#### 3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- E. Where more than one switch occurs in the same location, they shall be installed in gang type boxes.
- F. Duplex receptacles, shown on the Drawings outdoors or below grade, shall be mounted in weatherproof boxes and cover plates. The boxes shall be rust proof, cast metal having threaded openings for conduit connections and shall be mounted horizontally on or in the wall.
- G. Receptacles in dry, indoor locations shall be installed in surface mounting, Type FD boxes with mounting lugs.
- H. The threads of all hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, outlet box connections, wiring device boxes, cover plate screws, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.
- I. See Section 16195 for nameplate, circuit number marker, wire marker, etc. requirements.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights specified or indicated on the Drawings.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Section 01700 - Contract Closeout: Cleaning installed work.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16160  
CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal boxes.
- D. Accessories.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16055 - Basic I & C Materials and Methods.
- D. Section 16110 - Raceways.
- E. Section 16130 - Boxes.
- F. Section 16190 - Supporting Devices.
- G. Section 16195 - Electrical Identification.

1.3 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide manufacturer's standard data for enclosures and cabinets.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

- D. Certified shop drawings and diagrams shall be furnished by the Contractor and delivered to the Owner for approval as follows:
  - 1. General dimensions and outline drawings showing the principal dimensions of the equipment and the location and size of electrical conduit connections.
  - 2. Detailed drawings, descriptive data, and other data sheets showing design information which verified that the equipment meets the technical requirements of the Specifications.

#### 1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

#### 1.6 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide three (3) of each cabinet key.

### PART 2 PRODUCTS

#### 2.1 CABINETS AND HINGED COVER ENCLOSURES

- A. Manufacturers: Manufacturers and model numbers of cabinets, enclosures, and associated components shall be as follows:
  - 1. Cabinets and Enclosures: Hoffman Engineering Co., Saginaw Controls, Stahlin, or Hammond.
  - 2. Anti-condensation Heaters: Saginaw Control & Engineering No. SCE-AHC50 or equal.
  - 3. Terminal Blocks: Allen-Bradley No. 1492-CA1, CA3, or -CD8.
  - 4. Substitutions: Items of equal function and performance are acceptable, if in conformance with all sections of this Specification.
- B. Cabinets and enclosures in corrosive areas shall be water, dust, and sleet tight, rated NEMA Type 4X, and of stainless-steel construction or comparable non-metallic.
- C. Doors shall be equipped with a padlockable latch or padlock hasp and shall be provided with one padlock with three keys.
- D. The top, sides, and doors of outdoor cabinets and enclosures shall be insulated with a 2-inch thick layer of extruded polystyrene material.
- E. The doors shall be gasketed.
- F. Provide an internal, mild steel sub-plate for mounting of internal components.
- G. Provide and install two (2) minimum, 120 volt, anti-condensation heaters within each outdoor cabinet or enclosures. The heaters shall be of the self-limiting type, 50 watts, 120 VAC.

- H. Cabinets and enclosures shall be provided with full-length door hinges. Hinges shall be stainless steel and the doors shall have a one point latch.
- I. All interior cabinet or enclosure surfaces, except fittings, shall be painted with two coats of primer and two coats of white, high gloss, baked epoxy enamel paint. The exterior shall be painted with one coat of primer, two coats of ANSI 61 gray paint, and a final coat of clear polyurethane.
- J. Terminal blocks shall be provided for all wiring entering cabinets and enclosures from external devices. Provide 10 percent spare terminals, in addition to those required.
- K. Terminal boxes shall be similar to cabinets and enclosures, except they shall have screw covers in lieu of hinged and latched doors.

## 2.2 ENCLOSURE ACCESSORIES

- A. All hardware on the exterior of NEMA Type 4 and NEMA Type 4X enclosures, including hinge pins, screws, bolts, nuts, washers, etc., shall be made of 300 series stainless steel.
- B. Combination drain and breather shall be Crouse-Hinds ECD Combination Series, Appleton, or equal. Combination drain and breather shall be Stahlin Drain Vent or equal on NEMA Type 4X enclosures.
- C. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify installation conditions under provisions of Section 01039.
- B. Verify that surfaces are ready to receive work.

### 3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- C. Install cabinet fronts plumb.
- D. All equipment installed in hazardous areas shall be provided in explosion proof enclosures, except equipment listed as intrinsically safe may be provided in NEMA Type 4 or non-metallic NEMA Type 4X enclosures. All explosion proof enclosures shall be factory or field coated with a corrosion resistant finish.

- E. NEMA Type 4 and Type 4X enclosures in other than corrosive areas shall be equipped with a combination drain and breather. The drain shall be mounted on a bolt-on, gasketed hub.
- F. All internal cabinet and enclosure components shall be mounted on the sub-plate positioned for easy access, convenient wiring, and for easy removal.
- G. Convenience receptacle mounted within cabinets and enclosures shall be mounted in a handy box with a cover plate.
- H. See Section 16110, Raceways for conduit entrance to cabinets and enclosures requirements.
- I. Mark or label all boxes, cabinets, and enclosures as specified in Section 16195.
- J. The threads of all corrosive area, hazardous area, outdoor, and below grade equipment connections including conduit, conduit fittings, pull and junction box covers, cable fittings, etc. shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.

END OF SECTION

SECTION 16170  
GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16960 – Electrical Testing and Equipment.

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.4 GROUNDING ELECTRODE SYSTEM

- A. Metal underground utility piping.
- B. Metal frame of the building.
- C. Ground loops, risers, and conductors.
- D. Rod electrodes.
- E. Ground mat.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.
- B. In the event that the ground resistance is not 5 ohms or less, additional rods or longer rods shall be installed or the soil treated to reduce its resistance by approved practices. All ground resistance measurements shall be made using the fall-of-potential method only and test reports shall be provided as specified under Section 16960, Electrical Testing and Equipment.

## 1.6 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data for grounding electrodes and connections.
- C. Test Reports: Indicate facility's overall resistance to ground.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

## 1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Accurately record actual locations of grounding electrodes.

## 1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

## PART 2 PRODUCTS

### 2.1 ROD ELECTRODES

- A. Ground rods shall be 3/4" diameter by 10 feet long and shall have copper jackets and steel cores. The rods shall be as manufactured by Blackburn/Eritech, Erico Electrical Products, Harger, or equal.

### 2.2 MECHANICAL CONNECTORS

- A. All compression connectors, lugs, etc., used in grounding circuits in any location shall have bolts, nuts, etc., of silicon bronze alloy equal to "Everdur" metal. Grounding connections, clamps, etc., shall be as manufactured by Burndy Engineering Company, Thomas and Betts Company, Delta-Star Electric Company, Harger, or equal.
- B. Fittings for bonding a grounding conductor to metallic conduit shall be Thomas and Betts Series 3900BU or equal. Fittings for bonding a grounding conductor to its own conduit shall be Burndy Engineering Company GAR-BU Series, Thomas and Betts Series 3900, Harger, or equal.
- C. Where connections to ground rods or ground mats must be disconnected for testing, the fittings shall be Burndy Engineering Co. Type GD, GG, GAR; Thomas and Betts Co. Series 3902BU; Harger; or equal.

## 2.3 EXOTHERMIC CONNECTIONS

- A. Connections to steel, between conductors, and for water stops shall consist of exothermic welding similar and equal to Burndy Engineering Company's "Thermoweld", Erico Products, Inc. "Cadweld Kits", Thomas & Betts Corp. "Furseweld", or Harger.

## 2.4 CONDUCTORS

- A. Grounding conductors, loops, and risers shall be bare, stranded, soft-drawn copper and shall be of the sizes indicated on Drawings.
- B. All bonding jumpers shall be copper and of a cross-sectional area at least equal to their corresponding grounding conductors.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

### 3.2 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground. Rod electrodes shall be driven into undisturbed earth or engineered backfill only.
- C. Provide bonding to meet Regulatory Requirements.
- D. The non-current carrying parts of all electrical equipment installed under this Contract, including but not limited to raceways, raceway supports, and equipment enclosures, shall be bonded by means of bare copper cable or copper strap to the grounding system as shown on the Drawings and specified hereinafter.
- E. All exposed, including painted or coated, structural and architectural metal shall be bonded to the grounding system or rigidly secured to and in good electrical contact with grounded metal.
- F. All grounding cables, bus, etc., in locations where subject to mechanical damage, shall be protected by rigid metal conduit, steel guards, non-metallic conduit, or other suitable shield. In all cases, where conduit or other metallic encasement of grounding conductors is required, the conductor shall be permanently and effectively grounded to the enclosure at both ends of its length. This requirement applies to all such enclosures regardless of their length.
- G. Where grounding conductors pass through floor slabs, building walls, etc., and are not encased in the concrete pour, sleeves of rigid metal conduit or non-metallic conduit of the required size, shape, and length shall be provided with both ends of the sleeve sealed with duct seal after installation of the grounding conductor.

- H. Where grounding conductors pass through a concrete pour (encased), from underground to the interior of a structure, an exothermic water stop shall be provided on the grounding conductor within the pour.
- I. Where attached to equipment, conduits, cabinets, etc., suitable approved solderless lugs, compression connectors, or clamps shall be used. No soldered connections shall be used on grounding circuits at any point.
- J. Where welding to steel is prohibited, the grounding conductor shall be bolted directly to the steel as approved by the Engineer. The contact surfaces of all bolted connections shall be thoroughly cleaned and coated with Alcoa No. 2 Electrical Joint Compound or equal.
- K. Taps and splices in grounding cables and connections to ground rods shall be made by an exothermic weld process.
- L. All metal ducts, conduits, starters, panels, switches, etc., which are not rigidly secured to and in good electrical contact with the grounded structural metal frame of the building or grounded conduit system, or which are subject to excessive vibration and loosened ground contacts, shall be securely bonded to grounded building steel or to the grounded conduit system by means of stranded copper jumpers. This jumper shall have a circular-mil cross section of not less than 50 percent of that of the largest conductor entering the enclosure being grounded, with a minimum size of No. 8 AWG stranded copper being used in any jumper.
- M. Conduits which run to boxes or cabinets having concentric or eccentric knockouts which partially perforate the metal around the conduit and impair the electrical connection to ground shall be provided with approved bonding jumpers. Jumpers shall consist of a stranded, braided copper wire at least No. 8 AWG with solderless indent type lugs. Jumper shall be connected from a grounding type locknut or bushing on the conduit inside the box to a stud or silicon bronze alloy bolt in the cabinet frame.
- N. All metal support racks for electrical equipment and enclosures shall be securely bonded to grounded building steel or the grounding system with a No. 2 AWG grounding conductor.
- O. A copper ground conductor shall be carried for each power, lighting at 120 volts and higher, and receptacle circuit with the circuit conductors. The ground conductor shall have the same type insulation as the circuit conductors and shall be green in color through No. 10 AWG and bare copper wire for larger sizes.
- P. Distribution panelboard and automatic transfer switch grounding shall consist of ground connections to feeder conduits, ground busses, etc. as required or as indicated on the Drawings.
- Q. Splices in wire or cable ground leads shall not be permitted.

### 3.3 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system.

END OF SECTION

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SECTION 16190  
SUPPORTING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Conduit and equipment supports and hangers shall be made of 316 SS structural steel, with welded or bolted joints. Conduit and equipment supports and hangers shall be fabricated from "Unistrut" Series P1000SS stainless steel channels and fittings, as manufactured by the

Unistrut Products Company, Superstrut A-1200 Series, Grinnell "Power-Strut" PS-200, or equal.

- D. All conduit and equipment supports, hangers, beam clamps (no "C" clamps shall be allowed), and other similar devices made of steel shall be hot dipped galvanized or sherardized after fabrication. All hanger rods, U-bolts, bolts, nuts, and other threaded support components shall be electro-galvanized (per ASTM-B633 Type III SC1) or sherardized. Field cuts and all welds shall be coated with an approved cold or hot galvanizing compound: Z.R.C., CRC Chemicals Zinc-It, or equal. All hanger rods shall be 3/8 inch diameter minimum. All such hardware shall be factory encased with polyvinyl chloride (PVC) of minimum .040 inch (40 mil) thickness where indicated on the Drawings and where indicated elsewhere in Division 16. All touch-up required in the field shall be in strict accordance with the manufacturer's printed instructions.
- E. Concrete inserts shall be of the continuous channel or spot type. The channel type shall be No. 12 gauge steel with integral anchors, Super Strut No. C-302, Kindorf No. D-990, or equal. Spot inserts shall be Super Strut No. 452, Kindorf No. D-255, or equal.
- F. Threaded anchors for use in concrete shall be self-drilling type expansion anchors made of case hardened and drawn carburized steel. The anchors and expander plugs shall be furnished with a rustproof finish. The expansion anchors shall be concrete fasteners as manufactured by the ITW "Red Head", Ideal Industries Co., or equal.
- G. Threaded anchors for heavy loads (i.e.: panels, transformers, disconnect switches) supported from masonry or precast concrete panels shall be epoxy based adhesive anchors with threaded rod and screen tube. Adhesives shall match the application, as recommended by the anchor manufacturer. Threaded rods, nuts, and washers shall be furnished with a rustproof finish. Adhesive anchors shall be Hilti Type HIT or equal.
- H. Anchors for light loads (i.e.: conduit clamps, outlet boxes, small pull and junction boxes) supported from masonry or precast concrete panels shall be lead type or plastic expansion anchors with corrosion resistant screws.
- I. Threaded rods, nuts, washers, screws, and bolts for anchors used in areas classified as hazardous and in corrosive areas shall be made of 316 stainless steel. Also expansion anchors for light loads used in masonry or precast concrete panels in these areas shall be plastic only.
- J. Anti-seize, lubricating, and protective compound shall be Never-Seez as manufactured by Bostik Div. of Emhart Corp., "Dry Molybdenum Lubricant" No. 40-640 by Ideal Industries, CRC Chemicals Lectra-Shield, Crouse-Hinds HTL, Sanchem, Inc. NO-OX-ID "A Special", or equal.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions. Tighten all bolted connections to manufacturer's recommended torque values with compensation for lubricated threads (anti-seize, lubricating and protective compound applied) to avoid over-torqueing.

- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
- C. Do not anchor supports from pipes, ducts, mechanical equipment, or conduit.
- D. Do not use spring steel clips and clamps.
- E. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- F. The use of wood plugs for anchoring raceways, cabinets, enclosures, or equipment to concrete or masonry will not be permitted.
- G. The Contractor shall provide and install, where required, the additional steel to adequately support all conduits, boxes, and all other electrical equipment.
- H. All wires and cables shall be laced when entering or leaving pull or junction boxes and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit. All wiring entering and exiting electrical enclosures shall be bundled into groups. Power, lighting, control, alarm, annunciator, and instrumentation wiring shall be bundled and laced as specified herein.
- I. The threads of all corrosive area, hazardous area, outdoor, and below grade support connections shall be coated with an anti-seize, lubricating, and protective compound prior to final assembly.
- J. All metallic, except stainless steel, supports, hangers, and other exposed metal components installed in areas classified as hazardous and in corrosive areas shall be factory encased in polyvinyl chloride of minimum .040 inch (40 mil) thickness as specified under Section 16110, Raceways. Where factory PVC coating is not available, factory or field coating with a corrosion resistant, epoxy paint shall be provided.

END OF SECTION



SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide catalog data for nameplates, labels, signs, diagrams, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.

PART 2 PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. The nameplates shall be 1 1/4" high by 3 1/2" wide (minimum), except pushbutton and selector switch stations and other enclosures where space is limited may have smaller plates of suitable size, and shall be attached to the equipment by means of corrosion resistant screws. Nameplates may be attached to equipment located in dry, interior areas by means of pressure sensitive, firm acrylic adhesive tape, 3M "Scotch" No. 468 or equal. The plates shall be white laminated plastic with engraved black letters approximately 3/32" thick with beveled edges. Engraved letters shall be 1/8" high (minimum), block type.
- B. Circuit number markers shall consist of self-adhesive vinyl cloth or polyvinyl fluoride film markers with 1/8" high (minimum), black lettering on a yellow background, W. H. Brady Co. 3410 Series, Ideal Industries 44-500 Series and 44-600 Series, or equal. Circuit number markers may also consist of computer or typewriter generated, vinyl cloth, permanent,

non-smearing, self-adhesive markers such as Brady Datab, BradyMarker XC Plus, 3M Scotchcode SCS or STS, or equal. Circuit number markers for panelboard circuit breakers may be the manufacturer's standard.

- C. Meter address nameplates shall be white laminated plastic with engraved, 1/8" high (minimum), black, block type letters and shall be attached with corrosion resistant screws.

Warning labels shall be in compliance with NEC 110.16 requirements. Warning labels shall be Brady Signmark No. 89220, Lab Safety Supply Co. No. 68691, Seton Style No. M0548, or equal.

## 2.2 WIRE MARKERS

- A. Wire and cable number tags for use in pull or junction boxes and at termination points shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab, Brady Marker XC Plus, or 3M Scotchcode. Pre-printed, vinyl cloth, plastic coated, self-adhesive, tape markers as manufactured by W. H. Brady Co. or 3M Company shall also be acceptable.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive nameplates and labels.

### 3.2 INSTALLATION

- A. Nameplates shall be installed on the doors or covers of all panels, panelboards, starters, contactors, transfer switches, relays, control devices, signaling devices, and all other electrical equipment furnished under this Contract, except remote mounted pushbutton and selector switch stations, mounted adjacent to identified and associated disconnect switches or other control devices, need not be identified as described herein.
- B. Nameplate engraving for equipment and shall be engraved as follows and shall be included on nameplate schedules submitted to the Owner for approval:
  1. First Line - Process description, equipment served, or area served (if applicable).
  2. Second Line - Equipment or device description.
  3. Third Line - Equipment or device designation number and power source circuit number.
  4. Abbreviations shall be used only where full wording will not fit. See the Drawings for nameplate details.
- C. All devices and equipment powered from lighting panelboards shall be marked with the appropriate circuit number(s). Lighting circuits shall be identified on switch cover plates, receptacles on cover plates, and other devices on enclosure door or on associated disconnect switch door or cover.
- D. Utility power meter box(es) shall have an address nameplate of suitable size installed below each meter. The address for each meter shall be as provided by the utility company.

- E. The entire raceway system for intrinsically safe circuits shall be labeled "Intrinsic Safety Wiring" per National Electrical Code Article 504.80(B).
- F. All pull boxes shall be marked with the type of system within them, i.e.: 480V power, alarm, 120V control, etc.
- G. All wires and cables within control panels, motor starters, terminal boxes, etc. shall be tagged at each termination.
- H. The wires and cables of each circuit in pull boxes and junction boxes larger than 12" by 12" by 8" shall be bundled together, neatly arranged, and clearly identified with a tag secured with polyethylene cabling twine indicating circuit number, equipment served, and nominal voltage level.
- I. A system shall be developed and submitted to prevent duplication of wire numbers for all wiring external to equipment. Equipment numbers or designations may be used as prefixes. Interconnecting diagrams shall clearly show wire numbers, originating terminal numbers, and destination terminal numbers.

END OF SECTION

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SECTION 16441

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fusible disconnect switches.
- B. Non-fusible disconnect switches.
- C. Main service entrance switch.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16130 - Boxes.
- D. Section 16160 - Cabinets and Enclosures.
- E. Section 16170 - Grounding and Bonding.
- F. Section 16190 - Supporting Devices.
- G. Section 16195 - Electrical Identification.
- H. Section 16477 - Fuses.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches.
- B. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide switch ratings and enclosure dimensions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- A. 600 volt rated, NEMA Type 12 and NEMA Type 4 enclosed disconnect switches shall be Eaton Cutler-Hammer, Square D by Schneider Electric, or General Electric.
- B. 600 volt rated, non-metallic, NEMA Type 4X enclosed disconnect switches shall be Hubbell, Robroy, or Carlon.
- C. Fused disconnect switches for 120 VAC, 208 VAC, or 240 VAC, single phase loads and fractional horsepower motors shall be fusible, 30 ampere, 2 pole, 2 wire, 240 VAC rated switches in a NEMA Type 12 enclosure, unless indicated otherwise on the Drawings, similar to Eaton Cutler-Hammer No. DH-221NDK, Square D No. H221AWK, or equal. Disconnect switches for 120 VAC loads shall have a fuse eliminator in the neutral phase leg.
- D. Non-fused disconnect switches for 120 VAC, 240 VAC, or 208 VAC single phase loads and fractional horsepower motors shall be similar to 2 pole manual motor starters, except without overloads, Square D Class 2510, Eaton Cutler-Hammer, or equal. Enclosures for switches installed in hazardous areas shall be explosion proof, suitable for Class I, Division 1 use, Appleton Electric Co. Type GUSC or equal. Enclosures for switches installed in corrosive areas shall be non-metallic, corrosion resistant, FD type boxes with weatherproof, corrosion resistant, flexible silicone rubber, bubble type covers; Pass & Seymour No. 4517, Hubbell No. HBLDS3, or equal. Enclosures for all other areas shall be FD type boxes with padlock type covers.
- E. Auxiliary interlocks shall be provided where shown on the Drawings.
- F. All disconnect switches shall have provisions for padlocking in either the "On" or "Off" positions and all terminals or lugs shall be 75°C rated for copper conductors. Fused switches shall utilize Class R fuses.
- G. Enclosures shall be NEMA Type 12, NEMA Type 4 stainless steel, NEMA Type 4X non-metallic, or explosion proof, as indicated on the Drawings.
- H. Combination drain and breather shall be Crouse-Hinds ECD Combination Series, Appleton, or equal.

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## 2.2 MAIN SERVICE ENTRANCE SWITCH

- A. Main service entrance switch shall be heavy duty, 600 volt, fused type with solid neutral and ground lug and shall be mounted where indicated on the Drawings.
- B. The switch shall have switch blades that are visible when the switch is in the OFF position and the switch door is open. Switch shall be UL listed for use with aluminum or copper conductors.
- C. The switch shall have a quick-make and quick-break operating mechanism. Operating handle and mechanism shall be an integral part of the enclosure (not mounted on the cover). The switch shall have dual cover interlock to prevent unintentional opening of the switch door when the switch is in the ON position or turning the switch ON with the door open. A cover interlock bypass shall be provided. Handle position shall positively indicate if switch is ON or OFF. Provision for padlocking the operating handle and switch mechanism in the OFF position with at least three padlocks shall be included.
- D. The main service entrance switch shall be service entrance rated with NEMA 1 enclosure and shall be Eaton Cutler-Hammer Type DH, Square D H222N, General Electric, or equal.
- E. The main service entrance switch shall have provisions for padlocking in either the "On" or "Off" positions and all terminals or lugs shall be 75°C rated for copper conductors. The switch shall utilize Class R fuses.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install disconnect switches where indicated.
- B. Install fuses in fusible disconnect switches.
- C. Provide heavy duty, 3 pole, 600 volt, non-fused or fused disconnect switches through 100 amperes at locations indicated or as required.
- D. NEMA Type 4 and Type 4X enclosures in other than corrosive areas shall be equipped with a combination drain and breather. The drain shall be mounted on a bolt-on, gasketed hub.
- E. See Section 16195 for nameplate, circuit number marker, labeling, etc. requirements.
- F. Arc-flash and shock hazard warning labels shall be provided on the door of each switch enclosure and shall be marked as specified in Section 16195.

END OF SECTION



SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Distribution panelboards.
- B. Lighting panelboards.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16050 – Basic Electrical Materials and Methods.
- C. Section 16190 – Supporting Devices.
- D. Section 16195 – Electrical Identification: Engraved nameplates.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) “Standard of Installation.”
- B. NEMA AB 1 – Molded Case Circuit Breakers.
- C. NEMA PB 1 – Panelboards.
- D. NEMA PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less.
- E. NFPA 70 – National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.
- C. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.

- B. Record actual locations of Products; indicate actual branch circuit arrangement.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NECA Standard of Installation.

#### 1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

### PART 2 PRODUCTS

#### 2.1 LIGHTING PANELBOARDS

- A. Lighting panelboards shall be factory assembled for 208Y/120 volt, three phase, 4 wire, solid neutral service or 120/240 volt, single phase, 3 wire, solid neutral service, as shown on the Drawings, with ground bus. Panelboards shall have main circuit breakers or main lugs only with single, two, or three pole circuits as indicated on the Drawings.
- B. All panelboard bus work shall be copper and all terminals or lugs shall be 75°C rated for copper conductors.
- C. Provide locking devices for 20% of the circuit breakers in each panelboard.
- D. The panelboard boxes shall be surface or flush mounted, as indicated on the Drawings, of code gauge commercial hot galvanized sheet steel, and with angle iron supports provided for ease in alignment of panel interior. The door and panel trim shall be finished with one prime coat and at least one finish coat of gray enamel. Doors shall be furnished with flush type combination catch and lock. All lighting panel locks shall be keyed alike and six (6) keys shall be furnished and delivered to the Owner. Panelboards shall have a NEMA Type 12 rating.
- E. The panelboards shall be listed by UL with an integrated interrupting capacity of 22,000 RMS symmetrical amperes at 240 VAC, minimum.
- F. Interiors shall be furnished with circuit breakers of the molded case, bolt-in-place type using single pole or common trip, two or three pole as indicated on the Drawings. Circuit breakers shall be of the molded case type with thermal magnetic trip and breaker handles indicating "on" – "off" and "trip" positions. Ground fault circuit interrupter (GFCI) type breakers shall be provided where indicated on the Drawings. Breakers shall have 22,000 ampere interrupting

capacity and shall be approved for “switching duty.” Circuits shall be sequence phased. Panelboards shall be 20" w. x 5-3/4" d. minimum with an overall door, Panelboards shall be Eaton Cutler-Hammer Pow-R-Line 1, Square D by Schneider Electric NQOD, or General Electric Type AQ.

- G. The panels shall be provided with a directory on the inside of the door. Card shall be protected by a permanently transparent plastic window.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards in accordance with NEMA PB 1.1 and NECA 407-2015, Panelboards.
- B. Provide filler plates for unused spaces in panelboards.
- C. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- D. All panelboard circuit breakers or switches shall have a circuit number marker on or adjacent to the breaker or switch.
- E. Provide engraved plastic nameplates and circuit number markers under the provisions of Section 16195.

### 3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Sections 01400 and 16960.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers and lugs.

END OF SECTION



SECTION 16477

FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.

1.3 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide data sheets showing electrical characteristics including time-current curves and fuse let-through values for fault current available.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700.
- B. Submit series ratings for fuse and circuit breaker combinations, where applicable.
- C. Provide type II documents for motor starters.
- D. Record actual fuse sizes.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.7 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.

- B. Provide three (3) spare fuses of each size and type, rated 600 VAC and lower, installed.
- C. For additional spare parts requirements, see Section 16010.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Bussmann
- B. Mersen
- C. Edison
- D. Littelfuse

### 2.2 FUSE REQUIREMENTS

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses shall be dual element or current limiting type, Class R, or as otherwise required for installation in the equipment furnished, and as shown on the Drawings. Fuses shall provide type II protection for motor circuits.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install fuses in accordance with manufacturer's instructions.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. All fuse holders shall be provided with fuses.
- D. The Contractor shall replace all blown fuses and the quantities specified above shall be turned over to the Owner at the time of completion.
- E. Spare fuses shall, be packed and boxed for storing with each box labeled with fuse rating, class, etc.

END OF SECTION

SECTION 16496

ENCLOSED TRANSFER SWITCH

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Automatic Transfer Switch.
- B. Manual Transfer Switch.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16195 - Electrical Identification: Engraved nameplates.
- D. Section 16620 - Packaged Engine-Generator Set: Testing requirements.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- C. Submittals shall also include wiring diagrams, and a complete written sequential description of operation under the various modes of operation, describing complete control circuit and equipment operation.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions.
- C. Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other testing firm acceptable to authority having jurisdiction, as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure, and finish.

1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the Drawings.

1.9 WARRANTY

- A. Furnish a five (5) year comprehensive warranty beginning from substantial completion. The warranty shall cover all parts and labor and shall include annual testing and inspection by the equipment service representative.
- B. The annual testing shall include full operational exercising of the switch under simulated loss of normal power source, restoration of normal power source.
- C. Annual inspection service shall include the manufacturer's recommended preventative maintenance and lubrication procedures and all required parts and lubricants.

1.10 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 01700.
- B. Provide two of each special tool required for maintenance.
- C. Provide two (2) relays of each type installed in the supplied transfer switch(es).

- D. Provide five (5) lamps for each type of indicating light installed in the supplied transfer switch(es).
- E. See Section 16010 for additional spare parts requirements.

## PART 2 PRODUCTS

### 2.1 AUTOMATIC TRANSFER SWITCH

- A. Automatic transfer switches shall be 3 pole, 3 wire, 600 VAC, rated as indicated on the Drawings, shall be the product of one manufacturer. The system shall be listed to the latest requirements of Underwriters' Laboratories Standard UL-1008 and rated for the total system load.
- B. All conductors shall be copper and all power terminals or lugs shall be 75°C rated for copper conductors. Terminal boards or blocks shall be provided for all external connections and shall be readily accessible from the front of the switch enclosure. All wiring to external devices shall be terminated at the terminal blocks, excluding normal and emergency source and load conductors. All wires and terminals shall be tagged to agree with schematic and wiring diagrams.
- C. Electrical operation shall be accomplished by a momentarily energized single solenoid operating mechanism which receives power from the source to which the load is being transferred. Fuse or thermal protection of the main operator is prohibited. Mechanical locking in each position shall be accomplished without the aid of permanent magnets, latching solenoids, or motor operators.
- D. Operation shall be inherently double-throw whereby all contacts move simultaneously and with a programmed delay in the neutral position. Electrical spacings shall be equal to or exceed those listed in Table 15.1 of UL-1008. Only those main contact structures specifically manufactured for transfer switch service shall be acceptable. An overload or short circuit shall not cause the switch to go to a neutral position.
- E. Inspection of all contacts (movable and stationary) shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The maintenance handle shall be usable only after the switch has been taken out of service and shall permit the operator to stop the contacts at any point throughout the entire travel to properly inspect and service the contacts, when required.
- F. The automatic transfer switch shall include a separately mounted control module. The module's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent digital communications capability. The controls shall include as a minimum, an LCD display, real time clock with battery backup, time stamped event log, Modbus RTU and Modbus TCP/IP protocols and RJ45 connector for 10/100 Ethernet connection to Owner's SCADA System. The control module shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control module to be disconnected from the

transfer switch for routine maintenance. The following operational characteristics shall be provided:

1. Time delay on momentary dips in normal source, adjustable from 0.5 to 6.0 seconds.
  2. Time delay on retransfer to normal, adjustable from 0 to 20 minutes with switch to manually bypass time delay on retransfer.
  3. Time delay on engine shutdown after retransfer to normal, adjustable from 0 to 30 minutes.
  4. Programmed transition time delay, adjustable from 0.1 to 30 seconds.
  5. Close differential voltage sensing of all normal source phases with pickup adjustable from 85-100% of nominal and dropout adjustable from 75-98% of pickup.
  6. Independent three phase voltage (85-100%) and frequency (90-100% pickup) sensing of the emergency source to prevent premature transfer.
  7. Test switch (momentary type) to simulate failure of normal source.
  8. 10-ampere rated engine starting contacts (S.P.D.T.) wired to a terminal strip.
  9. Pilot lights to indicate switch position.
  10. Auxiliary contacts (one closed on "Normal" and one closed on "Emergency") rated 10 amps, 480 VAC, wired to a terminal strip.
  11. Engine/generator exercising timer designed to start and run the engine loaded or unloaded, automatically a minimum of 30 minutes, once every seven days.
  12. All time delay and sensing functions shall be adjustable without the use of any tools, meters, or power supplies over the ranges indicated and shall operate with minimum drift (not to exceed  $\pm 1\%$  of set frequency,  $\pm 2\%$  of set voltage, and  $\pm 10\%$  of set time delay) over a temperature range of  $-20^{\circ}$  to  $+70^{\circ}\text{C}$ . The control panel shall be provided with a protective cover and an isolation plug in the wiring harness to disconnect all the control wires between the control panel and the main transfer panel. The control panel shall not draw more than 15 volt-amperes continuously under normal operating conditions.
- G. The automatic transfer switch shall be supplied completely assembled in a NEMA Type 4X enclosure. The complete system shall be factory assembled and tested prior to shipment. Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the switch. All control interwiring shall be provided with disconnect plugs.
- H. Pilot lights shall indicate availability of power sources and automatic transfer switch position. A prominent and detailed instruction plate shall be furnished.
- I. The switch must comply with UL-1008 and NEMA Std. Pub. ICS 2-447. In addition, switch performance must meet or exceed the following requirements and, if so requested, be verified by certified laboratory test data.
1. Temperature Rise: Measurements shall be made after the overload and the endurance tests.
  2. Withstand: UL listed to withstand the magnitude of fault current available at the switch terminals when coordinated with the respective protective devices shown on the Drawings and as listed below. The main contacts of the transfer switch shall not trip open or weld when subjected to fault currents.
  3. Dielectric: Measurements shall be made at 1960 VAC RMS minimum following the withstand current rating test.

4. Transient Withstand: Control panel shall pass the voltage surge withstand test per IEEE Std. 472-1974 and the voltage impulse withstand test per NEMA Std. Pub. ICS 1-109.

J. The automatic transfer switch shall be rated to withstand and close-on the available RMS symmetrical short circuit current at the transfer switch terminals with the type of over-current protection shown on the Drawings, but not less than the following long-time "any breaker" rating per UL 4/13/89 edition:

Switch Rating	WCR with "any breaker" Rating
30-200	10,000
260-400	35,000
600-800	50,000
1000-1200	65,000
1600-4000	100,000

K. Switches that are not UL labeled at a minimum of the above "any breaker" ratings are not acceptable.

L. When protected by current limiting fuses of the Class J or L types, automatic transfer switches rated 70 through 4000 amperes must be suitable for use where the available fault current is up to 200,000 symmetrical amperes RMS at 480 VAC.

M. The automatic transfer switch shall be ASCO, Cummins LT III Series, or Russelectric.

## 2.2 MANUAL TRANSFER SWITCH

A. Manual transfer switches shall be three pole, double throw, 600 volt rated, quick-make, quick-break, fusible or non-fusible, and rated as indicated on the Drawings with neutral lug, ground lug, and provisions for padlocking in either position. All power terminals or lugs shall be 75°C rated for copper conductors. Enclosure shall be NEMA Type 4X with switch positions labeled "NORMAL" and "EMERGENCY".

B. Double throw transfer switches shall be as manufactured by Eaton Cutler-Hammer, Square D, or equal.

## PART 3 EXECUTION

### 3.1 EXAMINATION

A. Verify conditions under the provisions of Section 01039.

B. Verify that surface is suitable for transfer switch installation.

### 3.2 INSTALLATION

A. Install transfer switches in accordance with manufacturer's instructions.

- B. Provide labels and engraved plastic nameplates under the provisions of Section 16195.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Sections 01400 and 16970.

3.4 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 16980.
- B. Demonstrate operation of automatic transfer switches in normal and emergency modes.

END OF SECTION

SECTION 16620

PACKAGED ENGINE-GENERATOR SET

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Packaged engine-generator set.
- B. Exhaust silencer and fittings.
- C. Battery and charger.

1.2 RELATED SECTIONS

- A. Section 16010 - General Electrical, Instrument, and Control Requirements.
- B. Section 16050 - Basic Electrical Materials and Methods.
- C. Section 16170 - Grounding and Bonding.
- D. Section 16496 - Enclosed Transfer Switch.
- E. Section 16960 - Electrical Testing and Equipment.
- F. Section 16970 – Calibration and Start-up of Systems.
- G. Section 16980 - Demonstration and Training.

1.3 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum.)
- D. NFPA 70 - National Electrical Code.
- E. NFPA 101 - Life Safety Code.
- F. NFPA 110 - Emergency and Standby Power Systems.
- G. NFPA 37 - Stationary Combustion Engines and Gas Turbines.
- H. NFPA 54 - Natural Fuel Gas Code.
- I. NECA/EGSA 404-2007, Generator Sets.

#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.
- C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, housing, and vibration isolators.
- D. Test Reports: Indicate results of performance testing.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- F. Manufacturer's Field Reports: Submit under provisions of Section 01400.
- G. Manufacturer's Field Reports: Indicate procedures and findings.

#### 1.5 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 110.

#### 1.7 QUALIFICATIONS

- A. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience and with service facilities within 60 miles of Project.

#### 1.8 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 37, NFPA 54, NFPA 70, NFPA 110, and NFPA 101.
- B. Furnish Products listed and classified by Underwriters Laboratories or other testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.9 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this Section, under provisions of Section 01039.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Accept unit on site on skids. Inspect for damage.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.11 WARRANTY

- A. Furnish a five (5) year comprehensive warranty beginning from the date of start-up and acceptance of the equipment. The warranty shall cover all parts, including engine jacket heaters, and labor and shall include annual testing and bi-annual (twice per year) inspection of the equipment by the manufacturer's service representative.
- B. The annual testing shall include a three (3) hour minimum full load test utilizing a portable test bank and a simulated power failure including operation of the transfer switch, automatic engine-generator set starting, automatic shutdown, and return to normal conditions.
- C. Bi-annual (twice per year) inspection service shall include the manufacturer's recommended preventative maintenance and lubrication procedures and all required parts, lubricants, and fluids.
- D. A written report shall be provided for each test or inspection visit.

1.12 MAINTENANCE MATERIALS

- A. Provide maintenance materials under provisions of Section 01700.
- B. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.

1.13 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide two of each oil and air filter element under provisions of Section 01700.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Kohler Power Systems.
- B. Cummins Power Generation.

- C. Caterpillar, Inc.
- D. MTU Onsite Energy
- E. Section 01600 - Material and Equipment: Product Options and Substitutions.

## 2.2 ENGINE-GENERATOR SET

- A. Furnish and install a natural gas engine-generator set of the latest industrial type and design. In a standby power capacity, it shall be capable of continuous service at rated output for the duration of any utility power failure.
- B. The engine-generator set shall be the product of one company; and that company, and its authorized dealer, shall have sole responsibility for the performance of the engine-generator set and its accessories. It shall be a new, factory assembled, and tested set.
- C. The engine-generator set shall be complete with the necessary controls, exhaust silencer, and accessories to the extent that this equipment, in conjunction with the engine-generator set, will comprise a complete operating package for installation 600 feet above sea level in an ambient temperature of 100 degrees F maximum down to -10 deg. F minimum.
- D. Description: NFPA 110, engine-generator set to provide source of power for Level 1 applications.
- E. System Capacity: Continuous standby rating as indicated on the Drawings using engine-mounted radiator at the ambient and altitude conditions stated.
- F. The complete engine-generator set shall fit the space shown on the Drawings.
- G. The engine-generator set shall be rated based on operation of the set when equipped with all necessary operating accessories such as radiator, fan, air cleaners, lubricating oil pump and cooler, lube oil filters, fuel solenoid valve, jacket coolant pump, governor, charging generator, alternating current generator, and exciter regulator.

## 2.3 ENGINE

- A. Type: Water-cooled inline or V-type, four stroke cycle, electric ignition, internal combustion engine.
- B. Fuel System: Natural gas.
- C. Engine speed: 1800 rpm.
- D. Governor: Electro-mechanical, electro-hydraulic, or equal to maintain governed speed within 1.8 cycles of 60 cycles from no load to full load generator output. The frequency at any constant load, including no load, shall remain within a steady state band width of; +/- 0.25% of rated frequency. The governor shall not permit frequency modulation (defined as the number of times per second that the frequency varies from the average frequency in cyclic manner) to exceed one cycle per second.

- E. The natural gas fuel system shall include all required components and accessories including but not limited to the following:
  - 1. Primary and Secondary Regulators
  - 2. Low Gas Pressure Switch
  - 3. Solenoid Valve
  - 4. Fuel Filter
  - 5. Supply Line Flexible Connector
- F. To maintain environmental quality, the engine shall be equipped with suitable emission control equipment to meet, as a minimum, current Environmental Protection Agency specifications for stationary, industrial engines. Verification of the ability to meet these emission specifications shall be provided by the engine manufacturer.
- G. The engine shall have a gear-type lubricating oil pump for supplying oil under pressure to main bearings, crankpin bearings, pistons, piston pins, timing gears, camshaft bearings, and valve rocker mechanism.
- H. Full flow oil filters, conveniently located for servicing, shall be provided. Filters or filter housing shall be equipped with a spring loaded bypass valve to insure oil circulation if filters are clogged.
- I. The engine shall be provided with one or more dry type air cleaners.
- J. Safety Devices: Engine shutdown on high coolant temperature, low coolant level, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer. Each device shall have contacts for connection to alarm lights on the control panel.
- K. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- L. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C), and suitable for operation on 120 volts AC, single phase.
- M. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F (43 degrees C). Radiator air flow restriction 0.5 inches of water (1.25 Pa) maximum. A low coolant level switch shall be provided and connected to shutdown the engine and initiate an alarm on the plant annunciator upon low coolant level at the radiator.
- N. Mounting: Provide unit with suitable vibration isolators and mount on structural steel base.
- O. A suitable battery charging generator shall be provided with sufficient capacity to recharge the batteries back to normal starting requirements quickly.
- P. The engine mounted instrument panel shall contain as a minimum, the following gauges for proper engine surveillance and maintenance:
  - 1. Engine Coolant Temperature
  - 2. Engine Lube Oil Pressure

3. Engine Running Hourmeter
4. Battery Voltage

## 2.4 GENERATOR

- A. Generator: NEMA MG1, three phase, reconnectable brushless synchronous generator with brushless exciter.
- B. Rating: As indicated on the Drawings.
- C. Insulation Class: H.
- D. Temperature Rise: 150 degrees C Standby.
- E. Enclosure: NEMA MG1, open drip proof.
- F. Voltage Regulation: Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Include manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain. The maximum instantaneous voltage dip of the generator set shall not exceed 20%, as defined by NEMA MG1-16.48.

## 2.5 HOUSING

- A. Weather resistant and vandal-proof sheet metal housing enclosing the complete generating set shall have removable or hinged side panels and hinged control panel door. Housing shall consist of 14 gauge minimum sheet steel adequately braced to minimize vibration. All removable panels have a hasp, 4" to 6" maximum from each bottom corner. A hasp shall be provided on each hinged door and on the control panel door. All hasps shall accommodate locks with 3/8" shackles.
- B. The housing shall have stationary louvers for ventilating purposes. The area of the intake louvers shall not be less than 120% of the area of exhaust louvers. Provide valved drain lines for draining engine oil and engine coolant, piped to the outside of the generator enclosure with removable plugs on the ends of the piping. Housing shall have two metal "Danger High Voltage" signs, minimum 10" high by 24" long, bolted to its sides. The housing color shall be as approved by the Owner.
- C. The enclosure shall be of the sound attenuated type and rated to provide maximum 72 dBA at 23 feet average sound level, as measured in a free field environment. The enclosure design shall direct airflow into the enclosure through rain shedding fixed vane louvers with insulated interior sound baffles. These louvers shall be sized to provide adequate system cooling without exceeding 900 fpm face velocity. The exhausted cooling air shall be directed up via a sound insulated, directional airflow plenum. This plenum to be supplied with a curved air deflector, precipitation drains and a debris screen. The plenum shall be mounted to the enclosure frame to provide structural integrity. Hang on hoods will not be acceptable.

## 2.6 ACCESSORIES

- A. Guards: All engine and generator moving parts shall be guarded for personnel protection.

- B. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions, shall be horizontally mounted on or within the plant housing. An exhaust rain cap shall also be furnished
- C. Batteries: Lead-acid batteries shall be furnished having sufficient capacity for cranking the engine for at least 45 seconds at firing speed and with capacity for starting the natural gas engine a minimum of four successive times at zero degrees F. Batteries shall have 1000 cold cranking amps at 0°F and 1280 cold cranking amps at 32°F. Battery shall be complete with cables and clamps. Battery shall have 42 month guarantee.
- D. Battery Tray: treated for electrolyte resistance, constructed to contain spillage.
- E. Battery Charger: Unit shall comply with UL 1236 and provide fully regulated, constant voltage, current limited, battery charger for each battery bank. Equalizing-charging rate shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again. Include overload protection, half wave rectifier, low rate DC ammeter, high rate indicator, high-low rate selector switch, and 120 volts AC fused input. Provide unit-mounted enclosure to meet NEMA 250, Type 1 requirements. The battery charger shall be mounted within the housing.
- F. Line Circuit Breaker: NEMA AB 1, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70. Circuit breaker shall have a 35 kA short time rating and a 65 kA interrupting rating. Unit mount in enclosure to meet NEMA 250, Type 1 requirements. An arc flash and shock hazard warning label shall be provided on the front of the breaker enclosure and shall be marked as specified in Section 16195.
- G. Engine-Generator Control Panel: NEMA 250, Type 1, generator mounted control panel enclosure with engine and generator controls and indicators. The control panel shall be mounted with the top no higher than 78" above the engine-generator set's concrete slab. Include the following equipment and features:
  - 1. Frequency Meter: 45-65 Hz. range.
  - 2. AC Output Voltmeter: 2 percent accuracy, with phase selector switch.
  - 3. AC Output Ammeter: 2 percent accuracy, with phase selector switch.
  - 4. Output voltage adjustment.
  - 5. Audible and visual alarm annunciation of the following:
    - a. Failure to crank.
    - b. Failure to generate.
    - c. Overspeed stop.
    - d. High coolant temperature.
    - e. Lube low oil pressure.
    - f. Overcrank.
    - g. Engine low coolant level.
    - h. Engine high coolant temperature pre-alarm.
    - i. Lube low oil pressure pre-alarm.
    - j. Generator fault.
    - k. Generator running.

- l. Not in Auto.
- m. Battery fault.
- n. Battery charger fault.
6. Engine Auto/Start/Stop selector switch.
7. Engine running time meter.
8. Oil pressure gauge.
9. Coolant temperature gauge.
10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
11. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote trouble alarm connection. Remote alarm contacts shall indicate any engine shutdown or generator set alarm condition.
12. A D.C. panel light with ON-OFF switch shall be provided.
13. The control panel shall automatically provide four cranking and three rest periods.
14. Automatic operation shall be initiated by the closing and terminated by the opening of remote run contacts.
15. Terminal strip connections for all remote device connections.

### PART 3 EXECUTION

#### 3.1 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of the engine-generator set, after assembly.
- B. Factory tests shall include:
  1. Settings and testing of all shutdown and safety devices.
  2. Test running of set, under load, for a minimum of two (2) continuous hours. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, and single step load pickup.
  3. Verify performance of all appurtenances during testing.
  4. Record voltage and frequency variations during steady-state operation and during one-step application of full load.
- C. Submit three (3) copies of all certified factory test reports to the Owner.
- D. Permit the Owner's representative(s) to witness the factory testing at the Owner's expense. Notify the Owner two weeks prior to any scheduled factory test.

#### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and NECA/EGSA 404-2007, Generator Sets.
- B. Before the equipment is installed, a factory certified test log of the generator set showing a minimum of one hour testing at 100 percent rated load, continuously, shall be submitted to the Owner. Normal preliminary engine and generator tests shall have been performed before unit assembly.
- C. Provide labels and engraved plastic nameplates under the provisions of Section 16195.

### 3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400.
- B. Measure and record sound level in dBA at 23 feet average.
- C. Record in 20 minute intervals during three hour test:
  - 1. Kilowatts.
  - 2. Amperes.
  - 3. Voltage.
  - 4. Coolant temperature.
  - 5. Air temperature.
  - 6. Frequency.
  - 7. Oil pressure.
- D. Test alarm and shutdown circuits by simulating conditions.
- E. The Contractor shall provide the services of an electrician to assist the manufacturer's service representative on the field test and adjustments as may be made or required as the equipment is put into service. The Contractor shall make the manufacturer's service representative available to perform the testing and put the equipment into operation.
- F. Tests will be witnessed by the Owner and three (3) copies of all field test reports, as specified above, shall be submitted to the Owner. Twenty-four (24) hours written notice shall be given the Owner prior to performing the tests. Such tests shall be scheduled at a time agreed upon by the Owner and the Contractor.
- G. All improper connections, or materials, and equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by the Contractor at no additional cost to the Owner.

### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 16970.

### 3.5 ADJUSTING

- A. Adjust work under provisions of Section 01700.
- B. Adjust generator output voltage and engine speed.

### 3.6 CLEANING

- A. Clean work under provisions of Section 01700.
- B. Clean engine and generator surfaces. Replace oil filters.

3.7 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 16980.
- B. After acceptance of the engine-generator set, the Owner's operators shall be provided on site training in the use and maintenance of the equipment. The training shall cover the use of both automatic and manual controls, calibration of all instruments, preventative maintenance of all equipment, and trouble-shooting and repair/replacement procedures.
- C. All training shall be provided by qualified representatives of the engine-generator set manufacturer.
- D. Describe loads connected to the emergency system and restrictions for future load additions.
- E. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

END OF SECTION

SECTION 16830

LEVEL INSTRUMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field-mount Level measuring and sensing Instruments, and associated devices and appurtenances.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16960 – Electrical Testing and Equipment.
- C. Section 16980 – Demonstration and Training.

1.3 REGULATORY REQUIREMENTS AND REFERENCES

- A. Conform to requirements of NFPA 70 National Electrical Code.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.
- C. All equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.
- D. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
  - 1. ANSI/ISA applicable standards for measurement and instrumentation.
  - 2. NEMA, including ICS 1 – General Standards for Industrial Control Systems, NEMA ICS 2 – Standards for Industrial Control Devices, Controllers and Assemblies, and NEMA ICS 6 – Enclosures for Industrial Controls and Systems.

1.4 SUBMITTALS

- A. Submittals shall be as required under provisions of Division 1, and Section 16010. Shop Drawings shall indicate electrical characteristics and connection requirements, including layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied. Provide Product Data showing manufacturer's specifications, electrical characteristics, and connection requirements for each Product supplied.

- B. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or Product Testing Agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each Product supplied.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1, and Sections 16960, and 16970.
- B. Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submittals shall be as required under provisions of Division 1, and Section 16010.
- B. Installation and Start-Up Requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.
- C. Maintenance Data shall include component parts diagrams and Lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
- B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products as required under the provisions of Division 1, and Section 16010.
- B. Accept products on site in factory containers. Inspect for damage. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Instruments shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described hereinbelow. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.
- B. Maintain instruments free of dirt and dust during and after installation.

## PART 2 PRODUCTS

### 2.1 LEVEL TRANSMITTERS (SONIC TYPE)

- A. Sonic type level transmitters shall be as manufactured by: Milltronics MiniRanger Plus; or previously approved equal.
- B. The level transmitters shall convert ultrasonic pulse transit time into a 4-20 ma DC signal for level indication, recording, and other use as shown on the Drawings. The level transmitter shall measure level to within accuracy of +/- 0.5% of span and repeatability shall be +/- 0.2% of span. An integral indicator for reading output signal in 0 to 100%, or other scale as indicated on the Drawings, shall be provided for each level transmitter.
- C. The level transmitter shall be suitable for operation in an environment with temperature ranging from 0 degrees C to 50 degrees C and relative humidity ranging from 0% to 95% (non-condensing). Sensors, and/or transmitter-indicators, shall be either intrinsically safe, or explosion proof, if located in areas classified as hazardous as shown on the Drawings.
- D. Each level transmitter shall be of the "smart" type with communications provided for configuration by remote handheld calibrator, or by configuration software, loaded onto Owner's portable computer. The level transmitter-indicator shall be a PC-based, acoustic transit time type system, which shall utilize many discrete data samples to arrive at an average transit time. These transit time data points shall be integrated to determine the level.
- E. The transmitter shall evaluate each acoustic signal received and shall reject those which are distorted by reflections or reverberations or whose amplitude is below minimum value, or other intelligent filtering criteria. Each travel time resulting from accepted signals shall be checked to ensure that the measured time is within user-selectable limits. Level and rate-of-change-of-level limits shall be user selectable and adjustable on-site.
- F. The level transmitter-indicator shall have an alphanumeric keypad for user interface with the level transmitter. The user shall be able to enter all site-specific and operational parameters via the keypad. Parameter entry shall be aided by menu-driven, English language prompts on the unit display. The system shall also be capable of communication and set-up via a portable computer.
- G. The transmitter-indicator unit shall be installed in a NEMA Type 4X enclosure suitable for wall mounting. The keypad and display shall be mounted inside the front of the enclosure and shall be accessible by opening the front of the enclosure. The keypad shall be equipped with a password protect function to prevent unauthorized access to the level transmitter set-up functions.
- H. The transmitter-indicator shall be equipped with an EL or LCD-type level display. The system shall display any messages that indicate the type and of a signal interruption or transducer failure.
- I. The level transmitter console shall have a self-test routine that periodically checks for proper operation of the level transmitter transceiver, processor, and timing functions. The system shall alert the user to any self-test or acoustic path failure by displaying an error message on the level transmitter display. The level transmitter shall also provide a message indicating the

type of failure. The level transmitter shall be designed to return to full operation following a short-term power interruption, with all stored values retained.

- J. A 4-20 mADC output of level shall be provided. The analog output shall be programmed to output 4 mADC if the level transmitter is in error mode. A 'dry' contact output (normally held open) shall indicate transmitter-indicator "trouble". Provide dry contact closure control and alarm outputs as shown on the Drawing.
- K. Transducer Assemblies:
  - 1. Transducer cables shall be routed through raceways, and brought to a common penetration, exiting the raceway and routed to the level transmitter-indicator as shown on the Drawings.
- L. The Contractor shall furnish all cable between the transducers and the electronic console. The cable shall be the type of specified by the manufacturer. Any connectors to the transducers that may be required shall be supplied by the manufacturer.

## 2.2 FLOAT SWITCHES (NORMAL DUTY TYPE)

- A. Suspension mounted float switches shall be as manufactured Consolidated Electric Model LS with LSW1 weight kit or Anchor Scientific, Inc. "Rotofloat" Type S.
- B. Float switches shall be direct acting with 5-1/2 inch diameter, 316 type stainless steel sphere, either normally open or normally closed mercury switch (coordinate with Drawings) potted in epoxy, and flexible three conductor cable (two conductors plus ground) with PVC jacket suitable for heavy flexing service. Cable lengths shall be as required.
- C. Float switch contacts shall be rated 20 amps at 120 VAC.
- D. Float switches shall be suitable for support bracket mounting as shown on the Drawings.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Do not install products until major construction is complete and building interior is enclosed and heated.
- C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.
- D. See Section 16195 for nameplate, circuit number marker, and wire marker, etc. requirements.

### 3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 16960.

- B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 16970.
- B. Calibrate and/or verify each device for the zeros, ranges, spans, and setpoints indicated on the Drawings.

3.4 DEMONSTRATION

- A. Demonstrate calibration and operation of devices.
- B. Provide systems demonstration under provisions of Section 16980.

END OF SECTION

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SECTION 16905

INSTRUMENT & CONTROL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Instrument and Control Panels, and associated devices and appurtenances.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16055 – Basic I & C Materials and Methods.
- C. Section 16910 – Panel Components and Devices.
- D. Section 16960 – Electrical Testing and Equipment.
- E. Section 16970 – Calibration and Start-up of Systems.
- F. Section 16980 – Demonstration and Training.

1.3 REGULATORY REQUIREMENTS AND REFERENCES

- A. Conform to requirements of NFPA 70 National Electrical Code.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.
- C. All equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.
- D. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
  - 1. ANSI/ISA applicable standards for measurement and instrumentation.
  - 2. NEMA, including ICS 1 – General Standards for Industrial Control Systems, NEMA ICS 2 – Standards for Industrial Control Devices, Controllers and Assemblies, and NEMA ICS 6 – Enclosures for Industrial Controls and Systems.

1.4 SUBMITTALS

- A. Submittals shall be as required under provisions of Division 1, and Section 16010. Shop Drawings shall indicate electrical characteristics and connection requirements, including

layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied. Provide Product Data showing manufacturer's specifications, electrical characteristics, and connection requirements for each Product supplied.

- B. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or Product Testing Agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each Product supplied.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1, and Sections 16960, and 16970.
- B. Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submittals shall be as required under provisions of Division 1, and Section 16010.
- B. Installation and Start-Up Requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.
- C. Maintenance Data shall include component parts diagrams and Lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Control Panels as specified in this section with minimum five (5) years documented experience. Manufacturer shall be a UL Listed panel fabricator, and shall submit certification of Listing immediately after the Start of Contract.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products as required under the provisions of Division 1, and Section 16010.
- B. Accept products on site in factory containers. Inspect for damage. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Instruments shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described hereinbelow. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility

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site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.

- B. Maintain instruments free of dirt and dust during and after installation.

## PART 2 PRODUCTS

### 2.1 INSTRUMENT & CONTROL (I&C) PANELS – GENERAL

- A. Manufacturer(s) of the Instrument & Control Panels, shall be a U.L. Listed Industrial Control Panel Fabricator.
- B. Instrument and Control Panels shall be furnished as described in these Specifications and as indicated on the Drawings. I&C panel assemblies shall be U.L. Labeled when required by the Drawings or by the local codes.
- C. Unless otherwise noted, I&C panels shall be of NEMA Type 12, cold rolled steel minimum. Where noted, control panels shall be NEMA Type 4 stainless steel or NEMA Type 4X fiberglass as shown on the Drawings.
- D. Construction of all panels shall be adequate to properly support all devices and equipment mounted in and on the enclosure without bending or sagging. Panel layout and equipment spacing shall be sufficient to allow for device removal and maintenance without disassembly of adjacent devices. Interior and exterior panel shop drawings shall reflect dimensioned clearance of all panel-mounted devices.
- E. All front panel-mounted equipment requiring connection and/or service from the rear or inside of the panels shall be furnished with an identification plate mounted on the rear in duplicate to the front panel identification. All equipment devices mounted within the panels shall be identified as to function and schematic identification abbreviation.
- F. Front panel identification plates shall be 1" X 3" engraved white lamicaid with black letters, internal device identification plates may be smaller; both types shall be attached with corrosion resistant screws. Rear of panel face identification plates shall be attached with silicon adhesive. All engraved legends shall be a minimum 3/16" high block type characters. Legends shall be completely worded without abbreviations, except as approved by the Owner.
- G. Pilot lights, switches, and other panel devices shall be furnished with anti-rotation key ways or other to prevent slewing after mounting.
- H. Plastic wireway shall be used to train wires in all cabinets. Wireway fill shall not exceed 40% and shall be run in continuous lengths with snap on plastic covers.
- I. Each wire and terminal shall be labeled with a wire number generated by the instrument manufacturer. Each and every wire shall be tagged at both ends within three inches of each terminal. Tags shall be computer or typewriter generated, vinyl cloth, permanent, non-smearing, self-adhesive markers such as Brady Datab or 3M Scotchcode. Pre-printed,

vinyl cloth, plastic coated, self-adhesive, tape markers as manufactured by W. H. Brady Co. or 3M Company shall also be acceptable.

- J. All 4-20 ma analog instrument signals shall use 1 pair No. 18 AWG shielded cable and shall be run in a separate raceway system from all 120 VAC control and power wiring.
- K. All 120 VAC controls, and 12 or 24 VDC alarm wiring shall be No. 14 AWG. Unless otherwise noted, No. 14 AWG control and alarm wiring shall be Type MTW/THHN single conductor 600 volt, stranded, annealed copper, high temperature polyvinyl chloride, insulation with nylon jacket, oil and gasoline resistant, for use in indoor and outdoor applications, and wet and dry locations. Standard requirements to be met are ICEA Standard S-61-402 and UL Standard 83 for 75 degrees C.
- L. Wiring shall not be spliced. Wire shall be run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.
- M. Each wire for external connection, or for connection between subplate and door, shall be terminated on screw type terminals. Ten percent (10%) spare terminals shall be provided.
- N. All foreign circuit 120 VAC wiring shall be yellow and each foreign circuit shall be provided with a clearly labeled circuit disconnect switch. Foreign circuit disconnect switches shall be switch type terminal blocks complete with engraved nameplates.
- O. See Section 16195 for nameplate, circuit marker, wire marker, etc. requirements.
- P. Each of the I&C Panels shall contain all the instruments, recorders, annunciators, graphic displays, devices, and equipment in accordance with and as required to afford the operations for the systems herein described.
- Q. All steel panels and subpanels shall be thoroughly cleaned and bonderized or cold phosphated before painting. Panels shall be spray painted with two (2) coats of primer, and two (2) coats of finish hi-gloss epoxy enamel on both inside and outside surfaces. Inside surface shall be white and outside shall be ANSI 61 light grey, unless otherwise noted on the Drawings. Stainless steel and fiberglass panels shall not be painted, unless otherwise indicated on the Drawings.

## 2.2 I & C PANELS - RACK MOUNT

- A. Unless otherwise noted, wall or rack mounting panels shall be of NEMA Type 12, 14 gauge minimum cold rolled sheet steel construction with gasketed doors equipped with vault type hardware, removable hinge pins, locking handle, all panels keyed alike, with six (6) keys provided.
- B. The wall or rack mounted panels shall be equipped with a duplex service receptacle, and circuit breakers for instrumentation power distribution, as required, or as shown on the Drawings.

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2.3 PAINTING

- A. The steel panels shall be thoroughly cleaned and bonderized or cold phosphated before painting. Panels shall be spray painted with two (2) coats of primer and two (2) coats of finish hi-gloss epoxy enamel on both inside and outside surfaces. Inside surface shall be white and outside shall be ANSI 61 light grey, unless otherwise noted on the Drawings. Stainless steel and fiberglass panels shall not be painted.

2.4 NAMEPLATES AND IDENTIFICATION

- A. See Section 16195 for nameplate, circuit marker, wire marker, etc. requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Do not install products until major construction is complete and building interior is enclosed and heated.
- C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.
- D. See Section 16195 for nameplate, circuit number marker, and wire marker, etc. requirements.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 16960.
- B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 16970.
- B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings.

3.4 DEMONSTRATION

- A. Demonstrate calibration and operation of devices.
- B. Provide systems demonstration under provisions of Section 16980.

END OF SECTION



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SECTION 16910

PANEL COMPONENTS AND DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Panel components and devices, and associated appurtenances.

1.2 RELATED SECTIONS

- A. Section 16010 – General Electrical, Instrument, and Control Requirements.
- B. Section 16960 – Electrical Testing and Equipment.
- C. Section 16970 – Calibration and Start-up of Systems.
- D. Section 16980 – Demonstration and Training.

1.3 REGULATORY REQUIREMENTS AND REFERENCES

- A. Conform to requirements of NFPA 70 National Electrical Code.
- B. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, as acceptable to the authority having jurisdiction, and as suitable for purpose Specified, and as indicated on the Drawings.
- C. All equipment and workmanship shall be in conformance with all applicable standards and requirements of any and all Federal, State, and/or local codes, ordinances, or regulations, including OSHA/MIOSHA.
- D. All Products shall meet the latest approved standards of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories, including, but not limited to:
  - 1. ANSI/ISA applicable standards for measurement and instrumentation.
  - 2. NEMA, including ICS 1 – General Standards for Industrial Control Systems, NEMA ICS 2 – Standards for Industrial Control Devices, Controllers and Assemblies, and NEMA ICS 6 – Enclosures for Industrial Controls and Systems.

1.4 SUBMITTALS

- A. Submittals shall be as required under provisions of Division 1, and Section 16010. Shop Drawings shall indicate electrical characteristics and connection requirements, including layout of complete assemblies, interconnecting cabling, dimensions, weights, and external power requirements for each Product supplied. Provide Product Data showing manufacturer's

specifications, electrical characteristics, and connection requirements for each Product supplied.

- B. Include Application and Installation Instructions indicating all conditions and limitations of use stipulated by the manufacturer, and/or Product Testing Agency, and any instructions for storage, handling, protection, examination, preparation, installation, and starting for each Product supplied.

#### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1, and Sections 16960 and 16970.
- B. Record actual locations of primary devices, and other devices connected to instruments. Include interconnection wiring and cabling information, and all terminal arrangements.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submittals shall be as required under provisions of Division 1 and Section 16010.
- B. Installation and Start-Up Requirements shall be clearly identified, described and/or detailed. Include bound copies of programming and operating instructions.
- C. Maintenance Data shall include component parts diagrams and Lists, calibration, adjustment, and preventative maintenance procedures, troubleshooting procedures, and repair or replacement procedures.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
- B. Supplier: Authorized distributor, or representative of specified manufacturer with minimum three years documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products as required under the provisions of Division 1, and Section 16010.
- B. Accept products on site in factory containers. Inspect for damage. Store products in clean, dry area; maintain temperature to NEMA ICS 1.

#### 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Panel components and devices shall be provided in enclosures, or housings, suitable for the environment of the intended installed location, as shown on the Drawings, and as described hereinbelow. Manufacturer shall provide integral heater(s) and/or cooler(s) where required for proper operation under normally expected conditions. Normal ambient temperatures at the facility site range from minus 30 to plus 45 degrees Celsius (minus 25 to plus 115 degrees

Fahrenheit). Instruments in outdoor locations shall be suitable for operation under these conditions, while in direct sunlight, or under windy conditions with associated “chill” factors.

- B. Maintain instruments free of dirt and dust during and after installation.

## PART 2 PRODUCTS

### 2.1 INSTRUMENT AND CONTROL PANELS - GENERAL

- A. Instrument and control panels shall be furnished as described in Section 16905, and as indicated on the Drawings.

### 2.2 TERMINAL BLOCKS – 600 VOLTS AND LESS

- A. Terminal blocks shall be as manufactured by Allen Bradley 1492-CA1 or equal by Eaton Cutler-Hammer or Square D.
- B. Each wire for external connection, and other wiring inside enclosures requiring terminal blocks, shall be terminated on screw type compression terminal blocks rated at 600 VAC. Fused terminals shall match the terminal blocks and shall be complete with fuse puller, and fuse.
- C. All foreign circuit 120 VAC wiring shall be yellow and each foreign circuit shall be provided with a clearly labeled circuit disconnect switch. Foreign circuit disconnect switches shall be switch type terminal blocks complete with engraved nameplates.
- D. Ten percent spare terminals of each type shall be provided.

### 2.3 POWER DISTRIBUTION BLOCKS – 600 VOLTS AND LESS

- A. Power distribution blocks shall be as manufactured by Allen Bradley 1492-PD type or equal by Eaton Cutler-Hammer or Square D.
- B. Where power is to be distributed among many circuits this shall be accomplished using one, two, or three pole power distribution blocks. The blocks shall be rated for use at 600 VAC, and shall have copper connector block construction.

### 2.4 MANUFACTURERS (SWITCHES AND INDICATING LIGHTS)

- A. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 1, or NEMA Type 12, enclosures shall be of dust-tight, oiltight NEMA Type 13 design; as manufactured by Allen-Bradley Bulletin 800T, Eaton Cutler-Hammer 10250T Series, or Square D Type K.
- B. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 3R, or NEMA Type 4, enclosures shall be of watertight, NEMA Type 4 design; as manufactured by Allen-Bradley Bulletin 800T, Square D Type K, Eaton Cutler-Hammer 10250T Series with clear rubber boot and gaskets.

- C. Push-button switches, selector switches, and indicating lights mounted on NEMA Type 4X enclosures shall be of watertight, corrosion resistant, NEMA Type 4X design; as manufactured by Square D Type SK, Allen-Bradley Bulletin 800H with clear rubber boot and gaskets, or Eaton Cutler-Hammer 10250T Series with clear rubber boot and gaskets.
- D. Push-button switches, selector switches, and indicating lights mounted on explosion proof, (Class I, Div. 1, Groups C and D) enclosures shall be of explosion proof design, rated for Class I duty; as manufactured by Allen-Bradley Bulletin 800H, Square D Type BR, Crouse-Hinds Types EFS and EFD, Appleton EFD and EDS Series, or equal by Killark.
- E. Four or more position selector switches shall be rated as indicated above, as a minimum, with the number of contacts as required by the Drawings, shall have pistol grip type handles and shall be as manufactured by Electro Switch Type W-2, American Solenoid Blue Line Type C10, or equal.

## 2.5 INDICATING LIGHTS (LT)

- A. Indicating lights shall be heavy duty, push-to-test, transformer type with lens colors as shown on the Drawings.
- B. Indicating lights shall be equipped with legend plates marked as shown on the Drawings, and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

## 2.6 SELECTOR SWITCHES (SS)

- A. Selector switches shall be of the two or three position, maintained contact, heavy duty type, with contact arrangement as shown on the Drawings. The contacts shall be rated at least 10 amperes at 600 VAC.
- B. The selector switches shall be equipped with legend plates marked as shown on the Drawings, and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

## 2.7 PUSH-BUTTON SWITCHES (PB)

- A. Push-button switches shall be of the heavy duty, momentary contact, industrial type rated for 600 VAC, and the contacts shall be rated for 10 amperes continuous duty at 125 VAC. Push-button switches shall be the guarded type with full shroud and green button for start operation, the unguarded type with red button for stop operation, and the unguarded type with black or gray button for all others.
- B. Push-button switches shall be equipped with legend plates marked as shown on the Drawings, and shall be mounted on remote control stations as specified hereinafter or on other panels as shown on the Drawings.

2.8 EMERGENCY STOP-RESET/JOG PUSHBUTTON SWITCH STATIONS (ESRJ)

- A. Emergency stop-Reset/Jog pushbutton switch stations shall be of the three push-button operator type with padlocking provision on the Stop button. The switches shall be of the momentary (Reset and Jog buttons) – maintained (Stop button) type. The Stop and Reset operators shall be mechanically interlocked.
- B. The stations shall be rated for installation in hazardous locations; Class I, Division 1; where indicated as explosion proof; and shall be rated NEMA Type 4X for all other locations.
- C. The station enclosure shall be constructed of cast, copper-free aluminum with a corrosion resistant finish.

2.9 STOP-LOCKOUT SWITCH STATIONS

- A. Wherever “Emergency stop-Reset”, “Emergency stop lockout”, “Lock stop-Reset”, “Stop lockout-Reset”, or “Stop-Reset” pushbuttons are shown on the Drawings, they shall be two unit, mechanically interlocked, maintained contact type with locking device on stop button, and legend plates shall be “Stop” or “Emergency stop”, as indicated on the Drawings, and “Reset”.
- B. The stations shall be rated for installation in hazardous locations; Class I, Division 1; where indicated as explosion proof; and shall be rated NEMA Type 4X for all other locations.

2.10 LOGIC RELAYS (LR)

- A. Logic relays shall be of the miniature plug-in relay type, suitable for logic duty, with contacts rated not less than 3 amperes at 120 VAC.
- B. The relay coils shall be rated for continuous duty at 120 volts, 60 Hertz. Each logic relay shall have an internal pilot light for indication of coil energization.
- C. The contact arrangement shall be 4PDT. Each relay shall also have a manual operator, to provide for testing the logic circuits by manually operating the contacts.
- D. Each logic relay shall be complete with a double tier, 14 pin (spade type), plug-in base. The bases shall be suitable for either surface or track mounting. Each relay shall be provided with a hold-down device.
- E. Logic relays shall be as manufactured by Square D Class 8501 Type R, Allen-Bradley Bulletin 700 Type P, or equal by IDEC or Potter and Brumfield a division of Tyco Electronics.

2.11 CONTROL RELAYS (CR)

- A. Control relays shall be of the heavy duty, industrial type with convertible contacts rated not less than 10 amperes at 600 volts AC.
- B. The relay coils shall be of molded construction and shall be rated for continuous duty at 120 volts, 60 Hertz, alternating current.

- C. The contact arrangement shall be as required.
- D. NEMA Type 12 enclosures shall be provided for relays where shown on the Drawings.
- E. Induction relays shall be electro-mechanical type, 120 VAC powered with secondary coil voltage of 24 VAC and one N.O. and one N.C. contact rated 8 amps (min.) at 120 VAC. Induction relay sensitivity shall be field adjustable. Unit shall be suitable for use with contact closure devices.
- F. Control relays shall be as manufactured by Square D Class 8501 Type X, Allen-Bradley Bulletin 700 Type P, Eaton Cutler-Hammer Type ARB, or equal by General Electric.
- G. Induction relays shall be as manufactured by B/W Controls Model 1500-A-L1-S2-DC-X, or Warrick Controls equivalent

#### 2.12 ALTERNATING RELAYS (ALT)

- A. Duplex alternating relays shall be designed to alternate control of two loads through DPDT contacts. The relays shall be suitable for operation on 120 VAC. The contacts shall transfer on each pulse when the relay's control input is de-energized and shall be rated 5 amps (minimum) at 120 VAC resistive.
- B. Triplex alternating relays shall be designed to alternate control of three loads through SPST contacts. The relays shall be suitable for operation on 120 VAC. The contacts shall transfer on each pulse when the relay's control input is de-energized and shall be rated 2 amps (minimum) at 120 VAC resistive.
- C. The minimum life expectancy of the alternating relays shall be one million operations and each relay shall be equipped with screw terminals for direct wiring.
- D. Duplex alternating relays shall be as manufactured by Diversified Electronics Model No. ARA-120-ADA, or equal, by Time Mark.
- E. Triplex alternating relays shall be as manufactured by Diversified Electronics Model No. ARA-120-AFE, or equal, by Time Mark.

#### 2.13 TIME DELAY RELAYS (TD)

- A. Time delay relays of the solid-state type shall be heavy duty, industrial type timing relays with contacts rated not less than 7 amperes, non-inductive at 120 VAC. The timer shall be solid state, with digital setpoint and digital timing display, field-selectable for on, off, or interval delay, field-selectable for latching or non-latching operation, and four field-selectable ranges, from: 00.01 to 99.99 sec.; 000.1 to 999.9 sec.; 0001. to 9999. sec.; and 0010 to 9990 seconds. The relay coils shall be of molded construction and shall be rated for continuous duty at 120 volts, 60 Hertz, alternating current. The contact arrangement shall be: Instantaneous - one (1) SPST, N.O. and one (1) SPST, N.C.; Timed - one (1) SPDT, unless otherwise approved.
- B. Solid state time delay relays shall be Durant/Eagle Signal Model B856-511, or equal, with plug-in base and HOLD DOWN.

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2.14 DC LOOP POWER SUPPLIES

- A. Separately mounted dc power supplies shall be as manufactured by Acopian, or Power-One.

2.15 DC POWER SUPPLIES

- A. Each instrumentation device requiring a DC power supply shall each be powered by a single 24 VDC minimum, regulated 120 VAC input type power supply. Each power supply may be integral to an indicator or controller in the loop, or may be of the separately mounted type. In the case of several instruments in a common case or enclosure, a single DC power supply may be provided for all devices, providing that the distribution of DC power to each device is separately protected by fuse or circuit breaker.
- B. Separately mounted dc power supplies shall be as manufactured by Acopian, or Power-One.

2.16 ELAPSED TIME METERS (ETM)

- A. Elapsed time meters shall have a range of 0 to 99,999.9 hours, and shall be non-reset type suitable for panel mounting, with gasketing as required to maintain panel integrity (NEMA 12 or 4, as required).
- B. Elapsed time meters shall be as manufactured by General Electric Type 240, Simpson, or equal.

2.17 PANEL HEATERS

- A. Heaters shall be as manufactured by Hoffman Engineering, or equal. Heaters shall be provided complete with thermostat, ranged 40 to 100 degrees Fahrenheit.
- B. Panel heaters and thermostats shall provide thermostatically controlled protection from low temperatures, and the effects of condensation inside control panels. Heaters shall be of the fan-forced type, to maintain stable temperatures throughout the enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Do not install products until major construction is complete and building interior is enclosed and heated.
- C. Make all instrumentation interconnections (process, electrical, etc.) as indicated and required for proper operation and intended use.
- D. See Section 16195 for nameplate, circuit number marker, and wire marker, etc. requirements.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing shall be performed under provisions of Section 16960.
- B. Perform operational testing on instrumentation and control systems to verify proper operation and field wiring connections.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Section 16970.
- B. Calibrate and/or verify each device for the zeros, ranges, and spans indicated on the Drawings.

3.4 DEMONSTRATION

- A. Demonstrate calibration and operation of devices.
- B. Provide systems demonstration under provisions of Section 16980.
- C. After acceptance of the equipment, the Owner's operators shall be provided with one-half day (minimum) of on site training in the use and maintenance of the equipment. The training shall cover the calibration of the devices, preventative maintenance of all equipment, and troubleshooting and repair/replacement procedures.

3.5 SPARES

- A. Spares for panel mounted components and devices shall be furnished as Specified under Section 16905.
- B. Turn over all spares at the time of, and as a condition of, acceptance.

END OF SECTION

SECTION 16960

ELECTRICAL TESTING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Division 16 testing requirements.
- B. Test equipment requirements.
- C. Sample forms.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Section 16010 - General Electrical, Instrument, and Control Requirements.
- C. Section 16050 - Basic Electrical Materials and Methods.
- D. Section 16970 – Calibration and Start-up of Systems.

1.3 REFERENCES

- A. All testing methods shall be in conformance with the following documents:
  - 1. National Electrical Code, latest approved edition.
  - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
  - 3. NETA Acceptance and Maintenance Specifications and Safety Guidelines.
- B. All equipment shall be tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL, and OSHA, except as modified herein.

1.4 SUBMITTALS

- A. Submit on Products under provisions of Section 01300.
- B. Product Data: Indicate electrical characteristics and specifications; including layout of switches, buttons, displays, dimensions, weights, and external power requirements; and, list cables, connections and all available accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit test results under provisions of Section 01700.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.
- B. Operation Data: Include bound copies of operating and programming instructions.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and use of product(s).

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
- B. Cable testing shall be performed by technicians certified in accordance with ANSI/NETA ETT-2000 Standards for the Certification of Electrical Testing Technicians. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make an informed judgment on the continued serviceability or nonserviceability of the specific equipment. Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.

1.8 REGULATORY REQUIREMENTS

- A. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.
- B. All test instruments and devices shall be in conformance with all applicable standards and requirements of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories. NIST – traceable certificates of calibration shall be provided with each instrument/device.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Accept products on site in factory containers. Inspect for damage. Turn over to Owner immediately.

## PART 2 PRODUCTS

None.

## PART 3 EXECUTION

### 3.1 TESTING

- A. The Contractor shall perform all testing necessary to ensure that the work performed under the Contract is satisfactory and in conformity with the requirements of the Contract Documents.
- B. All tests shall be witnessed by the Owner's Representative and four (4) copies of all field tests, as specified herein and in other Sections, shall be submitted to the Owner. Twenty-four (24) hours (minimum) written notice shall be given the Owner prior to performing the tests. Such tests shall be scheduled at a time agreed upon by the Owner and the Contractor.
- C. Testing shall include, but shall not be limited to, the following tests:
  - 1. Insulation resistance to ground of all conductors and equipment.
  - 2. Continuity, connections, and integrity of the facility's entire grounding system.
  - 3. Continuity, polarity, phase sequence, and connection of all current carrying conductors and equipment.
  - 4. Power Cable Tests shall be made as follows:
  - 5. The following information shall be included in a test report on each cable:
    - a. Complete identification of cable, including approximate length.
    - b. Approximate average cable temperature.
    - c. Megger readings versus time data, including converted values
  - 6. In order to be acceptable, the cable must withstand the specified high voltage without breakdown or have satisfactory megger readings.
- D. All improper connections, or materials, and equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by the Contractor and re-tested at no additional cost to the Owner.

### 3.2 CONTRACTOR'S ASSISTANCE

- A. Testing of Package equipment, as described in Section 16010, shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturer's service representatives on any and all field test and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is put into service. The Contractor shall make equipment manufacturers' service representatives available as required to assist in testing or putting equipment into operation.

END OF SECTION

**CABLE TEST CERTIFICATE**

**1.0 TECHNICIAN INFORMATION**

Company Name: \_\_\_\_\_ Contact Person: \_\_\_\_\_  
 Address: \_\_\_\_\_ Phone No.: \_\_\_\_\_  
 \_\_\_\_\_

**2.0 CABLE IDENTIFICATION**

Cable Designation or Circuit No.: \_\_\_\_\_  
 Cable Source \_\_\_\_\_ Air Temperature \_\_\_\_\_  
 Termination Point \_\_\_\_\_ Humidity \_\_\_\_\_  
 Connected Equipment \_\_\_\_\_ Equipment Temperature \_\_\_\_\_  
 Test Voltage \_\_\_\_\_ No. of Conductors \_\_\_\_\_ Age \_\_\_\_\_  
 Length \_\_\_\_\_ Size \_\_\_\_\_ Operating Voltage \_\_\_\_\_  
 Cable Type \_\_\_\_\_ Rated Voltage \_\_\_\_\_ Ground Type \_\_\_\_\_  
 Manufacturer \_\_\_\_\_ Insulation Type \_\_\_\_\_  
 Insulation Thickness \_\_\_\_\_ Installed In \_\_\_\_\_  
 Conductor Material \_\_\_\_\_

Phase Color Identification

Phase A: \_\_\_\_\_ Phase B: \_\_\_\_\_ Phase C: \_\_\_\_\_

**3.0 TEST INSTRUMENT**

Manufacturer \_\_\_\_\_ Model No. \_\_\_\_\_

**4.0 POWER CABLE TEST – MEGGER TEST**

Time Minutes	Phase A Megohms		Phase B Megohms		Phase C Megohms	
	Before	After	Before	After	Before	After
.25						
.50						
.75						
1.00						
1.25						
1.50						
1.75						
2.00						
2.25						
2.50						
2.75						
3.0						
4.0						
5.0						

**5.0 CERTIFICATION**

I certify that the above information is correct and that the cable installation and condition conforms to manufacturer and Contract Specification requirements, unless otherwise noted.

Technician Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**6.0 ENGINEER REVIEW**

Test Witnessed:  Yes  No Reviewer Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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SECTION 16970

CALIBRATION AND START-UP OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Setup of devices and instruments.
- B. Requirements for Start-up of Systems furnished/installed under this Contract.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Section 16010 - General Electrical, Instrument, and Control Requirements.
- C. Section 16050 - Basic Electrical Materials and Methods.
- D. Section 16960 - Electrical Testing and Equipment.

1.3 REFERENCES

- A. All setup, calibration, and workmanship shall be in conformance with the following documents:
  - 1. National Electrical Code, latest approved edition.
  - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
- B. All equipment shall be designed, constructed, installed, tested and calibrated in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL, and OSHA.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Indicate electrical characteristics and specifications; including layout of switches, buttons, displays, dimensions, weights, and external power requirements; and, list cables, connections and all available accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit setup and programming documentation under provisions of Section 01700.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700.

- B. Operation Data: Include bound copies of operating and programming instructions. Include component parts replacement, adjustments, and preventative maintenance procedures and materials.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and use of product(s).

### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.

### 1.8 REGULATORY REQUIREMENTS

- A. Furnish Products listed and classified by Underwriters Laboratories, Inc. (UL), Factory Mutual (FM), and/or Canadian Standards Association (CSA), as specifically indicated, and as acceptable to authority having jurisdiction, as suitable for purpose specified and indicated.
- B. All instruments and devices shall be in conformance with all applicable standards and requirements of ISA, IEEE, ANSI, NEMA, and Underwriters' Laboratories.

### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Accept products on site in factory containers. Inspect for damage.
- C. Turn products over to Owner immediately.

## PART 2 PRODUCTS

None.

## PART 3 EXECUTION

### 3.1 START-UP REQUIREMENTS

- A. Setup and start-up of equipment and/or systems shall be performed as described below, and per the requirements of the Section under which the equipment/system was furnished.
- B. Prior to scheduling Start-up of any equipment and/or system, the Contractor shall have complied with the requirements of Section 16960, Electrical Testing and Equipment, and shall have submitted reports indicating successful completion of testing for the equipment/system being started.

- C. Prior to energizing and operating any equipment or system, the Contractor shall arrange for the manufacturer's representative to inspect the installation for compliance to the manufacturer's recommendations.
- D. The Contractor shall energize the equipment/system and perform all setting of equipment limit and safety switches. The Contractor shall then start-up the equipment/system and verify the proper operation of all features and functions as required by the Specifications and Drawings.
- E. After completing the above items, the Contractor shall schedule a "Witnessed" Start-up. Twenty-four (24) hours (minimum) written notice shall be given the Owner's Representative prior to performing any Start-up. Start-up shall be scheduled at a time agreed upon by the Owner and the Contractor.
- F. Start-up and operation of the equipment and/or system shall be performed using the manufacturer's Operation and Maintenance Manual. Any deficiencies in the O & M Manual noted during Start-up shall be corrected prior to scheduling the Owner's Demonstration as specified under Section 16980. Start-up will be witnessed by the Owner's Representative.
- G. Verification of the start-up performance of the equipment and/or system shall be provided in the form of a start-up report, indicating that the Owner's Representative witnessed all functions and operations required of the equipment and/or system. Four (4) copies of all Start-up reports, as specified herein and in other Sections, shall be submitted to the Owner.
- H. All improperly functioning equipment not adapted to the purpose for which it is intended, or material, or equipment found to be faulty while performing the tests, shall be corrected; and any changes or repairs necessary to put the work in satisfactory condition and operation shall be done by the Contractor at no additional cost to the Owner. Start-up of the repaired equipment/system shall be witnessed by the Owner's Representative.
- I. Successful and approved completion of the Start-up requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete as specified under Section 16010.

### 3.2 CONTRACTOR'S ASSISTANCE

- A. Setup and Start-up of Package Equipment as described in Section 16010 shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturer's service representatives on any and all field tests and adjustments as may be made or required by equipment manufacturers or the Contractor as the equipment is started up. The Contractor shall make equipment manufacturers' service representatives available as required to assist in putting equipment into operation.

END OF SECTION



SECTION 16980

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for Demonstration of equipment and/or systems for the Owner's personnel.
- B. Requirements for Training of Owner's personnel in the operation and maintenance of the equipment/system.
- C. Acceptance requirements.

1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturer's Field Reports.
- B. Section 01700 - Contract Closeout.
- C. Section 01800 - Training.
- D. Section 16010 - General Electrical, Instrument, and Control Requirements.
- E. Section 16050 - Basic Electrical Materials and Methods.
- F. Section 16960 - Electrical Testing and Equipment.

1.3 REFERENCES

- A. All equipment and workmanship shall be in conformance with the following documents:
  - 1. National Electrical Code (NEC), latest approved edition.
  - 2. Any and all Federal, State, and/or local codes, ordinances, or regulations.
- B. All equipment shall be designed, constructed, installed, and tested in conformity with all requirements, as a minimum, of applicable standards of IEEE, NEMA, ISA, ANSI, ICEA, UL and OSHA, except as modified herein.

PART 2 PRODUCTS

None.

## PART 3 EXECUTION

### 3.1 DEMONSTRATION OF EQUIPMENT

- A. Demonstration of equipment and systems, and training of the Owner's personnel in the proper operation and maintenance of the equipment and systems, shall be performed as required under Section 01800, as described below, and per the requirements of the Section under which the equipment/system was furnished.
- B. The following shall occur prior to scheduling demonstration and training of any equipment and/or system:
  - 1. The Contractor shall have fully complied with the requirements of Section 16970, Calibration and Start-up of Systems, and shall have submitted reports indicating successful completion of start-up for the equipment/system being started.
  - 2. Any deficiencies in the manufacturer's Operation and Maintenance (O&M) Manuals and/or "As-Built" drawings, noted during Start-up shall be corrected prior to scheduling the Owner's Demonstration and Training, as required per Section 16970.
  - 3. The Contractor shall submit for approval a proposed agenda for said demonstration/training, and shall adhere to the approved agenda for the demonstration and training session(s).
  - 4. Any and all test equipment, maintenance equipment, tools, or devices, and/or spare parts required to be furnished under Division 16 shall be turned over, and stored as required under Sections 01700 and 16010.
- C. After completing the above items, the Contractor shall schedule the Owner's Demonstration and Training. Seventy-two (72) hours (minimum) written notice shall be given the Owner's Representative prior to performing any Demonstration and/or Training. Such sessions shall be scheduled at a time agreed upon by the Owner and the Contractor. Multiple sessions shall be scheduled to allow attendance by all Owner's Personnel.
- D. The Demonstration shall instruct the Owner's personnel in all facets, features, and functions of the operation of the equipment and/or system. Training shall be performed using the manufacturer's Operation and Maintenance Manual and "As-Built" drawings, and shall familiarize the Owner's personnel in identifying improper operation, troubleshooting for the cause(s), and performing repair, replacement, and recalibration/setup necessary to correct the mis-operation. Use of any test equipment necessary, and a review of any recommended and/or provided spare parts shall be included in the Training.
- E. Verification of the Demonstration and Training for the equipment and/or system shall be provided in the form of a report, indicating that the Owner's personnel attended and witnessed all functions and operations required of the equipment and/or system, and received the required instruction. Demonstration and Training will be witnessed by the Owner's Representative and four (4) copies of all demonstration and training reports, as specified above and in other Sections, shall be submitted to the Owner.
- F. Successful and approved completion of the Demonstration and Training requirements is a prerequisite to determining whether the Work or a portion of the Work is Substantially Complete as specified under Section 16010.

### 3.2 CONTRACTOR'S ASSISTANCE

- A. Demonstration and Training of Package Equipment, as described in Section 16010, shall be as required in other Sections of this Specification.
- B. The Contractor shall provide the services of an electrician to assist either the Contractor or the equipment manufacturers' service representatives on any and all field set-ups and adjustments as may be required to demonstrate operation of the equipment or system. The Contractor shall make equipment manufacturers' service representatives available as required to assist in demonstrating equipment operation.

### 3.3 CLEANUP

- A. Cleanup shall occur as required under Section 01700, and as specified under Section 16010.

### 3.4 ACCEPTANCE

- A. Acceptance shall occur after all the above requirements have been satisfied, and as per Section 01700.
- B. Acceptance of equipment and/or systems shall be signified by execution of Guarantees as described below.

### 3.5 GUARANTEES

- A. The Contractor's Guarantee shall be furnished as follows:
  - 1. Provide multiple copies.
  - 2. Execute for Owner's signature a certificate of Contractor's guarantee, listing date of acceptance as start of warranty period (except where indicated otherwise under the detailed equipment specifications), for all work and materials provided and installed under this Division.\*
  - 3. Execute and assemble any and all transferable warranty and/or license documents from Subcontractors, suppliers, and manufacturers.
  - 4. Provide Table of Contents and assemble in three D, side ring binder with durable plastic cover.
- \* For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of Owner's acceptance as start of warranty period.
- B. The Owner's dated signature on these documents shall constitute acceptance for warranty purposes.

END OF SECTION





Professional Service Industries, Inc.  
37483 Interchange Drive, Farmington Hills, Michigan 48335  
Phone: (248) 957-9911  
Fax: (248) 957-9909  
July 8, 2019

Mr. Aaron Uranga, PE, Associate  
Hubbell Roth & Clark, Inc.  
535 Griswold Street, Suite 1650  
Detroit, Michigan 48226

**RE:** Geotechnical Exploration and Engineering Report  
Proposed Ann Arbor Lift Stations  
City of Ann Arbor, Washtenaw County, Michigan  
PSI Project No. **03811131**

Dear Mr. Uranga:

Professional Service Industries, Inc. (PSI) has completed a geotechnical exploration and engineering report for the proposed Ann Arbor lift stations to be constructed along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan. PSI understands the proposed work will include the construction of a new below grade valve chamber located up to 10 feet below the existing ground surface, an above grade generator with slab-on-grade foundation and an above grade control panel with slab-on-grade foundation at each of the five locations. PSI further understands that the existing wet well will remain in place. This report presents the results of our observations and analysis and our recommendations for the proposed site development.

PSI appreciates the opportunity to perform this geotechnical study and to assist you and the design team on this project. If you have any questions regarding this report, or if we may be of further service, please contact our office.

Respectfully,  
**PROFESSIONAL SERVICE INDUSTRIES, INC.**

Handwritten signature of Kevin F. Dubnicki in blue ink.

Kevin F. Dubnicki, P.E.  
Project Manager

Handwritten signature of Mahmoud El-Gamal in blue ink.

Mahmoud El-Gamal, Ph.D., P.E., D.GE  
Regional Vice President

1 pc: Enc.  
1 cc: via PDF

**Geotechnical Exploration  
and Engineering Report**



**For the Proposed**

**Ann Arbor Lift Stations  
City of Ann Arbor,  
Washtenaw County, Michigan**

**Prepared for**

**Hubbell Roth & Clark, Inc.  
535 Griswold Street, Suite 1650  
Detroit, Michigan 48226**

A handwritten signature in blue ink that reads "Kevin Dubnicki".

Kevin F. Dubnicki, PE  
Project Manager

**July 8, 2019**

**PSI Project 03811131**

A handwritten signature in blue ink that reads "Mahmoud El-Gamal".

Mahmoud El-Gamal,  
Ph.D., PE, D.GE  
Regional Vice President

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**APPENDIX**

- Site Vicinity Plan (Figure No. 1)
- Boring Location Plan (Figure No. 2 through No. 5)
- Test Boring Logs (Borings B-1 through B-5)
- Site Photograph’s (Sheet 1 and Sheet 2)
- General Notes
- Laboratory Test Results





## 1 EXECUTIVE SUMMARY

Professional Service Industries, Inc. (PSI) has completed our geotechnical exploration and engineering report for the proposed Ann Arbor lift stations to be constructed along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan. PSI understands the proposed work will include the construction of a new below grade valve chamber located up to 10 feet below the existing ground surface, an above grade generator with slab-on-grade foundation and an above grade control panel with slab-on grade foundation at each of the five locations. PSI further understands that the existing wet well will remain in place. A total of five (5) SPT soil test borings were performed and selected samples were tested in the laboratory.

Details regarding the specific design of the proposed valve chamber were not available at the time of this report. However, PSI anticipates that the proposed valve chamber may bear on native soils at similar elevations of the existing wet well at each location. Based on the boring logs and estimated fill depth, elevations greater than 10 feet may be required to match the existing wet wells.

Based on the borings performed, PSI anticipates that the support soils at and below the bottom elevation of the proposed valve chambers may consist predominately of native hard to stiff mottled sandy clays at the locations of Borings B-1 and B-5 and very loose to loose brown silty sands at the locations of Borings B-2, B-3 and B-4. PSI estimates that a net allowable bearing pressure to support the valve chambers at an estimated 10 to 15 feet bearing in native is as follows;

- 18900 Franklin Street – **4,000 psf** (Hard Sandy Clays)
- 3020 Sequoia Parkway (2 locations) – **1,500 psf** (Very Loose to Loose Silty Sand)
- 310 Parkwood Street (Located off Kingwood Street) – **1,500 psf** (Very Loose Silty Sand)
- 1150 Astor Avenue – **2,500 psf** (Stiff Sandy Clay)

When net contact pressures at the structure bottom elevation is considered as a result of the removal of approximately 10 feet of existing overburden soils and an estimated 10-foot diameter footprint for the proposed valve chamber, little to no increase in soil pressure will likely result. Therefore, PSI anticipates that the valve chambers should have an adequate factor of safety against bearing capacity failure. Based on assumed combined dead and live loads of less than 90 to 100 kips, settlement should be negligible and limited to the effects of construction disturbance. **However, due to the very loose to loose silty sands encountered, PSI highly recommends the contractor properly compact the existing native soils below the proposed lift station until no further densification is observed and under PSI supervision.** In addition, compaction of the very loose to loose sands may be dependent on soil conditions at the time of construction. Due to a high-water table encountered at the Sequoia Parkway lift stations, it may be necessary to stabilize the subgrade soils by undercutting a minimum depth of 12 to 18 inches and place a heavy-duty geotextile separation fabric and backfill with engineered fill consisting of MDOT 6A coarse aggregate.

The soil borings indicate the ground water level at the time the work was performed to be approximately 11.5 feet below the existing ground surface at the locations of the proposed valve structure at the locations of Borings B-1 through B-5. In addition, PSI understands the proposed valve structures may be installed at depths of up to 10 feet. Therefore, the structure bottom is not anticipated to be subjected to significant uplift force. Should the valve structure extend below the existing ground water table, the structure would be subjected to uplift force equal to 62.4 pounds per square foot for each foot. Uplift forces will be at the maximum during construction when the



structure is empty. The mass of the structure and foundation concrete, including the weight of the soil above the exterior perimeter “lip” if provided, may resist the uplift forces. Alternatively, uplift forces may be resisted or eliminated through pressure relief valves and the installation of tension piers below the manhole’s base slab.

Groundwater or perched water was generally encountered during drilling at depths ranging from approximately 11.5 to 22.0 feet below the existing ground surface at the locations of Borings B-2 through B-5. Boring B-1 was reported as dry during and following completion of the soil boring. The change in color of the soil from brown to gray may indicate the long-term minimum piezometric level in the area. Based on the subsurface conditions at the location of Boring B-1, the long term piezometric level at this site may be located at a depth of approximately 11.5 feet below the existing ground surface. **Earthwork and construction operations taking place within a distance of approximately 2 to 3 feet or so of the prevailing groundwater can cause groundwater to be ‘wicked’ upward, resulting in subgrade instability.** Therefore, while PSI does not expect significant water infiltration during the construction of the proposed valve chamber and slab-on grade foundation elements, it is possible that some dewatering or additional stabilization measures may be required depending on the final foundation invert elevation.

**This Executive Summary should not be considered separately from the entire text of this report with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are given in the following sections of this report.**



## 2 PROJECT INFORMATION

### 2.1 PROJECT AUTHORIZATION

Professional Service Industries, Inc. (PSI) has completed our geotechnical exploration and engineering report for the proposed Ann Arbor lift stations to be constructed along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan. PSI's work was authorized via a Subconsultant Services Agreement between Hubbell, Roth & Clark, Inc. and PSI dated June 10, 2019 and fully executed on June 12, 2019. PSI's work was performed in general accordance with the scope of service outlined in Exhibit B of the Subconsultant Services Agreement.

### 2.2 PROJECT DESCRIPTION

Project information was provided by Mr. Aaron Uranga, P.E. of Hubbell, Roth & Clark, Inc. in a request for proposal via an email on June 4, 2019. The information provided included a list of five proposed locations indicated below;

- 18900 Franklin Street
- 3020 Sequoia Parkway (2 locations)
- 310 Parkwood Street (Located off Kingwood Street)
- 1150 Astor Avenue

PSI understands the proposed work will include the construction of a new below grade valve chamber located up to 10 feet below the existing ground surface, an above grade generator with slab-on-grade foundation and an above grade control panel with slab-on grade foundation at each site location. PSI further understands that the existing wet well will remain in place. The proposed work will occur to replace ageing equipment currently located at a total of five (5) sites along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan.

The geotechnical recommendations presented in this report are based on the available project information, and the results of our geotechnical exploration described in this report. If any of the noted information is considered incorrect or is changed, please inform PSI in writing so that we may amend the recommendations presented in this report if appropriate and if desired by the client. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

### 2.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore the subsurface conditions at the site to provide the geotechnical parameters required to prepare recommendations for the construction of the proposed manholes. PSI's authorized scope of services included drilling a total of five (5) soil test borings, laboratory testing of selected samples, an engineering evaluation of the data generated, and the preparation of a geotechnical report.

This report presents available project information, briefly outlines the testing procedures, describes the site and supplementary subsurface conditions, and provides recommendations regarding the following:

- Earthwork considerations for site development.



- Soil parameters for temporary excavation support.
- Site dewatering requirements.
- Comments regarding geotechnical factors that may impact earthwork, construction and performance of the proposed manholes.

The geotechnical scope of services did not include an environmental assessment for determining the presence or absence of wetlands, hazardous or toxic materials in the soil, bedrock, surface water, groundwater or air on, below or around this site. Any statement in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. Prior to the development of any site, an environmental assessment is advisable.

PSI did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence of the amplification of the same. Hubbell, Roth & Clark, Inc. acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. Hubbell, Roth & Clark, Inc. further acknowledges that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.



## **3 SITE AND SUBSURFACE CONDITIONS**

### **3.1 SITE LOCATION AND DESCRIPTION**

The sites of the proposed sanitary lift stations are located at 18900 Franklin Street, 3020 Sequoia Parkway (2 locations), 310 Parkwood Street and 1150 Astor Avenue located in the city of Ann Arbor, Washtenaw County, Michigan. The general site location is shown on the Site Vicinity Map in the Appendix as Figure No. 1. At the time of our field exploration, the ground surface consisted predominantly of landscaped lawn area with occasional nearby large-diameter mature trees, adjacent concrete sidewalk, concrete curb and gutter and asphalt pavements. The surrounding area is predominantly residentially developed. The ground surface at the locations of Sequoia Parkway and Parkwood Street is relatively flat and exhibited a total difference in topography across the proposed development area of approximately 1 foot or less, based on visual observations. The ground surface at the locations of Franklin Street and Astor Avenue varied due to changes in slope at the Franklin Street locations and embankment/landscaping fill near Astor Avenue. The ground surface exhibited a total difference in topography across the proposed development area of approximately 1 to 3 feet, based on visual observations in the immediate area.

### **3.2 FIELD AND LABORATORY SERVICES**

The field exploration program consisted of drilling a total of five (5) soil borings. Each of the soil borings were drilled adjacent to the existing wet wells to a depth of approximately 25.5 feet below the existing ground surface. A truck-mounted rotary drill rig was used to perform the soil borings utilizing 3¼-inch diameter continuous flight hollow-stem augers to advance the boreholes. Standard Penetration Tests (SPT) were conducted and soil samples were obtained using split spoon sampling procedures at regular intervals not exceeding five (5) feet. Drilling and sampling techniques were performed in general accordance with ASTM Standard D1586. The SPT drilling and sampling operations were performed between June 11 and June 14, 2019.

Hubbell, Roth & Clark, Inc. selected the number and depth of the borings. PSI selected preliminary boring locations that were approved by Hubbell, Roth & Clark, Inc. and staked their locations in the field. The approximate boring locations are provided on the Boring Location Diagram, Figures No. 2 through No. 4 in the Appendix, which was prepared by PSI using the site plan/Google Earth image provided.

The elevation of the ground surface at the boring locations was estimated by PSI using Google Earth. If more accurate elevations are required prior to final design and construction, an actual field measurement at the boring locations should be made by a professional land surveyor. References to depths in this report and on the attached Boring Logs are from the existing ground surface unless otherwise noted.

Selected soil samples were tested in the laboratory to determine soil properties for PSI's engineering evaluation. Laboratory testing on the soil samples obtained during the field exploration included natural moisture content, partial sieve analysis, Atterberg limits, unit weight, unconfined compression and estimating the unconfined compressive strength of the cohesive soils encountered using a calibrated hand penetrometer. The results of the unconfined compressive strength and sieve analysis tests are included in the Appendix. The moisture content, Atterberg Limits, unit weight, unconfined compressive strength and hand penetrometer test results are indicated on the Boring Logs opposite the depths at which the samples were obtained. The laboratory tests were performed in general accordance with applicable ASTM procedures. The unused portions of the recovered soil samples obtained during PSI's geotechnical exploration will be placed in storage at PSI's Farmington Hills facility. Unless otherwise



requested in writing, the samples will be discarded after two months from the submission of the final report.

### 3.3 SUBSURFACE CONDITIONS

A generalized soil description encountered in the borings, beginning at the bottom of the surficial topsoil and proceeding downward, is as follows:

#### 3.3.1 18900 FRANKLIN STREET (BORING B-1)

**Stratum 1: Fill.** Apparent lift station backfill material consisting predominately of brown, dark brown and orangish brown sandy clay with variable percentages of organics was encountered below the surficial topsoil. The fill extended to a depth of approximately 9.0 feet below the existing ground surface. Standard Penetration Resistance (N) values within the apparent fill layer ranged from 10 to 16 blows per foot. The moisture contents of the tested soil samples from the apparent silty clay backfill soils ranged from 10 to 17 percent. The recovered soil samples visually appeared to be in moist condition when examined in the laboratory.

**Stratum 2: Yellowish Brown Sandy Clay.** A stratum of apparently native mottled yellowish brown and gray sandy clay was encountered below the apparent fill at the boring location. The mottled sandy clay stratum extended to a depth of approximately 11.5 feet below the existing ground surface. A Standard Penetration Resistance (N) value within the mottled sandy clay stratum of 24 blows per foot was reported. The unconfined compressive strength of the mottled sandy clay stratum was greater than 4.5 tsf (tons per square foot), thereby indicating a consistency of hard. The natural moisture content of the tested soil sample from the mottled sandy clay stratum was 12 percent. The recovered soil sample visually appeared to be in moist condition when examined in the laboratory.

**Stratum 3: Gray Sandy Clay.** A stratum of gray sandy clay with variable percentages of silt was encountered below the mottled sandy clay stratum. The gray sandy clay extended through the explored depth of the boring of approximately 25.5 feet below the existing ground surface. Standard Penetration Resistance (N) values within the gray sandy clay stratum ranged from 16 to 37 blows per foot. The unconfined compressive strength of the gray sandy clay stratum ranged from approximately 1.5 to greater than 4.5 tsf, thereby indicating consistencies of stiff to hard. The natural moisture contents of the tested soil samples from the gray sandy clay stratum ranged from 8 to 12 percent. The samples visually appeared to be in moist condition when examined in the laboratory. An Atterberg limit test performed on a representative sample of the gray sandy clay with silt stratum prepared from Borings B-1 indicates the soil to be relatively low in plasticity with a Liquid Limit (LL) of 14 and a Plastic Limit (PL) of 10.

#### 3.3.2 3020 SEQUOIA PARKWAY (BORINGS B-2 AND B-3)

**Stratum 1: Fill.** Apparent lift station backfill material consisting predominately of brown sand was encountered at the location of Boring B-2 extending to a depth of approximately 6.5 feet below the existing ground surface. The sand fill was underlain by mottled brown and dark brown sandy clay fill with trace amounts of organics at the location of Boring B-2 and beginning below the surficial topsoil at the location of Boring B-3. The sand and clay fill extended to depths ranging from approximately 11.5 to 14.0 feet below the existing ground surface. Standard Penetration Resistance (N) values within the apparent fill layer ranged from 3 to 9 blows per foot. The moisture contents of the tested soil samples from the apparent sand and



sandy clay backfill soils ranged from 6 to 19 percent. The recovered soil samples visually appeared to be in moist condition when examined in the laboratory.

**Stratum 2: Brown Silty Sand.** A stratum of brown fine to coarse silty sand was encountered below the mottled sandy clay fill. The brown fine to coarse silty sand stratum extended to a depth of approximately 19.0 feet at the location of Boring B-2 and through the explored depth of Boring B-3 of approximately 25.5 feet below the existing ground surface. Standard Penetration Resistance (N) values within the brown silty sand stratum ranged from 1 to 14 blows per foot, thereby indicating consistencies of very loose to medium dense. The natural moisture contents of the tested soil samples from the brown silty sand stratum ranged from 14 to 19 percent. The samples visually appeared to be in a moist to wet condition when examined in the laboratory.

**Stratum 3: Gray Sandy Clay.** A stratum of gray sandy clay with variable percentages of silt was encountered below the brown sand stratum. The gray sandy clay extended through the explored depth of Boring B-2 of approximately 25.5 feet below the existing ground surface. Standard Penetration Resistance (N) values within the gray sandy clay stratum ranged from 16 to 37 blows per foot. The unconfined compressive strength of the gray sandy clay stratum ranged from approximately 1.1 to 1.5 tsf, thereby indicating a consistency of stiff. The natural moisture contents of the tested soil samples from the gray sandy clay stratum ranged from 11 to 14 percent. The samples visually appeared to be in moist condition when examined in the laboratory.

### 3.3.3 310 PARKWOOD STREET (KINGWOOD STREET - BORING B-4)

**Stratum 1: Fill.** Apparent lift station backfill material consisting predominately of brown clayey sand was encountered below the surficial topsoil. The apparent fill extended to a depth of approximately 3.0 feet below the existing ground surface. A Standard Penetration Resistance (N) value within the apparent fill of 10 blows per foot was reported. The moisture contents of the tested soil samples from the apparent clayey sand backfill soil was 12 percent. The recovered soil sample visually appeared to be in moist condition when examined in the laboratory.

**Stratum 2: Brown Silty Sand.** A stratum of brown fine to coarse silty sand was encountered below the apparent fill layer. The brown silty sand stratum extended through the explored depth of the boring of approximately 25.5 feet below the existing ground surface. Standard Penetration Resistance (N) values within the brown silty sand stratum ranged from 4 to 14 blows per foot, thereby indicating consistencies of loose to medium dense. The natural moisture contents of the tested soil samples from the brown silty sand stratum ranged from 5 to 16 percent. The samples visually appeared to be in a moist to wet condition when examined in the laboratory.

### 3.3.4 1150 ASTOR AVENUE (BORING B-5)

**Stratum 1: Fill.** Apparent lift station backfill material consisting predominately of dark brown, brown and orangish brown sandy clay transitioning into a dark gray silty clay with variable percentages of organics was encountered below the surficial topsoil. The Loss-On-Ignition (LOI) of the tested soil sample of the fill from Boring B-5 was 4.5% (which can be characterized as moderate to high). Standard Penetration Resistance (N) values within the apparent fill layer ranged from 4 to 6 blows per foot. The fill extended to a depth of approximately 9.0 feet below the existing ground surface. The moisture contents of the tested soil samples



from the apparent sandy clay backfill soils ranged from 15 to 21 percent. The recovered soil samples visually appeared to be in moist condition when examined in the laboratory.

**Stratum 2: Gray Sandy Clay.** A stratum of apparently native gray sandy clay was encountered below the apparent fill at the boring location. The gray sandy clay stratum extended to a depth of approximately 11.5 feet below the existing ground surface. A Standard Penetration Resistance (N) value within the gray sandy clay stratum of 5 blows per foot was reported. The unconfined compressive strength of the gray sandy clay stratum was 1.0 tsf (tons per square foot), thereby indicating a consistency of stiff. The natural moisture content of the tested soil sample from the gray sandy clay stratum was 21 percent. The recovered soil sample visually appeared to be in moist condition when examined in the laboratory.

**Stratum 3: Gray Silty Clay.** A stratum of grayish brown to gray silty clay with variable percentages of sand was encountered below the gray sandy clay stratum. The gray silty clay extended through the explored depth of the boring of approximately 25.5 feet below the existing ground surface. Standard Penetration Resistance (N) values within the gray silty clay stratum ranged from 6 to 12 blows per foot. The unconfined compressive strength of the gray silty clay stratum ranged from approximately 1.0 to 2.8 tsf, thereby indicating consistencies of stiff to very stiff. The natural moisture contents of the tested soil samples from the gray silty clay stratum ranged from 20 to 29 percent. The samples visually appeared to be in moist condition when examined in the laboratory. An Atterberg limit test performed on a representative sample of the gray silty clay stratum prepared from Boring B-5 indicates the soil to be moderate in plasticity with a Liquid Limit (LL) of 33 and a Plastic Limit (PL) of 18.

The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The Boring Logs should be reviewed for specific information at the individual boring locations. These records include soil descriptions, stratification, penetration resistance, location of the samples, and laboratory test data. The Boring Logs are presented in the Appendix.

The stratification shown on the Boring Logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials; however, the actual transition may be gradual. Water level information obtained during field operations is also shown on the Boring Logs. The Boring Logs were prepared on the basis of the laboratory testing and supplemental visual engineering classification, as well as the field logs of the soil conditions encountered.

### 3.4 GROUNDWATER INFORMATION

The driller looked for indications of groundwater seepage both during and after the drilling operations. The following table summarizes the encountered ground water or perched water encountered at the soil borings.



Boring Number	Street Name	Approximate Water Level Below Existing Ground Surface While Drilling (ft)	Approximate Water Elevation Below Existing Ground Surface While Drilling (ft)	Approximate Water Level Below Existing Ground Surface Upon Completion (ft)	Approximate Water Elevation Below Existing Ground Surface Upon Completion (ft)
B-1	Franklin Street	Dry	--	Dry	--
B-2	Sequoia Parkway	14.0	917	14.0	917
B-3	Sequoia Parkway	11.5	919.5	11.5	919.5
B-4	Parkwood Street	22.0	899.0	23.0	898.0
B-5	Astor Avenue	11.5	816.5	20.5	807.5

Based on the table above, groundwater or perched water was generally encountered during drilling at depths ranging from approximately 11.5 to 22.0 feet below the existing ground surface at the locations of Borings B-2 through B-5. Boring B-1 was reported as dry during and following completion of the soil boring.

It is possible for a groundwater table to vary within the depths explored during other times of the year depending upon climatic conditions (seasonal fluctuation). Groundwater monitoring wells are required to accurately define the position and fluctuation of the groundwater table, especially if a boring is drilled in cohesive soil, where several days or weeks may be required for the groundwater to reach a static level. The installation of such monitoring wells was not included in the scope of services for this project.

### 3.5 SITE SEISMIC CLASSIFICATION

Washtenaw County, Michigan lies in the Central Stable Tectonic Region and in the Seismic Zone 1 of probable seismic activity of the Building Officials Congress of America (BOCA), National Building Code and the Uniform Building Code (UBC). This zone indicates that minor damages due to occasional earthquakes might be expected in this area. In the 2015 Michigan Building Code (MBC), the State of Michigan has adopted the provisions of the 2012/2015 International Building Code (IBC). The IBC requires a Site Class be established for the calculation of earthquake design forces. This class is a function of soil or rock type as well as the depth of soil, strata types and strength/consistency for the uppermost 100 feet of the subsurface profile. Soil borings at the project site extended to a maximum depth of approximately 25.5 feet below the existing ground surface. Based on regional geologic mapping and past experience in the general project area, PSI anticipates that the subsurface conditions below the explored depth may generally consist of End Moraines of fine textured till (Borings B-1 through B-4) or Glacial outwash sand and gravel and post glacial alluvium (Boring B-5) underlain by the Coldwater Shale bedrock formation at a depth of approximately 100 feet or greater. Based on our review of the available data, knowledge of regional geology, the Standard Penetration Test (SPT) N-values and unconfined compressive strength tests, we recommend that the seismic design for this project be based on **Site Class D** as defined in the 2012/2015 IBC Section 1613.3.2.



### 3.5.1 SITE SEISMIC CLASSIFICATION – FRANKLIN/SEQUOIA/PARKWOOD

The 2012/2015 IBC recommended seismic parameters for the site (which uses 2008 USGS hazard data) interpolated between the nearest four grid points from latitude 42.298630; longitude -83.778861 (Franklin), latitude 42.293158; longitude -83.790201 (Sequoia) and latitude 42.287476; longitude -83.791036 (Parkwood) and **Site Class D** obtained from the USGS geohazards web page (<http://eqdesign.cr.usgs.gov/html/designmaps/us/application.php>), are as follows:

Period (seconds)	2% Probability of Event in 50 years* (%g)	Site Coefficients	Max. Spectral Acceleration Parameters	Design Spectral Acceleration Parameters	
				$S_{D_s}$	$T_0$
0.2 ( $S_s$ )	9.30	$F_a = 1.60$	$S_{m_s} = 0.149$	$S_{D_s} = 0.099$	$T_0 = 0.154$
1.0 ( $S_1$ )	4.80	$F_v = 2.40$	$S_{m_1} = 0.114$	$S_{D_1} = 0.076$	$T_s = 0.768$

$$S_{m_s} = F_a S_s \quad S_{D_s} = 2/3 * S_{m_s} \quad T_0 = 0.2 * S_{D_1} / S_{D_s}$$

$$S_{m_1} = F_v S_1 \quad S_{D_1} = 2/3 * S_{m_1} \quad T_s = S_{D_1} / S_{D_s}$$

The site coefficients  $F_a$  and  $F_v$  were interpolated from the 2012/2015 IBC Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classification and the mapped spectral response acceleration at the short ( $S_s$ ) and 1 second ( $S_1$ ) periods.

Based on the spectral response acceleration coefficients  $S_{D_s}$  and  $S_{D_1}$  above, the Seismic Design Category for this site is **Category B** for occupancy categories I, II and III as prescribed by 2012/2015 IBC Tables 1613.3.5(1) and 1613.3.5(2).

### 3.5.2 SITE SEISMIC CLASSIFICATION – ASTOR

The 2012/2015 IBC recommended seismic parameters for the site (which uses 2008 USGS hazard data) interpolated between the nearest four grid points from latitude 42.256759 and longitude -83.735182 and **Site Class D** obtained from the USGS geohazards web page (<http://eqdesign.cr.usgs.gov/html/designmaps/us/application.php>), are as follows:

Period (seconds)	2% Probability of Event in 50 years* (%g)	Site Coefficients	Max. Spectral Acceleration Parameters	Design Spectral Acceleration Parameters	
				$S_{D_s}$	$T_0$
0.2 ( $S_s$ )	9.50	$F_a = 1.60$	$S_{m_s} = 0.152$	$S_{D_s} = 0.101$	$T_0 = 0.152$
1.0 ( $S_1$ )	4.80	$F_v = 2.40$	$S_{m_1} = 0.115$	$S_{D_1} = 0.077$	$T_s = 0.762$

$$S_{m_s} = F_a S_s \quad S_{D_s} = 2/3 * S_{m_s} \quad T_0 = 0.2 * S_{D_1} / S_{D_s}$$

$$S_{m_1} = F_v S_1 \quad S_{D_1} = 2/3 * S_{m_1} \quad T_s = S_{D_1} / S_{D_s}$$

The site coefficients  $F_a$  and  $F_v$  were interpolated from the 2012/2015 IBC Tables 1613.3.3(1) and 1613.3.3(2) as a function of the site classification and the mapped spectral response acceleration at the short ( $S_s$ ) and 1 second ( $S_1$ ) periods.

Based on the spectral response acceleration coefficients  $S_{D_s}$  and  $S_{D_1}$  above, the Seismic Design Category for this site is **Category B** for occupancy categories I, II and III as prescribed by 2012/2015 IBC Tables 1613.3.5(1) and 1613.3.5(2).



## 4 EVALUATION AND RECOMMENDATIONS

PSI has performed our analysis based on the information developed during this exploration. The resulting recommendations are provided in the following sections. If our estimations or understandings of the project are considered incorrect or if conditions during construction are significantly different from those described in this report, please contact PSI immediately in writing so that we may amend our recommendations presented in this report if appropriate and if desired by the client.

PSI understands the proposed work will include the construction of a new below grade valve chamber located up to 10 feet below the existing ground surface, an above grade generator with slab-on-grade foundation and an above grade control panel with slab-on grade foundation at each site location. PSI further understands that the existing wet well will remain in place. The proposed work will occur to replace ageing equipment currently located at a total of five (5) sites along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan.

Prior to site grading activities or excavation for the valve chambers, any existing underground utilities and structures should be identified and rerouted or properly abandoned in-place. Existing underground utilities that are not rerouted or abandoned should be adequately marked and protected to minimize the potential for damage during construction activities. Depressions resulting from the removal of these items should be backfilled with engineered fill or specified materials, such as lean concrete or grout, to the final design grade.

Dependent on the final location of the proposed valve chamber, fill may be encountered at variable depths and locations of the project sites. PSI has evaluated the locations based on soil boring completed in the vicinity of the proposed equipment. Variability in type of fill, compaction and depth may vary based on the final location of the proposed equipment installation.

### 4.1 OPEN EXCAVATION SUPPORT RECOMMENDATIONS

#### 4.1.1 FRANKLIN STREET (BORING B-1)

PSI anticipates that the native very stiff to hard mottled to gray sandy clay soils may stand relatively vertical and stable without support for a moderate period of time. However, difficulty with side-slope instability including soil sloughing may occur during excavations for the proposed valve chamber within the encountered fill at depths of up to 9.0 feet (depending on the materials used and degree of compaction). Apparent fill from the initial construction of the lift station consisting predominately of brown, dark brown and orangish brown sandy clay with variable percentages of organics was encountered below the surficial topsoil. The fill extended to a depth of approximately 9.0 feet below the existing ground surface. The sandy clay backfill materials appear to have been placed with some degree of compaction. However, neither compaction tests results or fill placement observation reports were provided to PSI for review. Based on the soil borings performed, PSI anticipates that excavations for the proposed valve chamber may be relatively stable for a short period of time; however, the moisture condition, compaction and associated stability of the cohesive backfill materials are likely to be extremely variable. Difficulty with soil sloughing and excavation instability may be encountered.

Where adequate space is available, the proposed valve chamber excavation may be sloped to achieve a stable condition. The angle of the excavation side slopes should be decided based on the soil type and unconfined compressive strength of the excavated soil per OSHA requirements as outlined later in Section 5.2 of this report.



Where adequate space is not available, the proposed manhole excavations may be performed as a vertical cut with properly designed and installed bracing or driven interlocking sheet piling.

The following average short-term soil parameters may be used as an aid in the design of temporary excavation retaining structures at this site, based on the borings performed. The soil parameters used in the sheeting or bracing design should be adjusted as necessary based on the actual soil profile encountered at the specific location of the valve chamber structure being excavated/constructed:

Estimated Average Short-Term Soil Parameters				
Stratum	Typical Depth Range (ft)	Total/ Submerged Unit Weight, pcf	Angle of Internal Friction (degrees)	Un-drained Shear Strength, c (psf)
Sandy Clay Backfill	0 – 9	125/63	0	1,500
Native Hard Mottled to Gray Sandy Clay	9 – 14.0	140/78	0	4,500
Native Very Stiff to Hard Gray Sandy Clay	14.0 – 25.5	130/68	0	2,000

The above estimated strength parameters represent ultimate values. Appropriate factors of safety should be used for design. Submerged unit weights should be used below the groundwater level. For design purposes, PSI recommends a groundwater depth of approximately 11.5 feet (Approximate Elevation 929 feet) or less be used in the design of the earth retention system.

#### 4.1.2 SEQUOIA PARKWAY (BORING'S B-2 AND B-3)

Difficulty with side-slope instability including soil sloughing may occur during excavations for the proposed valve chamber within the encountered fill at depths ranging from 11.5 to 14 feet (depending on the materials used and degree of compaction). Apparent fill from the initial construction of the lift station consisting predominately of brown sand was encountered at the location of Boring B-2 extending to a depth of approximately 6.5 feet below the existing ground surface. The sand fill was underlain by mottled brown and dark brown sandy clay fill with trace amounts of organics at the location of Boring B-2 and beginning below the surficial topsoil at the location of Boring B-3. The sand and clay fill extended to depths ranging from approximately 11.5 to 14.0 feet below the existing ground surface. The sand and sandy clay backfill materials appear to have been placed with some degree of compaction. However, neither compaction tests results or fill placement observation reports were provided to PSI for review.

Based on the soil borings performed, PSI anticipates that excavations for the proposed valve chamber may be relatively stable for a short period of time within the sandy clay fill; however, the moisture condition, compaction and associated stability of the cohesive backfill materials are likely to be extremely variable. Significant difficulty with soil sloughing and excavation instability may be encountered within the encountered fill sand.

Where adequate space is available, the proposed valve chamber excavation may be sloped to achieve a stable condition. The angle of the excavation side slopes should be decided based on the soil type and unconfined compressive strength of the excavated soil per OSHA requirements as outlined later in Section 5.2 of this report. Where adequate space is not available, the proposed manhole excavations may be performed as a vertical cut with properly designed and installed bracing or driven interlocking sheet piling.



The following average short-term soil parameters may be used as an aid in the design of temporary excavation retaining structures at this site, based on the borings performed. The soil parameters used in the sheeting or bracing design should be adjusted as necessary based on the actual soil profile encountered at the specific location of the valve chamber structure being excavated/constructed:

Estimated Average Short-Term Soil Parameters				
Stratum	Typical Depth Range (ft)	Total/ Submerged Unit Weight, pcf	Angle of Internal Friction (degrees)	Un-drained Shear Strength, c (psf)
Sandy Clay Backfill	0 – 14	125/63	0	1,500
Sand Fill (B-2)	0 – 6.5	115/53	30	--
Native Very Loose to Medium Dense Brown Fine to Coarse Silty Sand	14 – 25.5	120/58	28	0
Native Stiff Gray Sandy Clay (B-2)	19.0 – 25.5	125/63	0	1,500

The above estimated strength parameters represent ultimate values. Appropriate factors of safety should be used for design. Submerged unit weights should be used below the groundwater level. For design purposes, PSI recommends a groundwater depth of approximately 11.5 feet (Approximate Elevation 919.5 feet) or less be used in the design of the earth retention system.

#### 4.1.3 PARKWOOD STREET (BORING B-4)

Difficulty with side-slope instability including soil sloughing may occur during excavations for the proposed valve chamber. While limited fill was encountered at the boring location, Standard Penetration Resistance (N) values within the apparently native brown silty sand stratum ranged from 4 to 14 blows per foot, thereby indicating consistencies of loose to medium dense. Therefore, significant difficulty with soil sloughing and excavation instability may be encountered within the encountered silty sand.

Where adequate space is available, the proposed valve chamber excavation may be sloped to achieve a stable condition. The angle of the excavation side slopes should be decided based on the soil type and unconfined compressive strength of the excavated soil per OSHA requirements as outlined later in Section 5.2 of this report. Where adequate space is not available, the proposed manhole excavations may be performed as a vertical cut with properly designed and installed bracing or driven interlocking sheet piling.

The following average short-term soil parameters may be used as an aid in the design of temporary excavation retaining structures at this site, based on the borings performed. The soil parameters used in the sheeting or bracing design should be adjusted as necessary based on the actual soil profile encountered at the specific location of the valve chamber structure being excavated/constructed:



Estimated Average Short-Term Soil Parameters				
Stratum	Typical Depth Range (ft)	Total/ Submerged Unit Weight, pcf	Angle of Internal Friction (degrees)	Un-drained Shear Strength, c (psf)
Clayey Sand Backfill	0 – 3.0	120/58	28	--
Native Loose to Medium Dense Brown Fine to Coarse Silty Sand	3.0 – 25.5	120/58	30	0

The above estimated strength parameters represent ultimate values. Appropriate factors of safety should be used for design. Submerged unit weights should be used below the groundwater level. For design purposes, PSI recommends a groundwater depth of approximately 22.0 feet (Approximate Elevation 899.0 feet) or less be used in the design of the earth retention system.

#### 4.1.4 ASTOR AVENUE (BORING B-5)

PSI anticipates that the native stiff to very stiff gray sandy clay soils may stand relatively vertical and stable without support for a moderate period of time. However, difficulty with side-slope instability including soil sloughing may occur during excavations for the proposed valve chamber within the encountered fill at depths of up to 9.0 feet (depending on the materials used and degree of compaction). Apparent fill from the initial construction of the lift station consisting predominately of mottled dark brown, brown and orangish brown sandy clay with variable percentages of organics was encountered below the surficial topsoil. The fill extended to a depth of approximately 9.0 feet below the existing ground surface. The sandy clay backfill materials appear to have been placed with some degree of compaction. However, neither compaction tests results or fill placement observation reports were provided to PSI for review. Based on the soil borings performed, PSI anticipates that excavations for the proposed valve chamber may be relatively stable for a short period of time; however, the moisture condition, compaction and associated stability of the cohesive backfill materials are likely to be extremely variable. Difficulty with soil sloughing and excavation instability may be encountered.

Where adequate space is available, the proposed valve chamber excavation may be sloped to achieve a stable condition. The angle of the excavation side slopes should be decided based on the soil type and unconfined compressive strength of the excavated soil per OSHA requirements as outlined later in Section 5.2 of this report. Where adequate space is not available, the proposed manhole excavations may be performed as a vertical cut with properly designed and installed bracing or driven interlocking sheet piling.

The following average short-term soil parameters may be used as an aid in the design of temporary excavation retaining structures at this site, based on the borings performed. The soil parameters used in the sheeting or bracing design should be adjusted as necessary based on the actual soil profile encountered at the specific location of the valve chamber structure being excavated/constructed:



Estimated Average Short-Term Soil Parameters				
Stratum	Typical Depth Range (ft)	Total/ Submerged Unit Weight, pcf	Angle of Internal Friction (degrees)	Un-drained Shear Strength, c (psf)
Sandy Clay Backfill	0 – 9.0	125/63	0	1,500
Native Stiff Gray Sandy/Silty Clay	9.0 – 25.5	130/68	0	1,000

The above estimated strength parameters represent ultimate values. Appropriate factors of safety should be used for design. Submerged unit weights should be used below the groundwater level. For design purposes, PSI recommends a groundwater depth of approximately 11.5 feet (Approximate Elevation 816.5 feet) or less be used in the design of the earth retention system.

#### 4.2 GENERAL EXCAVATION SUPPORT RECOMMENDATIONS

The sloped bank excavation, shoring or sheeting design should include surcharge loads from adjacent structures, heavy construction equipment operating immediately adjacent to the manhole excavation or other surface loads in or adjacent to the proposed manholes such as excavated soil piles or imported backfill material stock piles. To minimize surcharge loads at the top of the excavation, the excavated materials from the proposed manholes should be stockpiled away from the edge of the excavation, a distance at least equal to the depth of the excavation. If sufficient space is not available within the construction easement to stockpile the excavated soil at a safe distance from the edge of the excavation, it will be necessary to provide adequately designed sheeting or shoring to support the surcharge loads. Alternately, the excavated soils should be temporarily removed from the site during placement of the manholes until such time as the excavations are ready to be backfilled.

Although not encountered at the boring location performed, it would also not be unusually for cobbles and boulders to be present throughout the existing soil profile given the geologic depositional environment of the project area. Excavation of very dense/hard soils, cobbles, boulders and other obstructions may be difficult if proper equipment is not used. The earthwork contractor should verify these conditions prior to the start of excavation. If cobbles, boulders, buried utilities or structures are revealed during excavation of the proposed manholes, the Contractor should be prepared to break up, remove or relocate the obstructions at no additional cost to the owner. In addition, the temporary earth system chosen should be appropriate for the soil conditions encountered (i.e. driven or vibrated sheeting may not be appropriate where heavy cobbles and boulders or heavily over-consolidated glacial till soils may be present).

Where a driven or vibrated sheeting or shoring system is proposed, PSI recommends that the Contractor evaluate the potential effect of vibrations associated with the installation of the earth retention elements on existing building structures, pavements and critical below-grade utilities nearby the valve chambers. Where significant construction vibrations and risk to existing structures and utilities are present, PSI recommends that the Contractor develop a vibration control and monitoring plan for the Owner or Owner’s representative review prior to installation of the proposed earth retention system.

The attached soil borings should be reviewed by the Contractor's "responsible person" or Engineer as defined in 29 CFR Part 1926 when designing the sheeting, shoring and bracing system. The soil parameters and depth ranges used in the sheeting or bracing design should be adjusted as necessary based on the actual soil profile encountered or



anticipated to be encountered at the specific location of the manhole being excavated/constructed. PSI recommends that the Contractor's proposed earth retention system design be reviewed by the Owner or Owner's representative prior to commencement of excavation and installation of the earth retention system.

### 4.3 SITE DEWATERING RECOMMENDATIONS

Groundwater or perched water was generally encountered during drilling at depths ranging from approximately 11.5 to 22.0 feet below the existing ground surface at the locations of Borings B-2 through B-5. Boring B-1 was reported as dry during and following completion of the soil boring. The change in color of the soil from brown to gray may indicate the long-term minimum piezometric level in the area. Based on the subsurface conditions at the location of Boring B-1, the long term piezometric level at this site may be located at a depth of approximately 11.5 feet below the existing ground surface. **Earthwork and construction operations taking place within a distance of approximately 2 to 3 feet or so of the prevailing groundwater can cause groundwater to be 'wicked' upward, resulting in subgrade instability.** Therefore, while PSI does not expect significant water infiltration during the construction of the proposed valve chamber and slab-on grade foundation elements, it is possible that some dewatering or additional stabilization measures may be required depending on the final foundation invert elevation.

PSI estimates that the mottled to sandy clay soils may have a soil hydraulic conductivity of approximately  $1.0 \times 10^{-6}$  to  $1.0 \times 10^{-8}$  cm/sec. PSI estimates that the underlying fine silty sand soils may have a soil hydraulic conductivity of approximately  $1.0 \times 10^{-3}$  to  $1.0 \times 10^{-5}$  cm/sec. The dewatering system must be designed to avoid ground loss due to flow of silty or fine sandy soil with water. If pumping methods are used, note that silt/silty fine sands are difficult to de-water. Interfaces between more permeable soil strata underlain by less permeable strata are especially difficult to de-water and can promote difficult construction situations when they are exposed to sudden flows or runs caused by concentrated seepage on the interface. Concentrated seepage along the interface could lead to piping, erosion and catastrophic ground loss. If a well point system is installed, PSI recommends that adjacent building structures, roadways and utilities be monitored for settlement due to the ground water table draw down during the de-watering process. Nearby surface water features or ponds and subsurface wells should also be monitored for the effects of the ground water table draw down.

The effectiveness of deep well points may be limited by the clayey nature of the surface subsurface soils encountered at the soil boring locations performed. An alternative procedure of de-watering for this site would be to remove the groundwater from the excavations through shallow large diameter casing wells or sump pits placed between the bottom edge of the open-cut excavation or earth retention system and the existing sanitary sewer. Installation of inter-locking sheet piling or trench boxes may also be considered to aid in the control of groundwater seepage water into the excavation. The technique of de-watering from the bottom of open cut excavations with shallow large diameter casing wells or sump pits should be used with caution where loose fine sand and silt strata are present at or near the bottom elevation of the proposed excavations. The loose fine sand and silt strata are highly sensitive to disturbance, especially when wet. These soils may become "quick" or boil when the confining effects of the overburden or surcharge is removed during excavation. Considerable difficulty with excavation and subgrade stability should be anticipated where the contractor attempts to excavate these soils without de-watering prior to the commencement of excavation.

Please note, water infiltration may occur if saturated utility trenches or interbedded seams of silt/sand are encountered within the existing fill. PSI recommends that the Contractor verify the actual groundwater and seepage conditions at the time of the construction activities and propose site-specific groundwater control methods for the



Engineer's approval, including the disposal of discharge water. The de-watering system, including the type, size, depth and spacing of de-watering wells, if used, should be properly designed by an experienced local de-watering contractor utilizing the soil borings performed along the existing sanitary sewer alignment as well as the available public well information and records in the vicinity of the proposed project and independent test pit excavations performed by the Contractor.

#### 4.4 VALVE CHAMBER SUPPORT AND BACKFILL RECOMMENDATIONS

Details regarding the specific design of the proposed valve chamber were not available at the time of this report. However, PSI anticipates that the proposed valve chamber may bear on native soils at similar elevations of the existing wet well at each location. Based on the boring logs and estimated fill depth, elevations greater than 10 feet may be required to match the existing wet wells.

Based on the borings performed, PSI anticipates that the support soils at and below the bottom elevation of the proposed valve chambers may consist predominately of native hard to stiff mottled sandy clays at the locations of Borings B-1 and B-5 and very loose to loose brown silty sands at the locations of Borings B-2, B-3 and B-4. PSI estimates that a net allowable bearing pressure to support the valve chambers at an estimated 10 to 15 feet bearing in native is as follows;

- 18900 Franklin Street – **4,000 psf** (Hard Sandy Clays)
- 3020 Sequoia Parkway (2 locations) – **1,500 psf** (Very Loose to Loose Silty Sand)
- 310 Parkwood Street (Located off Kingwood Street) – **1,500 psf** (Very Loose Silty Sand)
- 1150 Astor Avenue – **2,500 psf** (Stiff Sandy Clay)

When net contact pressures at the structure bottom elevation is considered as a result of the removal of approximately 10 feet of existing overburden soils and an estimated 10-foot diameter footprint for the proposed valve chamber, little to no increase in soil pressure will likely result. Therefore, PSI anticipates that the valve chambers should have an adequate factor of safety against bearing capacity failure. Based on assumed combined dead and live loads of less than 90 to 100 kips, settlement should be negligible and limited to the effects of construction disturbance. **However, due to the very loose to loose silty sands encountered, PSI highly recommends the contractor properly compact the existing native soils below the proposed lift station until no further densification is observed and under PSI supervision.** In addition, compaction of the very loose to loose sands may be dependent on soil conditions at the time of construction. Due to a high-water table encountered at the Sequoia Parkway lift stations, it may be necessary to stabilize the subgrade soils by undercutting a minimum depth of 12 to 18 inches and place a heavy-duty geotextile separation fabric and backfill with engineered fill consisting of MDOT 6A coarse aggregate.

The soil borings indicate the ground water level at the time the work was performed to be approximately 11.5 feet below the existing ground surface at the locations of the proposed valve structure at the locations of Borings B-1 through B-5. In addition, PSI understands the proposed valve structures may be installed at depths of up to 10 feet. Therefore, the structure bottom is not anticipated to be subjected to significant uplift force. Should the valve structure extend below the existing ground water table, the structure would be subjected to uplift force equal to 62.4 pounds per square foot for each foot. Uplift forces will be at the maximum during construction when the structure is empty. The mass of the structure and foundation concrete, including the weight of the soil above the exterior perimeter "lip" if provided, may resist the uplift forces. Alternatively, uplift forces may be resisted or eliminated through pressure relief valves and the installation of tension piers below the manhole's base slab.



The gray sandy clay and brown silty sand soils anticipated to be encountered at the bearing elevation of the valve chambers are sensitive to disturbance, especially when wet. Therefore, difficulty in achieving a stable bearing surface may be experienced within these soils depending on the groundwater conditions at the time of construction and the dewatering effort implemented.

Based on the information provided to PSI, the proposed valve structure appears to be located above the estimated groundwater elevation of 11.5 feet at the boring locations. However, if the structure does extend down below 10 feet and bear on the silty sand encountered at the locations of Borings B-2, B-3 and B-4, considerable difficulty with excavation and bearing surface stability should be anticipated where the Contractor attempts to excavate the saturated granular soils without de-watering prior to the commencement of excavation for the proposed valve structure. PSI anticipates that it may be necessary to place a heavy-duty geotextile separation fabric and a layer of coarse aggregate, crushed stone or crushed concrete in the bottom of the manhole excavations to provide a stable working platform.

Sufficient space between the valve chamber and excavation side walls should be maintained at all times to provide free working space on each side of the structure to make it possible to place and thoroughly compact backfill around the valve chamber. The width of the excavation should also be sufficient to permit the placing of trench supports, sheeting and bracing as necessary. Following excavating to the proposed lift station invert elevation, the exposed subgrade should be thoroughly inspected. The valve chamber base surface should be prepared to provide adequate support of the structure and to preclude settlement of the structure and adjacent sanitary sewer and consequent rupture thereof.

Localized areas of loose, soft, saturated or otherwise unstable soils that are exposed at the bottom of the manhole excavations should be undercut a minimum depth of 12 to 18 inches and replaced with engineered fill consisting of MDOT 6A coarse aggregate, crushed stone or crushed concrete prior to placement of the base materials below the proposed structure. The exact undercut depth should be determined at the time of construction. Depending on the groundwater conditions and stability of the subgrade soils at the time of construction, it may be necessary to place a woven geotextile separation fabric conforming to Section 910.03 D of the *"2012 MDOT Standard Specifications for Construction"* in the bottom of the undercut excavation prior to placement of the coarse stabilization aggregate.

PSI recommends that excavations be backfilled as soon as practical after the valve structures have been properly installed. The engineered backfill soils should comply with the project specifications and should meet the requirements of the design engineer. In general, backfill material should be mechanically tamped and compacted to achieve stability and to avoid undesirable settlement. Backfill materials should be placed in maximum lifts of 8 inches of loose material and should be compacted to the required density specifications within the range of  $\pm 3\%$  of the optimum moisture content value as determined by ASTM D1557. The moisture/density relationship (Proctor) of the material to be used as backfill should be evaluated by PSI's engineer prior to placement in the field. Each lift of compacted-engineered fill should be tested by a PSI representative prior to placement of subsequent lifts. Considering the confined space between the manhole structures and excavation sidewalls using hand-operated pneumatic tampers or plate compactors will likely be required.

#### **4.5 SLAB-ON-GRADE RECOMMENDATIONS**

PSI understands the improvements for the existing sanitary sewer lift station may include installation of new generators and control panels to be supported by slab-on-grad construction. PSI was not provided information



on the existing foundation systems. Based on visual observations, PSI assumes the existing generator foundations are constructed using slab-on-grade construction and the existing control panels appear to be supported by pipe piles driven into the soil to support the above ground control boxes.

As outlined previously, old fill consisting predominately of brown to dark brown to brown sandy clays and silty sand was encountered at the locations of Borings B-1 through B-5. The apparent fill ranged in depth from 3.0 to 14.0 feet below the existing ground surface and is likely due to original construction of the lift stations. Standard Penetration Resistance (N) values within the apparent fill ranged from 5 to 16 blows per foot at the locations of Borings B-1 through B-6. Uncontrolled fills (defined as fill material that consist of organics and other deleterious materials or soil materials that have not been placed in a manner to produce consistent density, uniform moisture content and consistent engineering properties) may experience significant volume changes, resulting in excessive foundation settlement and poor slab performance including faulting and cracking, when subjected to loads over them. Due to the variability of the fill soil materials, presence of deleterious materials and variability of the N-values, the engineering characteristics of the fill soils, including bearing capacity and settlement potential, are likely to be extremely variable.

After site stripping and excavating as necessary, the exposed soils should be thoroughly proof rolled/compacted with a large, heavy rubber-tired vehicle prior to the placement of engineered fill or backfill required to achieve the proposed subgrade elevation. Areas that exhibit instability or are observed to rut or deflect excessively under the moving load should be further undercut, stabilized by aeration, drying (if wet) and additional compaction to attain a stable finished subgrade. The proof rolling/compacting and undercutting activities should be performed during a period of dry weather and should be performed under the supervision of the geotechnical engineer's representative.

Where subgrade conditions are not improved through aeration, drying and compaction, or where undercut and replacement is considered impractical due to the underlying soil and groundwater conditions, it may be necessary to stabilize localized areas of subgrade instability with a woven geotextile, geogrid and a layer of well graded crushed concrete or well graded coarse aggregate such as MDOT 4AA or 6A or 21AA dense-graded aggregate. The need for the use of geotextile and the thickness and gradation requirements of the crushed aggregate layer required should be determined at the time of the subgrade preparation, based on the condition of the exposed subgrade at the time of construction. The subgrade should be stabilized prior to placement of engineered fill or aggregate base course. Engineered fill or backfill required to achieve the proposed subgrade elevation should be placed and properly compacted as outlined below under the full-time observation of PSI.

New fill supporting at-grade structures should be an environmentally clean material, free of organic matter, frozen soil, or other deleterious material. The material proposed to be used as engineered fill should be evaluated and approved for use by a PSI geotechnical engineer or his representative prior to placement in the field. Fill materials should be placed in maximum horizontal lifts of 8 inches of loose material and should be compacted within the range of  $\pm 2\%$  of the optimum moisture content value. Moisture contents should be adjusted to the proper levels prior to placement and compaction. Adequate compaction will not be achieved if the fill is in a saturated condition. Wet soils may require drying or mixing with dry soil to facilitate compaction. If water must be added to dry soil, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying prior to compaction.

The structural fill should be compacted to 95% of the Modified Proctor maximum dry density as determined by ASTM D1557. Each lift of engineered fill should be tested for conformance to the project density requirements by a representative of PSI prior to placement of subsequent lifts. A minimum of one test should be performed



for each lift, unless otherwise specified by the engineer. The moisture/density relationship (proctor) of the material to be used as engineered fill should be evaluated by a PSI geotechnical engineer or his representative prior to placement in the field. PSI recommends one proctor test for every 5,000 cubic yards (cyds) of fill and one test per each change in fill material.

Loading conditions for the proposed control panel and generator were not available at the time of this report. However, PSI anticipates the loading conditions for the proposed control panel will be relatively light and light to moderate for the proposed generator. PSI estimates the existing slab-on-grade may be approximately 3 to 4 feet wide by approximately 7 to 8 feet long.

PSI recommends the proposed new generator pad be located at the same position as the previous/old generator to reduce the potential for detrimental settlement to occur. Loads exerted by the old generator will have consolidated loose or soft soils and significantly reduce the risk of poor slab-on-grade performance. If this is not possible, PSI recommends visual inspection by PSI's geotechnical representative at the time of construction verify suitable soils are present at the time of construction. PSI only completed one soil boring at each of the site locations. It is possible that the proposed generator and control panel locations may be free of fill and deleterious materials or that differing soil conditions may occur. If fill is encountered, PSI recommends undercutting a minimum depth of 12 to 18 inches and replaced with properly placed and compacted engineered fill consisting of MDOT 21AA. The exact undercut depth should be determined at the time of construction and dependent on the soils encountered.

Based on the presence of fill soils, PSI recommends the foundation be sized for a **net allowable bearing pressure of up to 1,000 pounds per square foot (psf) bearing on newly placed and properly compacted engineered fill over the encountered fill as outlined above or on native sandy clay or native silty sands.**

In addition, PSI recommends that the vertical subgrade modulus,  $k$  be limited to 100 pounds per cubic inch, as determined by a 1-foot by 1-foot plate load test, in slab-on-grade design calculations. PSI recommends that a minimum of 6 inches of free-draining, compacted aggregate be placed beneath the floor slab-on-grade to facilitate fine grading and provide increased support for the slab-on-grade.

Settlement of the cohesive soils beneath the proposed floor slab has been analyzed using the Terzaghi equation and the Boussinesq stress distribution for footing areas for the anticipated loading conditions discussed above and empirical correlations between the soil moisture content, Atterberg limit tests and estimated consolidation settlement properties. PSI estimates that total settlement of the native soils and properly compacted engineered fill may be on the order of 1 inch or less due to loads exerted by the proposed generator and control panel foundations.



## 5 CONSTRUCTION CONSIDERATIONS

### 5.1 DRAINAGE, GROUNDWATER AND RELATED CONSIDERATION

Difficulty with groundwater seepage may be anticipated during excavation and construction of the proposed deep structures. It is possible for a groundwater table to vary within the depths explored during other times of the year depending upon climatic conditions (seasonal fluctuation). PSI recommends that the Contractor verify the actual groundwater and seepage conditions at the time of the construction activities and propose a groundwater control method for the Engineer's approval, including the disposal of discharge water.

Water should not be allowed to collect in the lift station excavations or over other prepared subgrades of the construction area, either during or after construction. Water accumulation should be removed from excavations by pumping from sump pits placed around the perimeter of the excavation.

Every effort should be made to keep the excavations and any other prepared subgrades dry if water is encountered or if rainfall or snowmelt occurs during construction. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and manhole construction activities during dry weather. Positive site surface drainage should be provided to reduce infiltration of surface water. The grades should be sloped away from the valve chambers and surface drainage should be collected and discharged.

### 5.2 EXCAVATION SAFETY CONSIDERATIONS

Typically, soils penetrated by augers can be removed with conventional earthmoving equipment (backhoe and/or trencher). However, subsurface excavation equipment varies, and field refusal conditions may vary as well. Therefore, it is possible that difficult excavation conditions may be encountered at the proposed site location between the boring locations.

Excavation near any existing structure or utility must be performed with the utmost of care and under the supervision of the geotechnical engineer's representative. Locations of all underground utilities within the proposed site must be verified by the Contractor prior to excavation.

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the Owner and the Contractor could be liable for substantial penalties.

The Contractor is solely responsible for designing and constructing stable, safe, temporary excavations and should shore, slope or bench the sides of the excavations as required to maintain stability of both the excavation sides and



bottom. The Contractor's "responsible person", as defined in 29 CFR Part 1926, must evaluate the soil exposed in the excavations as part of the Contractor's safety procedures.

The angle of the excavation side slopes must strictly be decided based on the soil type and unconfined compressive strength of the excavated soil per OSHA requirements. For Type A soils, such as clay above water table having unconfined compressive strength values equal to or more than 1½ ton per square foot (tsf), the maximum allowable slope for excavations up to 20 feet deep is ¾ (Horizontal) :1 (Vertical). For Type B soils, such as clay above water table having unconfined compressive strength values between ½ to 1½ ton per square foot (tsf), or angular gravel, the maximum allowable slope for excavations up to 20 feet deep is 1 (Horizontal) :1 (Vertical). For Type C soils, such as clay above water table having unconfined compressive strength values less than ½ ton per square foot (tsf), or granular soils such as gravel and sand, and all submerged soils, the maximum allowable slope for excavations up to 20 feet deep is 1½ (Horizontal) :1 (Vertical). The Contractor should be aware that slope height, slope inclination, and excavation depth should not exceed the specified local, state, and federal regulations.

Earthwork, subgrade preparation, and foundation construction operations must be conducted in strict accordance with the project specifications and under the supervision of the geotechnical engineer or his representative. PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulation



## 6 REPORT LIMITATIONS

The recommendations submitted in this report are based on the available subsurface information obtained by PSI and the project information furnished by Hubbell, Roth & Clark, Inc. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the earthwork, subgrade preparation and foundation design parameter recommendations are required. If PSI is not notified of such changes, PSI will not be responsible for the impact of those changes on the project.

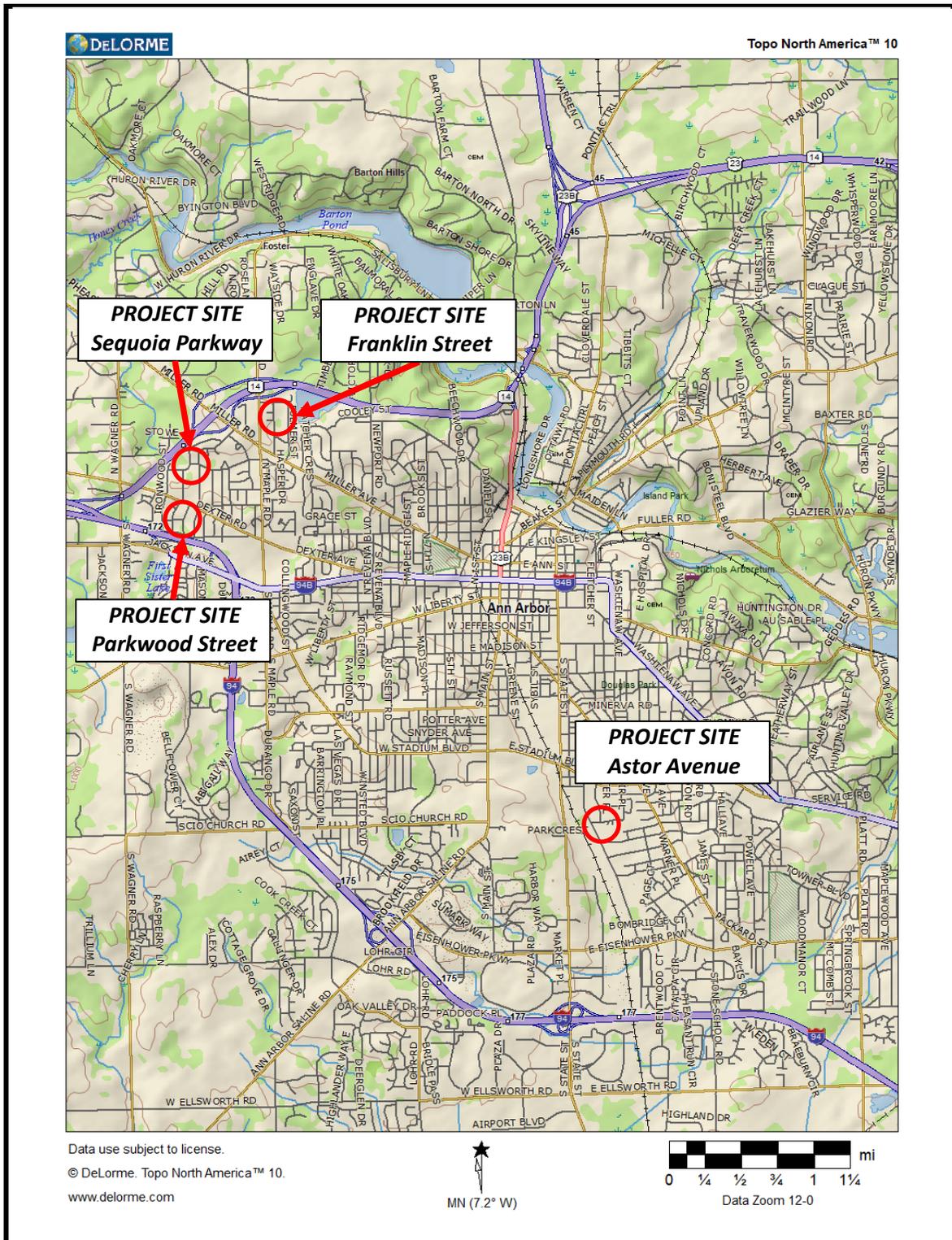
The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional engineering practices in the local area. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of Hubbell, Roth & Clark, Inc. and their authorized representatives. This report is intended for the specific application to the proposed Ann Arbor lift stations to be constructed along Franklin Street, Sequoia Parkway (2 locations), Parkwood Street and Astor Avenue in the city of Ann Arbor, Washtenaw County, Michigan.



## APPENDIX

# SITE LOCATION MAP



**PROJECT NAME:**  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

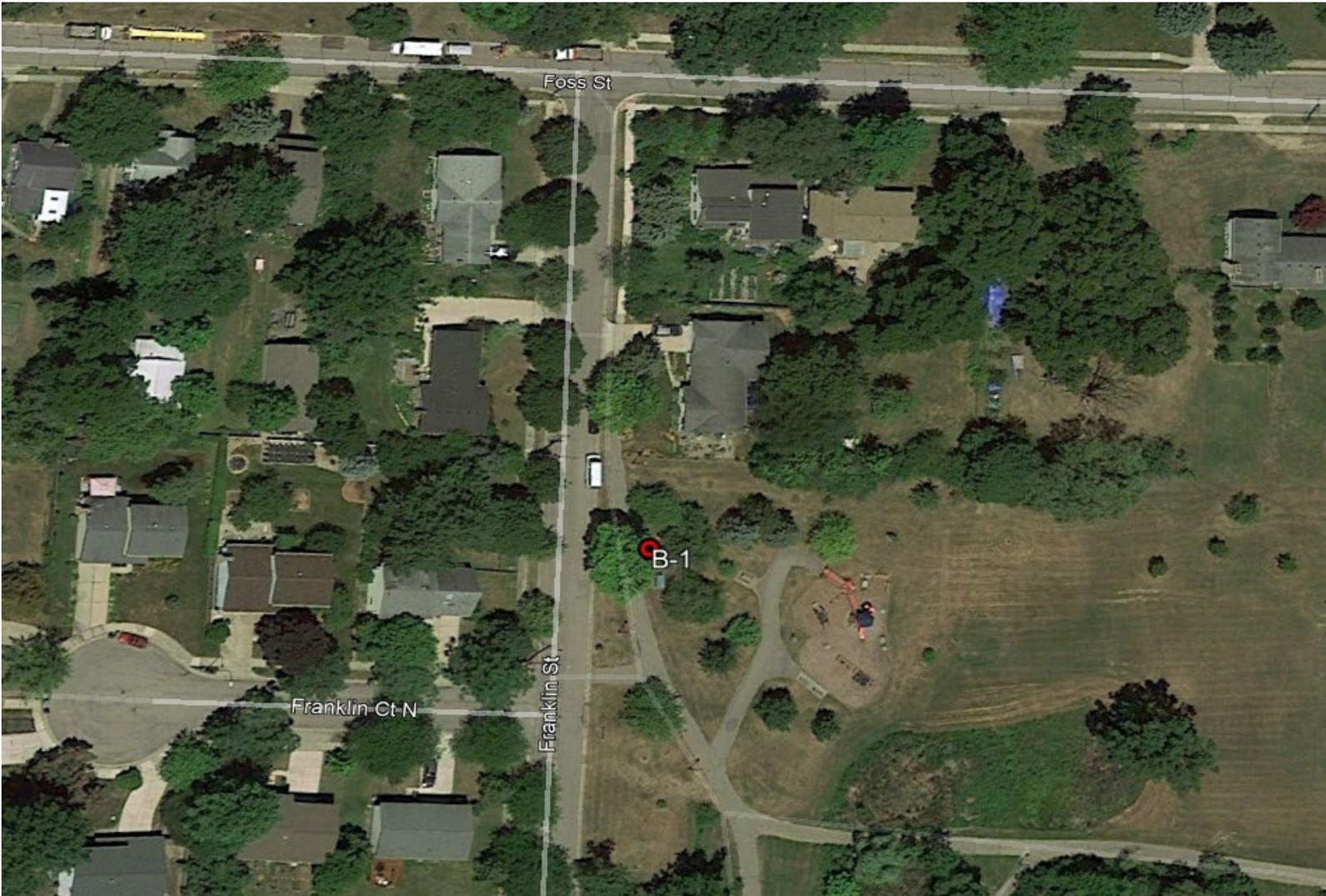
**PROJECT NUMBER**  
03811131

Date: July 5, 2019

**Figure No.**  
1



# BORING LOCATION PLAN



## LEGEND:

 - APPROXIMATE BORING LOCATION

PROJECT NAME:  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

Produced by PSI from a Google Earth Image of the Site

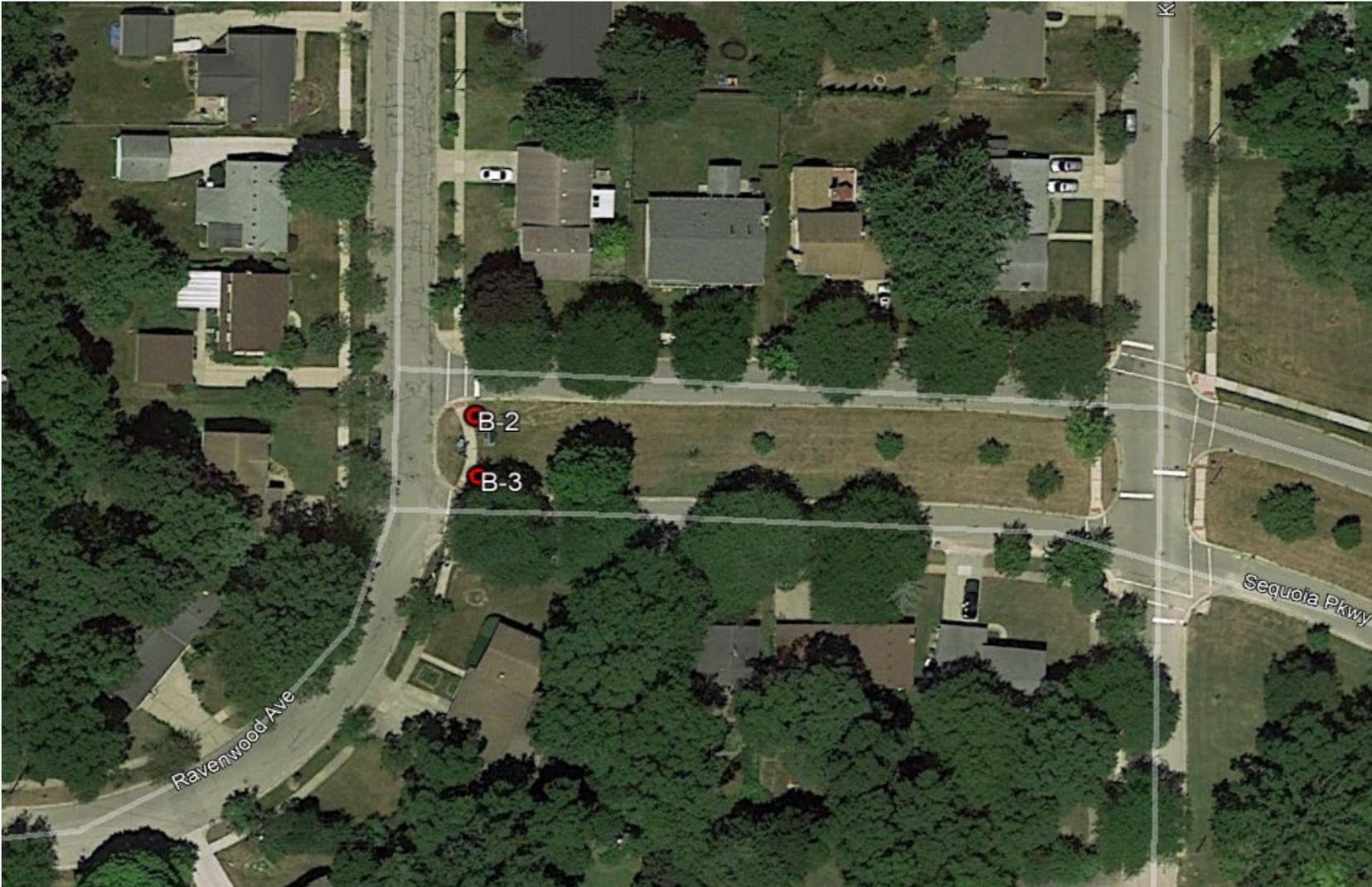
PROJECT NUMBER  
03811131

Date: July 5, 2019

Figure No.  
2



# BORING LOCATION PLAN



## LEGEND:

 - APPROXIMATE BORING LOCATION

PROJECT NAME:  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

Produced by PSI from a Google Earth Image of the Site

PROJECT NUMBER  
03811131

Date: July 5, 2019

Figure No.  
3



# BORING LOCATION PLAN



## LEGEND:

 - APPROXIMATE BORING LOCATION

PROJECT NAME:  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

Produced by PSI from a Google Earth Image of the Site

PROJECT NUMBER  
03811131

Date: July 5, 2019

Figure No.  
4



# BORING LOCATION PLAN



## LEGEND:

 - APPROXIMATE BORING LOCATION

PROJECT NAME:  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

Produced by PSI from a Google Earth Image of the Site

PROJECT NUMBER  
03811131

Date: July 5, 2019

Figure No.  
5



## Site Pavement Photographs



Photo No. 1 - Facing Northeast Towards Boring B-1



Photo No. 2 - Facing Southeast Towards Boring's B-2 and B-3

**PROJECT NAME:**  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

SITE PHOTOGRAPHS

**PROJECT NUMBER**  
03811131

Date: July 5, 2019

**Sheet**  
1

intertek  
**psi**

## Site Pavement Photographs



Photo No. 3 - Facing Northeast Towards Boring B-4



Photo No. 4 - Facing Northeast Towards Boring B-5

**PROJECT NAME:**  
Ann Arbor Lift Stations  
City of Ann Arbor  
Washtenaw County, Michigan

SITE PHOTOGRAPHS

**PROJECT NUMBER**  
03811131

Date: July 5, 2019

Sheet  
2

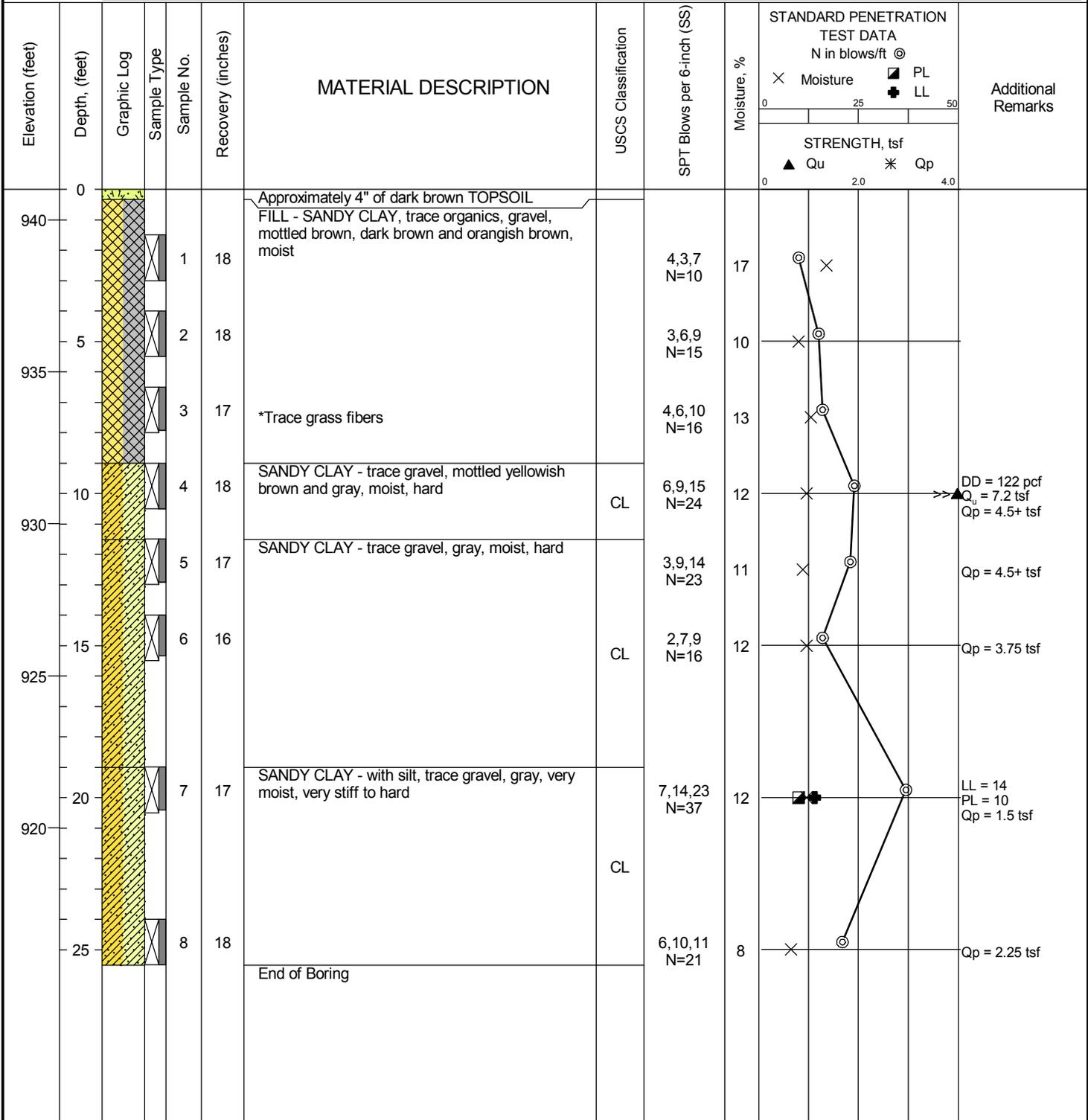
intertek  
**psi**

**DATE STARTED:** 6/14/19 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 6/14/19 **DRILLER:** H. Pace **LOGGED BY:** K. Dubnicki  
**COMPLETION DEPTH:** 25.5 ft **DRILL RIG:** CME 75  
**BENCHMARK:** N/A **DRILLING METHOD:** 2.25" HSA  
**ELEVATION:** 941 ft **SAMPLING METHOD:** 2" SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** 82%  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:** M. El-Gamal  
**REMARKS:** Borehole backfilled with auger cuttings

**BORING B-01**

<b>Water</b>	▽	While Drilling	Dry
	▼	Upon Completion	Dry
	▽	Delay	N/A

**BORING LOCATION:**  
 See Boring Location Plan  
 18900 Franklin Street



Professional Service Industries, Inc.  
 37483 Interchange Drive  
 Farmington Hills, MI 48335  
 Telephone: (248) 857-9911

**PROJECT NO.:** 03811131  
**PROJECT:** Ann Arbor Lift Stations  
**LOCATION:** City of Ann Arbor  
 Washtenaw County, Michigan

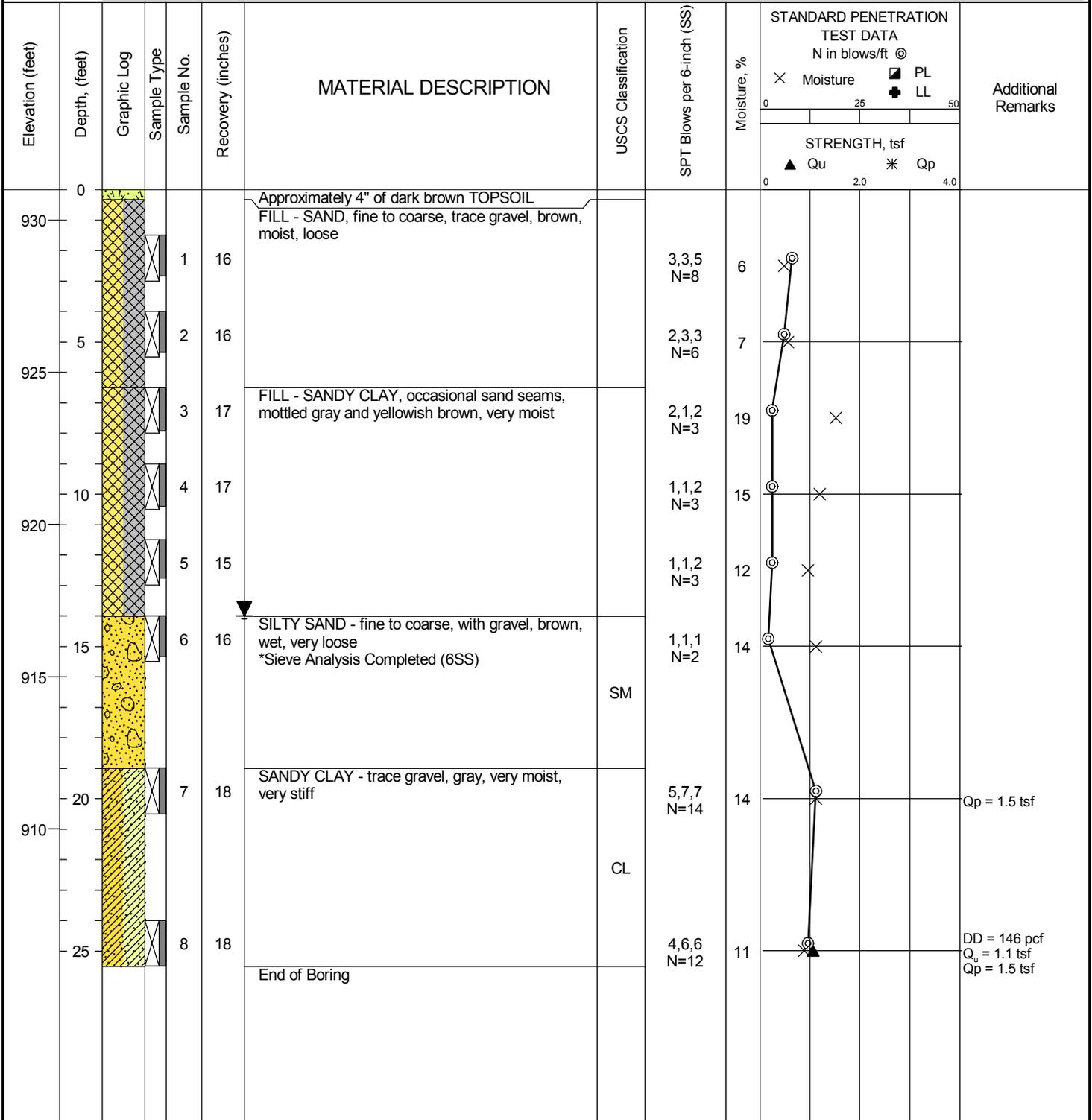
**DATE STARTED:** 6/14/19  
**DATE COMPLETED:** 6/14/19  
**COMPLETION DEPTH:** 25.5 ft  
**BENCHMARK:** N/A  
**ELEVATION:** 931 ft  
**LATITUDE:**  
**LONGITUDE:**  
**STATION:** N/A **OFFSET:** N/A  
**REMARKS:** Borehole backfilled with auger cuttings

**DRILL COMPANY:** PSI, Inc.  
**DRILLER:** H. Pace **LOGGED BY:** K. Dubnicki  
**DRILL RIG:** CME 75  
**DRILLING METHOD:** 2.25" HSA  
**SAMPLING METHOD:** 2" SS  
**HAMMER TYPE:** Automatic  
**EFFICIENCY:** 82%  
**REVIEWED BY:** M. El-Gamal

## BORING B-02

<b>Water</b>	▽ While Drilling	14 feet
	▼ Upon Completion	14 feet
	▽ Delay	N/A

**BORING LOCATION:**  
 See Boring Location Plan  
 3020 Sequoia Parkway



Professional Service Industries, Inc.  
 37483 Interchange Drive  
 Farmington Hills, MI 48335  
 Telephone: (248) 857-9911

**PROJECT NO.:** 03811131  
**PROJECT:** Ann Arbor Lift Stations  
**LOCATION:** City of Ann Arbor  
 Washtenaw County, Michigan

**DATE STARTED:** 6/14/19 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 6/14/19 **DRILLER:** H. Pace **LOGGED BY:** K. Dubnicki  
**COMPLETION DEPTH:** 25.5 ft **DRILL RIG:** CME 75  
**BENCHMARK:** N/A **DRILLING METHOD:** 2.25" HSA  
**ELEVATION:** 931 ft **SAMPLING METHOD:** 2" SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** 82%  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:** M. El-Gamal  
**REMARKS:** Borehole backfilled with auger cuttings

**BORING B-03**

<b>Water</b>	▽ While Drilling	11.5 feet
	▼ Upon Completion	11.5 feet
	▽ Delay	N/A

**BORING LOCATION:**  
 See Boring Location Plan  
 3020 Sequoia Parkway

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	STANDARD PENETRATION TEST DATA N in blows/ft @	Moisture, %	Strength, tsf	Additional Remarks
930	0					Approximately 4" of dark brown TOPSOIL FILL - SANDY CLAY, trace organics and gravel, occasional interbedded sand seams, mottled brown and dark brown, moist						
				1	14	*Trace glass fragments		2,2,3 N=5				
	5			2	13			2,2,4 N=6				
925				3	15			2,3,4 N=7				
	10			4	17			2,3,6 N=9				
920				5	16	SILTY SAND - fine to coarse, trace gravel, brown, moist to wet, very loose to medium dense		1,1,1 N=2				
	15			6	16		SM	HW,HW,1 N=1				
915				7	17	*Sieve Analysis Completed		2,1,2 N=3				
910	20			8	18			4,6,8 N=14				
	25					End of Boring						



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 37483 Interchange Drive  
 Farmington Hills, MI 48335  
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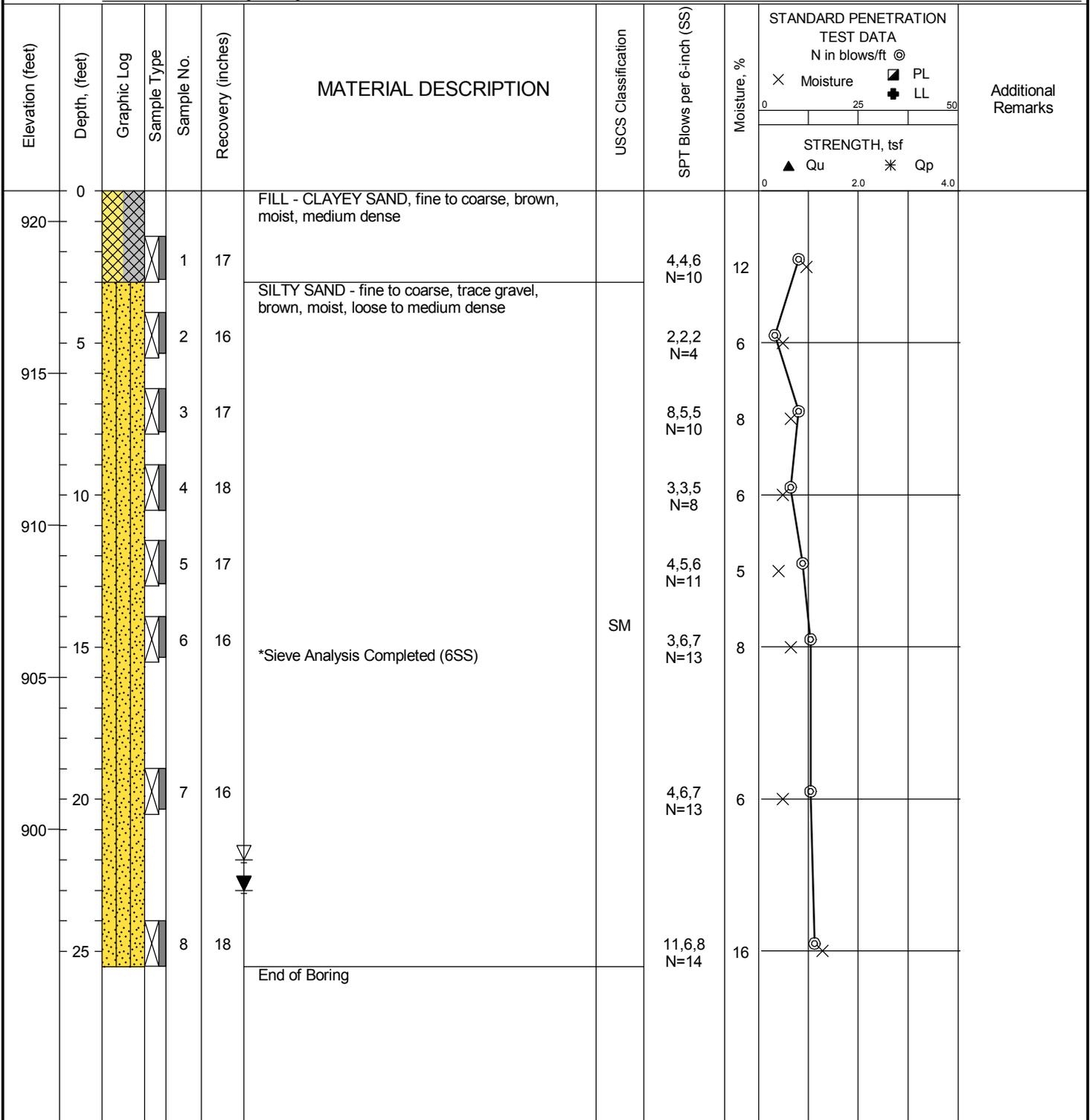
**PROJECT NO.:** 03811131  
**PROJECT:** Ann Arbor Lift Stations  
**LOCATION:** City of Ann Arbor  
 Washtenaw County, Michigan

**DATE STARTED:** 6/11/19 **DRILL COMPANY:** PSI, Inc.  
**DATE COMPLETED:** 6/11/19 **DRILLER:** H. Pace **LOGGED BY:** K. Dubnicki  
**COMPLETION DEPTH:** 25.5 ft **DRILL RIG:** CME 75  
**BENCHMARK:** N/A **DRILLING METHOD:** 2.25" HSA  
**ELEVATION:** 921 ft **SAMPLING METHOD:** 2" SS  
**LATITUDE:** **HAMMER TYPE:** Automatic  
**LONGITUDE:** **EFFICIENCY:** 82%  
**STATION:** N/A **OFFSET:** N/A **REVIEWED BY:** M. El-Gamal  
**REMARKS:** Borehole backfilled with auger cuttings

## BORING B-04

**Water**  
 ∇ While Drilling 22 feet  
 ▼ Upon Completion 23 feet  
 ∇ Delay Cave in @ 22 feet

**BORING LOCATION:**  
 See Boring Location Plan  
 310 Parkwood Street



Professional Service Industries, Inc.  
 37483 Interchange Drive  
 Farmington Hills, MI 48335  
 Telephone: (248) 857-9911

**PROJECT NO.:** 03811131  
**PROJECT:** Ann Arbor Lift Stations  
**LOCATION:** City of Ann Arbor  
 Washtenaw County, Michigan

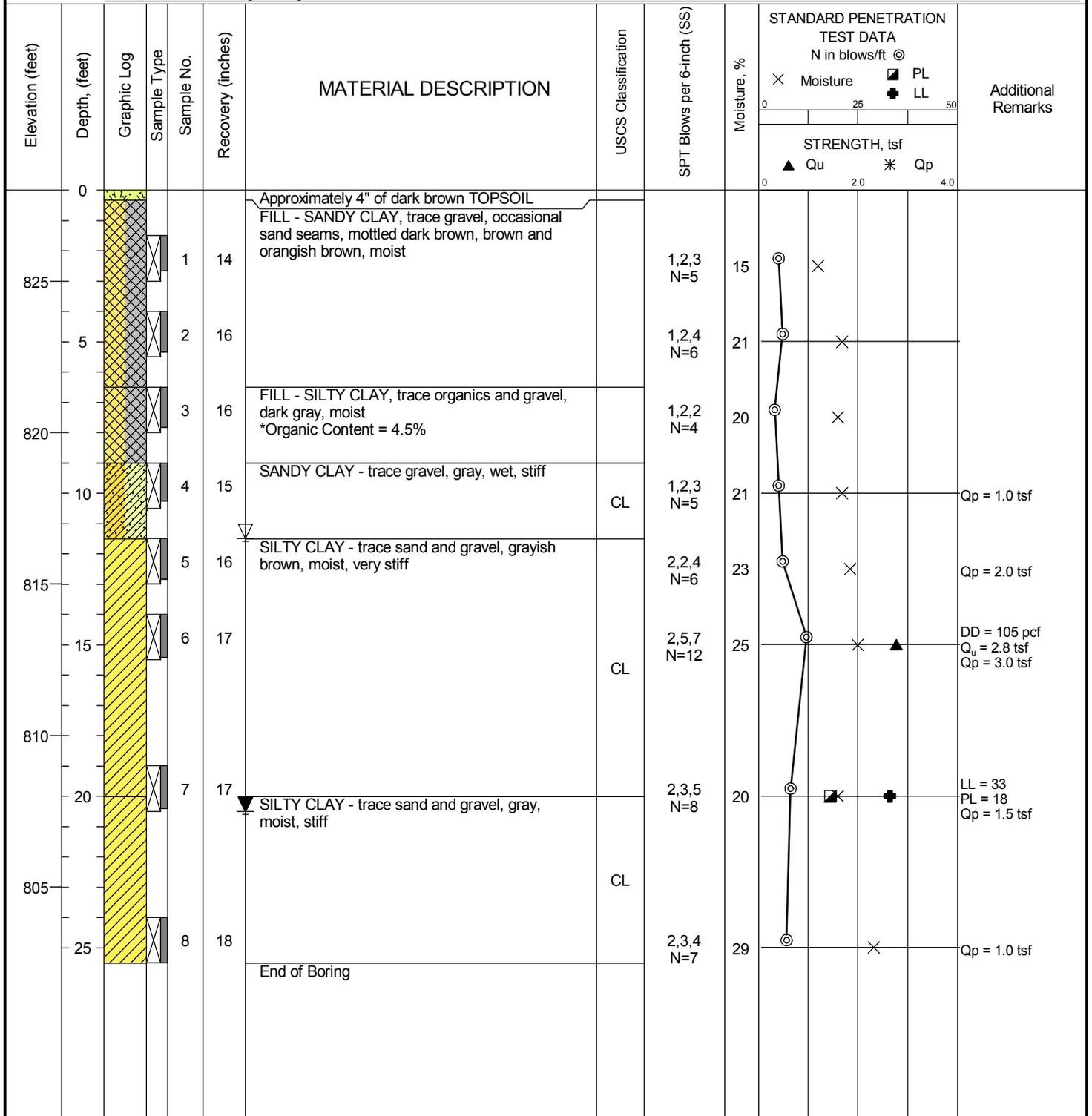
DATE STARTED: 6/14/19  
 DATE COMPLETED: 6/14/19  
 COMPLETION DEPTH: 25.5 ft  
 BENCHMARK: N/A  
 ELEVATION: 828 ft  
 LATITUDE:  
 LONGITUDE:  
 STATION: N/A OFFSET: N/A  
 REMARKS: Borehole backfilled with auger cuttings

DRILL COMPANY: PSI, Inc.  
 DRILLER: H. Pace LOGGED BY: K. Dubnicki  
 DRILL RIG: CME 75  
 DRILLING METHOD: 2.25" HSA  
 SAMPLING METHOD: 2" SS  
 HAMMER TYPE: Automatic  
 EFFICIENCY: 82%  
 REVIEWED BY: M. El-Gamal

**BORING B-05**

Water  
 ▽ While Drilling 11.5 feet  
 ▼ Upon Completion 20.5 feet  
 ▽ Delay N/A

**BORING LOCATION:**  
 See Boring Location Plan  
 1150 Astor Avenue



Professional Service Industries, Inc.  
 37483 Interchange Drive  
 Farmington Hills, MI 48335  
 Telephone: (248) 857-9911

PROJECT NO.: 03811131  
 PROJECT: Ann Arbor Lift Stations  
 LOCATION: City of Ann Arbor  
 Washtenaw County, Michigan



## GENERAL NOTES

### SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

### DRILLING AND SAMPLING SYMBOLS

- |   |   |
|---|---|
| SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.    | ☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted. |
| HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted. | ■ ST: Shelby Tube - 3" O.D., except where noted.              |
| M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry          | ▮ RC: Rock Core   |
| R.C.: Diamond Bit Core Sampler  | ⬇ TC: Texas Cone  |
| H.A.: Hand Auger  | ☞ BS: Bulk Sample   |
| P.A.: Power Auger - Handheld motorized auger                                    | ☒ PM: Pressuremeter   |
- CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

### SOIL PROPERTY SYMBOLS

- N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
- N<sub>60</sub>: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
- Q<sub>u</sub>: Unconfined compressive strength, TSF
- Q<sub>p</sub>: Pocket penetrometer value, unconfined compressive strength, TSF
- w%: Moisture/water content, %
- LL: Liquid Limit, %
- PL: Plastic Limit, %
- PI: Plasticity Index = (LL-PL),%
- DD: Dry unit weight, pcf
- ▼, ▼, ▼ Apparent groundwater level at time noted

### RELATIVE DENSITY OF COARSE-GRAINED SOILS    ANGULARITY OF COARSE-GRAINED PARTICLES

<u>Relative Density</u>	<u>N - Blows/foot</u>
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

<u>Description</u>	<u>Criteria</u>
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

### GRAIN-SIZE TERMINOLOGY

<u>Component</u>	<u>Size Range</u>
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

### PARTICLE SHAPE

<u>Description</u>	<u>Criteria</u>
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

### RELATIVE PROPORTIONS OF FINES

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%



## GENERAL NOTES

(Continued)

### CONSISTENCY OF FINE-GRAINED SOILS

<u>Q<sub>u</sub> - TSF</u>	<u>N - Blows/foot</u>	<u>Consistency</u>
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

### MOISTURE CONDITION DESCRIPTION

<u>Description</u>	<u>Criteria</u>
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

### RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

### STRUCTURE DESCRIPTION

<u>Description</u>	<u>Criteria</u>	<u>Description</u>	<u>Criteria</u>
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick	Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick	Lensed:	Inclusion of small pockets of different soils
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing	Layer:	Inclusion greater than 3 inches thick (75 mm)
Slickensided:	Fracture planes appear polished or glossy, sometimes striated	Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
		Parting:	Inclusion less than 1/8-inch (3 mm) thick

### SCALE OF RELATIVE ROCK HARDNESS

<u>Q<sub>u</sub> - TSF</u>	<u>Consistency</u>
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

### ROCK BEDDING THICKNESSES

<u>Description</u>	<u>Criteria</u>
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

### ROCK VOIDS

<u>Voids</u>	<u>Void Diameter</u>
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

### GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

### ROCK QUALITY DESCRIPTION

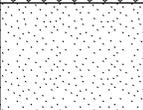
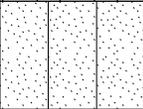
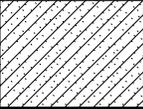
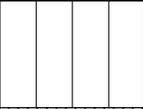
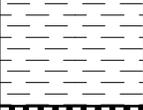
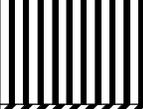
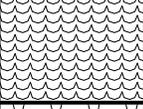
<u>Rock Mass Description</u>	<u>RQD Value</u>
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

### DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

# SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
<p><b>COARSE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE</p>	<p>GRAVEL AND GRAVELLY SOILS</p> <p>(LITTLE OR NO FINES)</p>	CLEAN GRAVELS		<b>GW</b>	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		(LITTLE OR NO FINES)		<b>GP</b>	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES		<b>GM</b>	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
	<p>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>	GRAVELS WITH FINES		<b>GC</b>	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES	
		<p>SAND AND SANDY SOILS</p> <p>(LITTLE OR NO FINES)</p>	CLEAN SANDS		<b>SW</b>	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			(LITTLE OR NO FINES)		<b>SP</b>	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	SANDS WITH FINES			<b>SM</b>	SILTY SANDS, SAND - SILT MIXTURES	
	<p>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE</p> <p>(APPRECIABLE AMOUNT OF FINES)</p>	SANDS WITH FINES		<b>SC</b>	CLAYEY SANDS, SAND - CLAY MIXTURES	
		<p><b>FINE GRAINED SOILS</b></p> <p>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE</p>	<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT LESS THAN 50</p>		<b>ML</b>	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
					<b>CL</b>	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	<b>OL</b>			ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY		
<p>SILTS AND CLAYS</p> <p>LIQUID LIMIT GREATER THAN 50</p>			<b>MH</b>	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS		
			<b>CH</b>	INORGANIC CLAYS OF HIGH PLASTICITY		
			<b>OH</b>	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS		
<p>HIGHLY ORGANIC SOILS</p>				<b>PT</b>	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

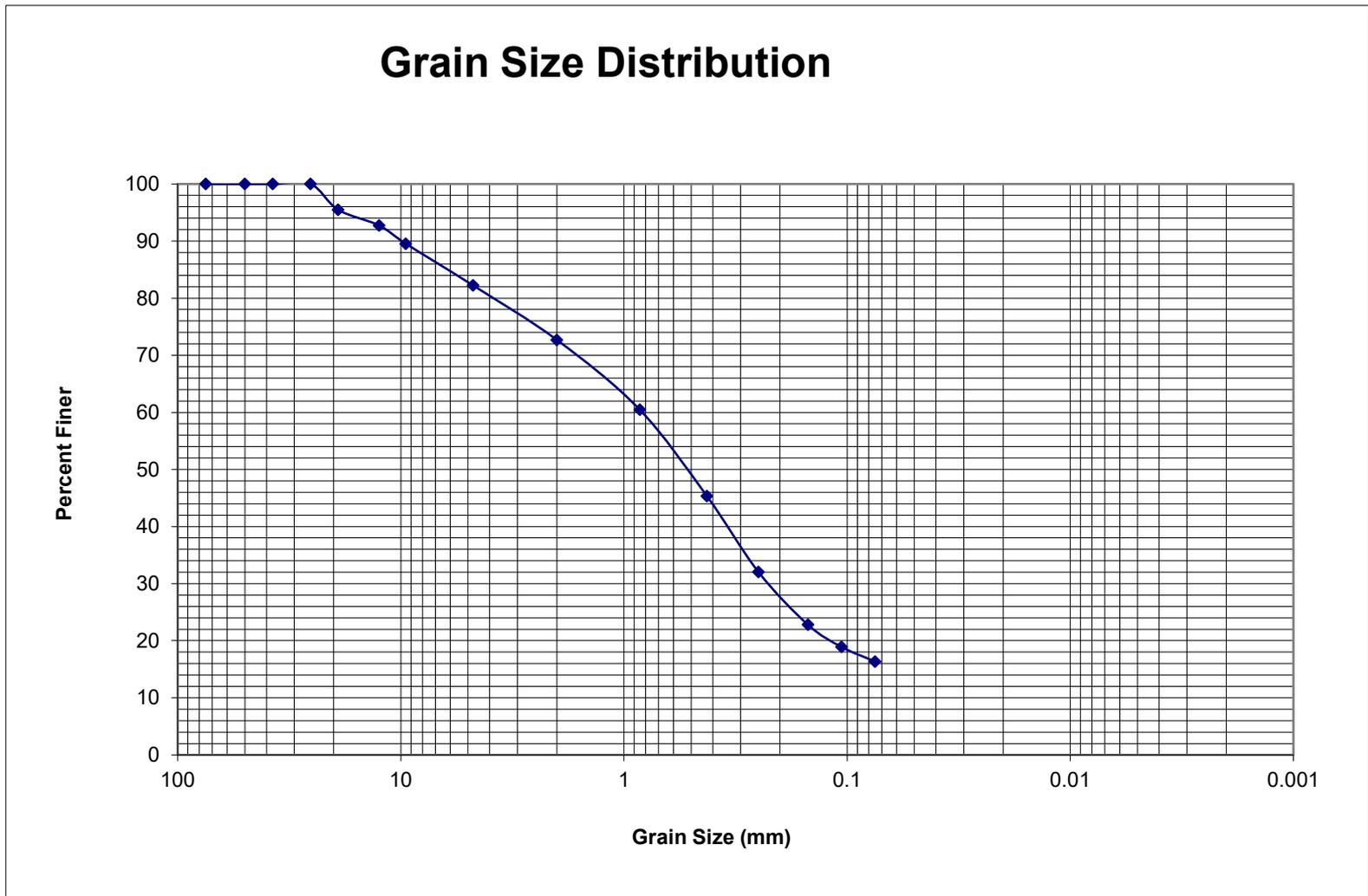


# Sieve Analysis

## ASTM D6913/D6913M-17(Washed Gradation)

<b>Project:</b> Ann Arbor Lift Station	<b>Project #:</b> 03811131
<b>Client:</b> City of AnnArbor	<b>Date Tested:</b> 6/19/2019
<b>Date Sampled:</b> 6/14/2019	<b>Sample Source:</b> SB-2; 6SS
<b>Sampled by:</b> PSI - Harold Pace	<b>Depth:</b> 14'-15.5'

Soil Information:				
% Gravel=	17.8		LL=	--
% Sand=	65.9		PL=	--
	Coarse	9.5%	PI=	--
	Medium	27.4%	USCS:	<b>SP-SM</b>
	Fine	29.0%	AASHTO:	<b>A-1-b</b>
% Fines=	16.4		D <sub>10</sub> =	n/a
	Silt	n/a	D <sub>30</sub> =	0.220
	Clay	n/a	D <sub>60</sub> =	0.800
		Description: <b>SAND - fine to coarse, with gravel and silt, brown</b>		

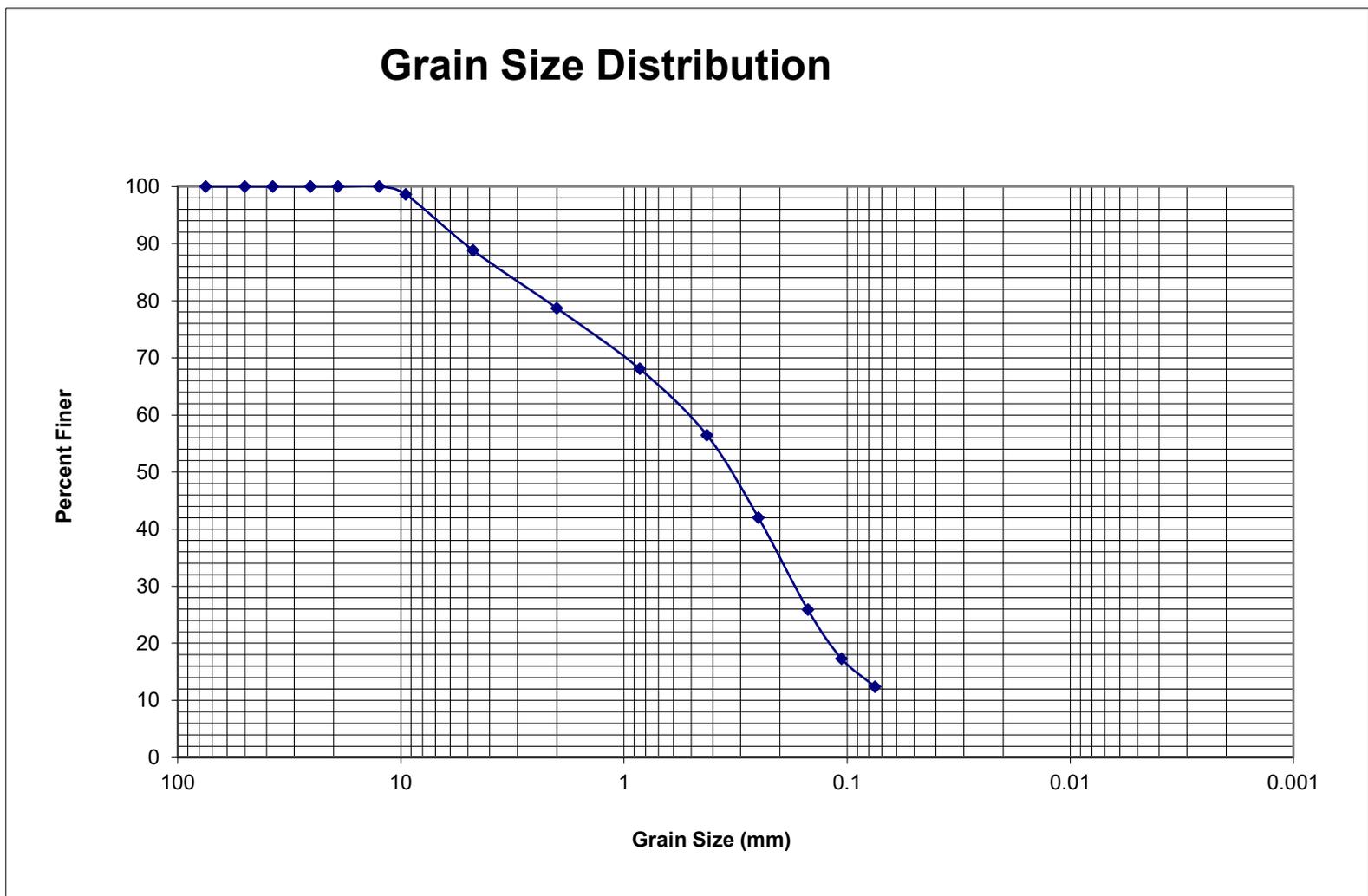


# Sieve Analysis

## ASTM D6913/D6913M-17(Washed Gradation)

<b>Project:</b> Ann Arbor Lift Station	<b>Project #:</b> 03811131
<b>Client:</b> City of Ann Arbor	<b>Date Tested:</b> 6/19/2019
<b>Date Sampled:</b> 6/14/2019	<b>Sample Source:</b> SB-3; 7SS
<b>Sampled by:</b> PSI - Harold Pace	<b>Depth:</b> 19'-20.5'

Soil Information:						
% Gravel=	11.2	LL=	--	D <sub>10</sub> =	n/a	
% Sand=	76.5	PL=	--	D <sub>30</sub> =	0.170	
	Coarse	10.1%	PI=	--	D <sub>60</sub> =	0.500
	Medium	22.2%	USCS:	<b>SM</b>	Cu=	n/a
	Fine	44.1%	AASHTO:	<b>A-2-4</b>	Cc=	n/a
% Fines=	12.4	Description: <b>SILTY SAND - fine to coarse, trace gravel, brown</b>				
	Silt	n/a				
	Clay	n/a				



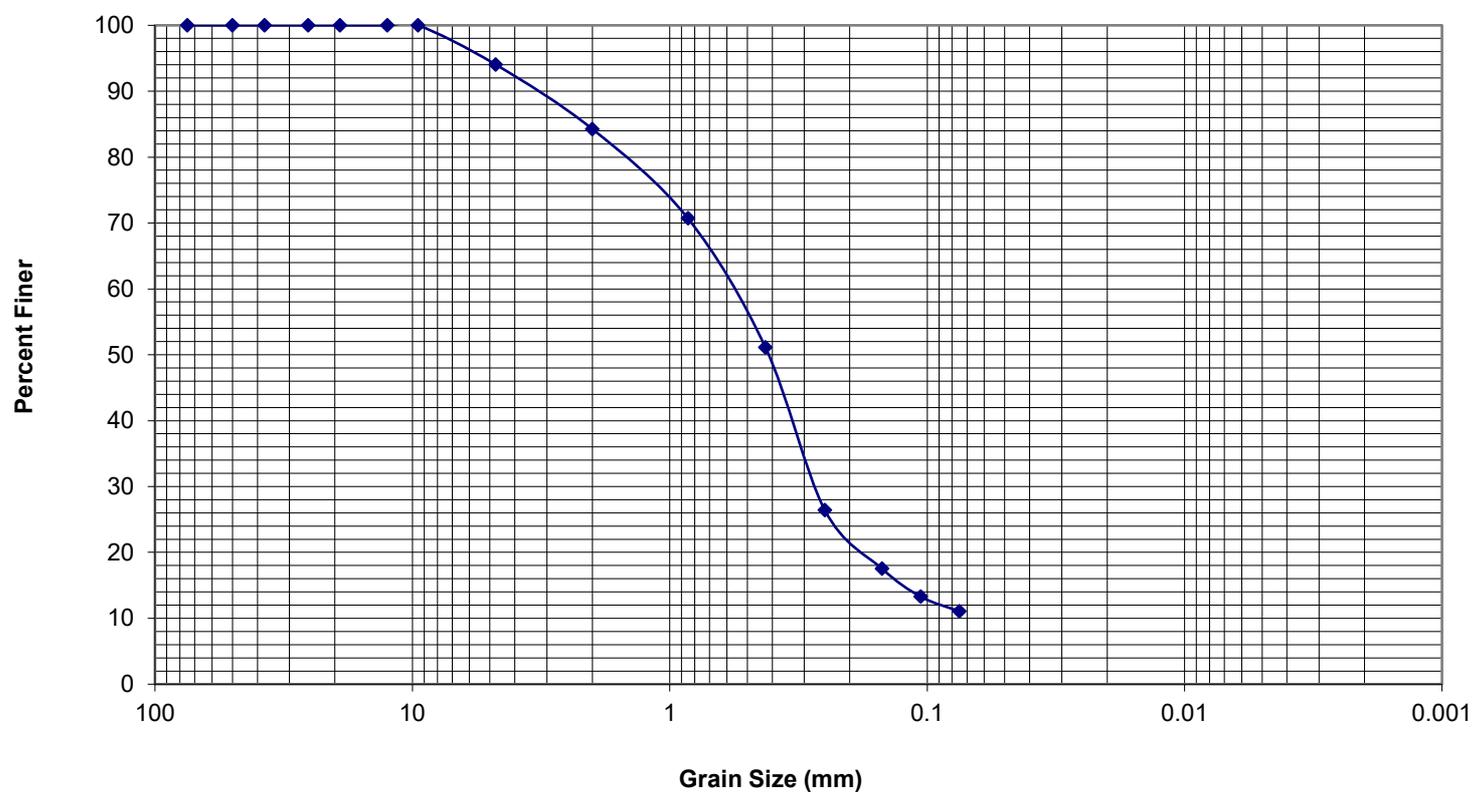
# Sieve Analysis

ASTM D6913/D6913M-17(Washed Gradation)

<b>Project:</b> Ann Arbor Lift Station	<b>Project #:</b> 03811131
<b>Client:</b> City of Ann Arbor	<b>Date Tested:</b> 6/19/2019
<b>Date Sampled:</b> 6/14/2019	<b>Sample Source:</b> SB-4; 6SS
<b>Sampled by:</b> PSI - Harold Pace	<b>Depth:</b> 14'-15.5'

Soil Information:						
% Gravel=	5.9	LL=	--	D <sub>10</sub> =	n/a	
% Sand=	83.0	PL=	--	D <sub>30</sub> =	0.280	
	Coarse	9.8%	PI=	--	D <sub>60</sub> =	0.460
	Medium	33.1%	USCS:	<b>SM</b>	Cu=	n/a
	Fine	40.1%	AASHTO:	<b>A-2-4</b>	Cc=	n/a
% Fines=	11.0	Description: <b>SILTY SAND - fine to coarse, trace gravel, brown</b>				
	Silt	n/a				
	Clay	n/a				

## Grain Size Distribution

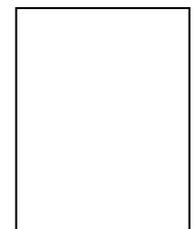
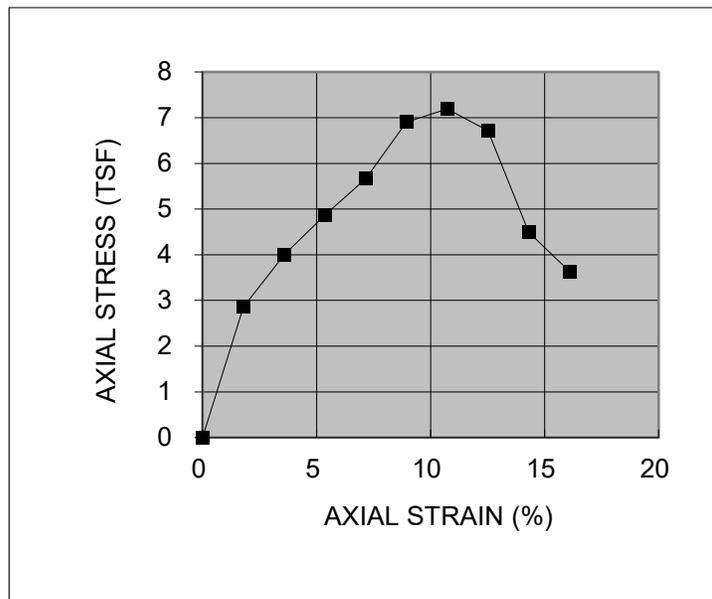


## UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

**Project Name:** Ann Arbor Lift Station  
**Location:** City of Ann Arbor, Washtenaw County, Michigan  
**Project No.:** 03811131  
**Source:** SB - 1; 4SS **Sample Depth:** 9.0'-10.5'  
**Description:** SANDY CLAY (CL), trace gravel, brown  
**Qp (tsf):** 4.5+  
**Wet Weight (gm):** 151.70  
**Date Tested:** 6/19/2019  
**Tested By:** EM

<b>Height:</b>	2.797 inches	71.04 mm
<b>Diameter:</b>	1.387 inches	35.23 mm
<b>Moisture Content:</b>	12%	<b>Saturation (%):</b>
<b>Ht.-Diameter Ratio:</b>	2.02	<b>Specific Gravity:</b>
<b>Dry Density:</b>	122 pcf	

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in <sup>2</sup> )	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.511	0.00
1	0.050	197	61	1.79	1.538	2.86
2	0.100	285	87	3.58	1.567	4.00
3	0.150	353	108	5.36	1.596	4.87
4	0.200	422	128	7.15	1.627	5.66
5	0.250	491	159	8.94	1.659	6.90
6	0.300	507	169	10.73	1.692	7.19
7	0.350	494	161	12.51	1.727	6.71
8	0.400	362	110	14.30	1.763	4.49
9	0.450	297	91	16.09	1.800	3.64
10	0.500					
11	0.550					
12	0.600					
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					
Qu =		7.19 tsf	688.63 kPa, Strain 10.73%			



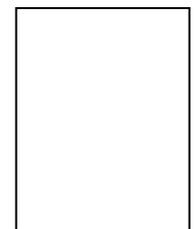
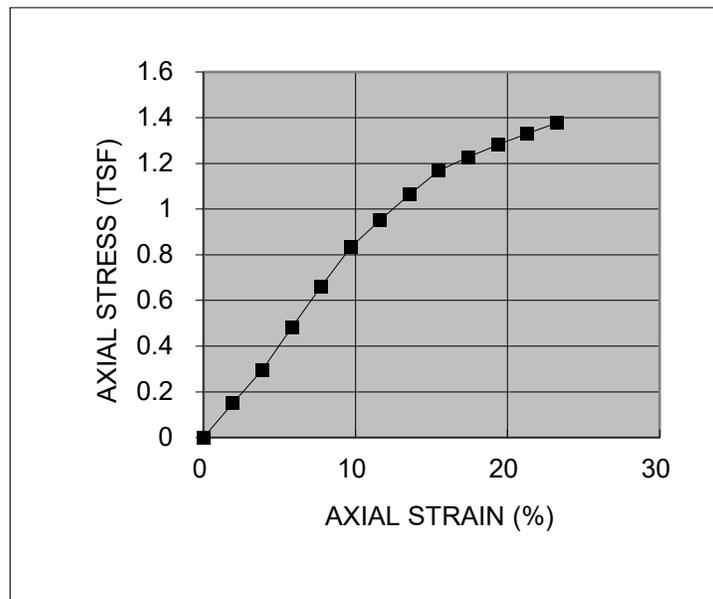
Failure Sketch

## UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

**Project Name:** Ann Arbor Lift Station  
**Location:** City of Ann Arbor, Washtenaw County, Michigan  
**Project No.:** 03811131  
**Source:** SB - 2; 8SS **Sample Depth:** 24.0'-25.5'  
**Description:** SILTY CLAY (CL), with sand, trace gravel, gray  
**Qp (tsf):** 1.50  
**Wet Weight (gm):** 154.83  
**Date Tested:** 6/19/2019  
**Tested By:** EM

<b>Height:</b>	2.583 inches	65.62 mm
<b>Diameter:</b>	1.338 inches	33.97 mm
<b>Moisture Content:</b>	11%	<b>Saturation (%):</b>
<b>Ht.-Diameter Ratio:</b>	1.93	<b>Specific Gravity:</b>
<b>Dry Density:</b>	146 pcf	

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in <sup>2</sup> )	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.405	0.00
1	0.050	6	3	1.94	1.433	0.15
2	0.100	16	6	3.87	1.462	0.30
3	0.150	28	10	5.81	1.492	0.48
4	0.200	43	14	7.74	1.523	0.66
5	0.250	56	18	9.68	1.556	0.83
6	0.300	67	21	11.61	1.590	0.95
7	0.350	77	24	13.55	1.625	1.06
8	0.400	87	27	15.48	1.662	1.17
9	0.450	92	29	17.42	1.701	1.23
10	0.500	98	31	19.35	1.742	1.28
11	0.550	105	33	21.29	1.785	1.33
12	0.600	112	35	23.23	1.830	1.38
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					
Qu =		1.06 tsf	101.82 kPa, Strain 15.00%			



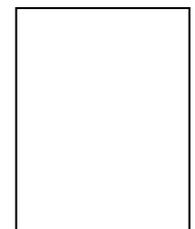
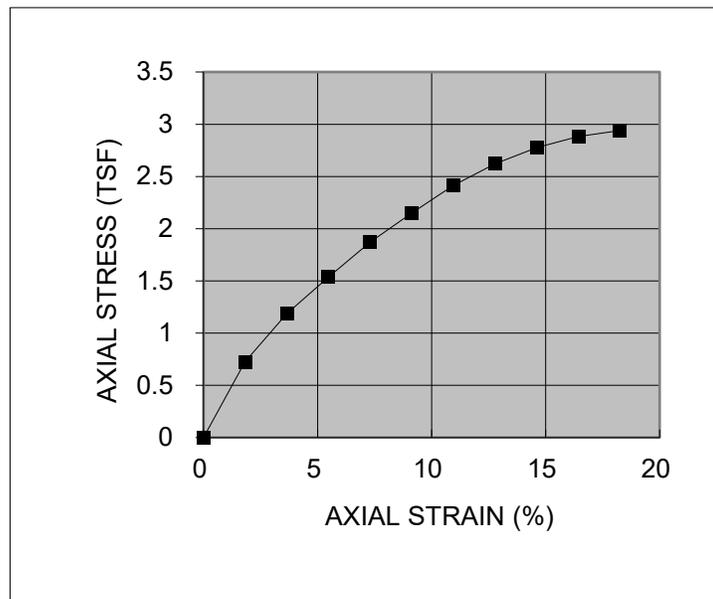
Failure Sketch

## UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

**Project Name:** Ann Arbor Lift Station  
**Location:** City of Ann Arbor, Washtenaw County, Michigan  
**Project No.:** 03811131  
**Source:** SB - 5; 6SS **Sample Depth:** 14.0'-15.5'  
**Description:** SILTY CLAY (CL), gray  
**Qp (tsf):** 3.00  
**Wet Weight (gm):** 137.28  
**Date Tested:** 6/19/2019  
**Tested By:** EM

<b>Height:</b>	2.738 inches	69.55 mm
<b>Diameter:</b>	1.364 inches	34.65 mm
<b>Moisture Content:</b>	25%	<b>Saturation (%):</b>
<b>Ht.-Diameter Ratio:</b>	2.01	<b>Specific Gravity:</b>
<b>Dry Density:</b>	105 pcf	

READING NUMBER	DEFORM. (in.)	LOAD DIAL READING	LOAD (lbs)	STRAIN (%)	CORRECTED AREA (in <sup>2</sup> )	AXIAL STRESS (tsf)
0	0.000	0	0.0	0.00	1.462	0.00
1	0.050	46	15	1.83	1.489	0.73
2	0.100	78	25	3.65	1.517	1.19
3	0.150	106	33	5.48	1.546	1.54
4	0.200	132	41	7.30	1.577	1.87
5	0.250	155	48	9.13	1.608	2.15
6	0.300	178	55	10.96	1.641	2.41
7	0.350	197	61	12.78	1.676	2.62
8	0.400	215	66	14.61	1.712	2.78
9	0.450	229	70	16.43	1.749	2.88
10	0.500	237	73	18.26	1.788	2.94
11	0.550					
12	0.600					
13	0.650					
14	0.700					
15	0.750					
16	0.800					
17	0.850					
18	0.900					
19	0.950					
20	1.000					
Qu =		2.78 tsf	265.86 kPa, Strain 15.00%			



Failure Sketch  
 intertek  
**psi**



intertek.  
psi

# APPENDIX



## CITY OF ANN ARBOR LIVING WAGE ORDINANCE DECLARATION OF COMPLIANCE

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that an employer who is (a) a contractor providing services to or for the City for a value greater than \$10,000 for any twelve-month contract term, or (b) a recipient of federal, state, or local grant funding administered by the City for a value greater than \$10,000, or (c) a recipient of financial assistance awarded by the City for a value greater than \$10,000, shall pay its employees a prescribed minimum level of compensation (i.e., Living Wage) for the time those employees perform work on the contract or in connection with the grant or financial assistance. The Living Wage must be paid to these employees for the length of the contract/program.

*Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from compliance with the Living Wage Ordinance. If this exemption applies to your company/non-profit agency please check here  No. of employees \_\_*

The Contractor or Grantee agrees:

- (a) To pay each of its employees whose wage level is not required to comply with federal, state or local prevailing wage law, for work covered or funded by a contract with or grant from the City, no less than the Living Wage. The current Living Wage is defined as \$13.61/hour for those employers that provide employee health care (as defined in the Ordinance at Section 1:815 Sec. 1 (a)), or no less than \$15.18/hour for those employers that do not provide health care. The Contractor or Grantor understands that the Living Wage is adjusted and established annually on April 30 in accordance with the Ordinance and covered employers shall be required to pay the adjusted amount thereafter to be in compliance with Section 1:815(3).

**Check the applicable box below which applies to your workforce**

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage without health benefits

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage with health benefits

- (b) To post a notice approved by the City regarding the applicability of the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.
- (c) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.
- (d) To permit access to work sites to City representatives for the purposes of monitoring compliance, and investigating complaints or non-compliance.
- (e) To take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee covered by the Living Wage Ordinance or any person contracted for employment and covered by the Living Wage Ordinance in order to pay the living wage required by the Living Wage Ordinance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services or agrees to accept financial assistance in accordance with the terms of the Living Wage Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Living Wage Ordinance, obligates the Employer/Grantee to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract or grant of financial assistance.

\_\_\_\_\_  
Company Name

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
City, State, Zip

\_\_\_\_\_  
Print Name and Title

\_\_\_\_\_  
Phone/Email address

# CITY OF ANN ARBOR LIVING WAGE ORDINANCE

**RATE EFFECTIVE APRIL 30, 2019 - ENDING APRIL 29, 2020**

**\$13.61** per hour

If the employer provides health care benefits\*

**\$15.18** per hour

If the employer does **NOT** provide health care benefits\*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than \$10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

## ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than \$500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

\* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed \$.50 an hour for an average work week; and the employer cost or contribution must equal no less than \$1/hr for the average work week.

**The Law Requires Employers to Display This Poster Where Employees Can Readily See It.**

**For Additional Information or to File a Complaint contact  
Colin Spencer at 734/794-6500 or [cspencer@a2gov.org](mailto:cspencer@a2gov.org)**



<b>Vendor Conflict of Interest Disclosure Form</b>
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All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor’s conflict of interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

1. No City official or employee or City employee’s immediate family member has an ownership interest in vendor’s company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor’s Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

<b>Conflict of Interest Disclosure*</b>	
Name of City of Ann Arbor employees, elected officials or immediate family members with whom there may be a potential conflict of interest.	<input type="checkbox"/> Relationship to employee <hr style="border: 0; border-top: 1px solid black;"/> <input type="checkbox"/> Interest in vendor’s company <input type="checkbox"/> Other (please describe in box below)

\*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

<b>I certify that this Conflict of Interest Disclosure has been examined by me and that its contents are true and correct to my knowledge and belief and I have the authority to so certify on behalf of the Vendor by my signature below:</b>		
<b>Vendor Name</b>	<b>Vendor Phone Number</b>	
<b>Signature of Vendor Authorized Representative</b>	<b>Date</b>	<b>Printed Name of Vendor Authorized Representative</b>

Questions about this form? Contact Procurement Office City of Ann Arbor Phone: 734/794-6500, [procurement@a2gov.org](mailto:procurement@a2gov.org)



# CITY OF ANN ARBOR NON-DISCRIMINATION ORDINANCE

Relevant provisions of Chapter 112, Nondiscrimination, of the Ann Arbor City Code are included below.  
You can review the entire ordinance at [www.a2gov.org/humanrights](http://www.a2gov.org/humanrights).

**Intent:** It is the intent of the city that no individual be denied equal protection of the laws; nor shall any individual be denied the enjoyment of his or her civil or political rights or be discriminated against because of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight.

**Discriminatory Employment Practices:** No person shall discriminate in the hire, employment, compensation, work classifications, conditions or terms, promotion or demotion, or termination of employment of any individual. No person shall discriminate in limiting membership, conditions of membership or termination of membership in any labor union or apprenticeship program.

**Discriminatory Effects:** No person shall adopt, enforce or employ any policy or requirement which has the effect of creating unequal opportunities according to actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight for an individual to obtain housing, employment or public accommodation, except for a bona fide business necessity. Such a necessity does not arise due to a mere inconvenience or because of suspected objection to such a person by neighbors, customers or other persons.

**Nondiscrimination by City Contractors:** All contractors proposing to do business with the City of Ann Arbor shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All city contractors shall ensure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon any classification protected by this chapter. All contractors shall agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of any applicable protected classification. All contractors shall be required to post a copy of Ann Arbor's Non-Discrimination Ordinance at all work locations where its employees provide services under a contract with the city.

**Complaint Procedure:** If any individual believes there has been a violation of this chapter, he/she may file a complaint with the City's Human Rights Commission. The complaint must be filed within 180 calendar days from the date of the individual's knowledge of the allegedly discriminatory action or 180 calendar days from the date when the individual should have known of the allegedly discriminatory action. A complaint that is not filed within this timeframe cannot be considered by the Human Rights Commission. To file a complaint, first complete the complaint form, which is available at [www.a2gov.org/humanrights](http://www.a2gov.org/humanrights). Then submit it to the Human Rights Commission by e-mail ([hrc@a2gov.org](mailto:hrc@a2gov.org)), by mail (Ann Arbor Human Rights Commission, PO Box 8647, Ann Arbor, MI 48107), or in person (City Clerk's Office). For further information, please call the commission at 734-794-6141 or e-mail the commission at [hrc@a2gov.org](mailto:hrc@a2gov.org).

**Private Actions For Damages or Injunctive Relief:** To the extent allowed by law, an individual who is the victim of discriminatory action in violation of this chapter may bring a civil action for appropriate injunctive relief or damages or both against the person(s) who acted in violation of this chapter.

THIS IS AN OFFICIAL GOVERNMENT NOTICE AND  
MUST BE DISPLAYED WHERE EMPLOYEES CAN READILY SEE IT.

## MICHIGAN DEPARTMENT OF TRANSPORTATION CERTIFIED PAYROLL

COMPLETION OF CERTIFIED PAYROLL FORM FULFILLS THE MINIMUM MDOT PREVAILING WAGE REQUIREMENTS

(1) NAME OF CONTRACTOR / SUBCONTRACTOR (CIRCLE ONE) (2) ADDRESS

(3) PAYROLL NO. (4) FOR WEEK ENDING (5) PROJECT AND LOCATION (6) CONTRACT ID

(a) EMPLOYEE INFORMATION	(b) WORK CLASSIFICATION	(c) Hour Type	(d) DAY AND DATE							(e) TOTAL HOURS ON PROJECT	(f) PROJECT RATE OF PAY	(g) PROJECT RATE OF FRINGE PAY	(h) GROSS PROJECT EARNED		(i) TOTAL WEEKLY HOURS WORKED ALL JOBS	(j) DEDUCTIONS						(k) TOTAL WEEKLY WAGES PAID FOR ALL JOBS		
														GROSS PROJECT EARNED		GROSS WEEKLY EARNED	FICA	FEDERAL	STATE		OTHER		TOTAL DEDUCT	
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00
ETH#GEN: ID #:	GROUP/CLASS #:	S							0				\$0.00										\$0.00	\$0.00
NAME:									0				\$0.00										\$0.00	\$0.00

Date \_\_\_\_\_

I, \_\_\_\_\_ (Name of Signatory Party) \_\_\_\_\_ (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

\_\_\_\_\_ on the \_\_\_\_\_ (Contractor or Subcontractor)  
 \_\_\_\_\_; that during the payroll period commencing on the \_\_\_\_\_ (Building or Work)  
 \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_, and ending the \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_,  
 all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

\_\_\_\_\_ from the full \_\_\_\_\_ (Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

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

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

- in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

- Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION
REMARKS:	
NAME AND TITLE	SIGNATURE
THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.	