

PROJECT MANUAL

*Wastewater Treatment Facility Improvements
Moberly Correctional Center
Moberly, Missouri*

Designed By: Bartlett & West
1719 Southridge Dr, Suite 100
Jefferson City, MO 65109

Date Issued: May 4, 2022

Project No.: C1806-01

STATE *of* MISSOURI

OFFICE *of* ADMINISTRATION
Facilities Management, Design & Construction

SECTION 000107 - PROFESSIONAL SEALS AND CERTIFICATIONS

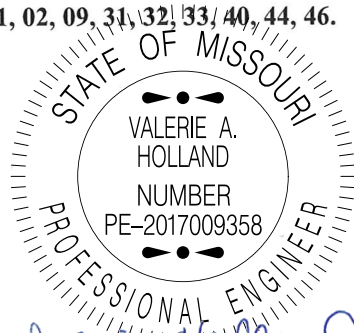
PROJECT NUMBER: C1806-01 - MOBERLY WASTEWATER TREATMENT FACILITY IMPROVEMENTS

THE FOLLOWING DESIGN PROFESSIONALS HAVE SIGNED AND SEALED THE ORIGINAL PLANS AND SPECIFICATIONS FOR THIS PROJECT, WHICH ARE ON FILE WITH THE DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION:

GENERAL, CIVIL, AND PROCESS

I AM RESPONSIBLE FOR THE FOLLOWING SPECIFICATION SECTIONS:

DIVISION 01, 02, 09, 31, 32, 33, 40, 44, 46.



(SEAL)

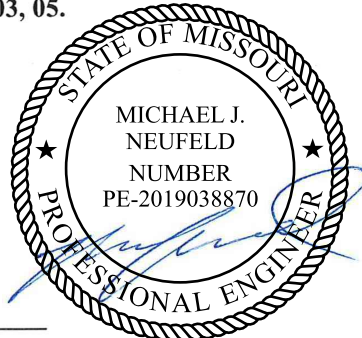
Valerie Holland

05-04-2022

STRUCTURAL

I AM RESPONSIBLE FOR THE FOLLOWING SPECIFICATION SECTIONS:

DIVISION 03, 05.



(SEAL)

05-04-2022

MECHANICAL, ELECTRICAL, AND PLUMBING

I AM RESPONSIBLE FOR THE FOLLOWING SPECIFICATION SECTIONS:

DIVISION 26.



(SEAL)

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SECTION 000115 – LIST OF DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section provides a comprehensive list of the drawings that comprise the Bid Documents for this project.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 LIST OF DRAWINGS

- A. The following list of drawings is a part of the Bid Documents:

	<u>TITLE</u>	<u>SHEET #</u>	<u>DATE</u>	<u>CAD #</u>
1.	Cover Sheet	Sheet G-001	5/4/2022	G-001
2.	General Notes	Sheet G-002	5/4/2022	G-002
3.	Location Map	Sheet G-003	5/4/2022	G-003
4.	Process Flow Diagram	Sheet G-004	5/4/2022	G-004
5.	Hydraulic Profile	Sheet G-005	5/4/2022	G-005
6.	Project Abbreviations	Sheet G-006	5/4/2022	G-006
7.	Existing Conditions Plan	Sheet C-101	5/4/2022	C-101
8.	Demolition Plan	Sheet C-102	5/4/2022	C-102
9.	Site Plan - Overall	Sheet C-103	5/4/2022	C-103
10.	Site Plan - Headworks Building	Sheet C-104	5/4/2022	C-104
11.	Site Plan - Triplepoint Equipment	Sheet C-105	5/4/2022	C-105
12.	Site Plan - UV & Flow Meter	Sheet C-106	5/4/2022	C-106
13.	Site Plan - Aeration Plan	Sheet C-107	5/4/2022	C-107
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15.	Site Grading & Erosion Control Plan - West Area	Sheet C-109	5/4/2022	C-109
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18.	Sanitary Sewer Plan & Profile	Sheet C-112	5/4/2022	C-112

19.	Sanitary Sewer Plan & Profile	Sheet C-113	5/4/2022	C-113
20.	Civil Details	Sheet C-501	5/4/2022	C-501
21.	Civil Details	Sheet C-502	5/4/2022	C-502
22.	Civil Details	Sheet C-503	5/4/2022	C-503
23.	Erosion Control Details	Sheet C-504	5/4/2022	C-504
24.	Structural Notes	Sheet S-001	5/4/2022	S-001
25.	Triplepoint Tank Structural Plans	Sheet S-101	5/4/2022	S-101
26.	Blower Pad Structural Plan	Sheet S-102	5/4/2022	S-102
27.	UV Pad Structural Plan	Sheet S-103	5/4/2022	S-103
28.	Structural Details	Sheet S-501	5/4/2022	S-501
29.	Symbols 1 of 2	Sheet D-001	5/4/2022	D-001
30.	Symbols 2 of 2	Sheet D-002	5/4/2022	D-002
31.	Pipe System Codes and Equipment Abbreviations	Sheet D-003	5/4/2022	D-003
32.	Flow Control Structure Plan	Sheet D-101	5/4/2022	D-101
33.	Triplepoint Tank Plan & Sections	Sheet D-102	5/4/2022	D-102
34.	Blower Plan & Section	Sheet D-103	5/4/2022	D-103
35.	UV Plan & Section	Sheet D-104	5/4/2022	D-104
36.	Flow Meter Washdown Mhs Plan & Section	Sheet D-105	5/4/2022	D-105
37.	Process Details	Sheet D-501	5/4/2022	D-501
38.	IO Schedules	Sheet D-601	5/4/2022	D-601
39.	Electrical Symbols Legend & Abbreviations	Sheet E-001	5/4/2022	E-001
40.	Site Electrical Demolition Plan	Sheet E-101	5/4/2022	E-101
41.	Site Electrical Improvement Plan	Sheet E-102	5/4/2022	E-102
42.	Triplepoint System Electrical Plan	Sheet E-103	5/4/2022	E-103
43.	UV System Electrical Plan	Sheet E-104	5/4/2022	E-104
44.	Flow Meter Electrical Plan	Sheet E-105	5/4/2022	E-105
45.	Electrical Riser Diagrams	Sheet E-401	5/4/2022	E-401
46.	Electrical Schedules & Details	Sheet E-501	5/4/2022	E-501
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SECTION 001116 - INVITATION FOR BID

1.0 OWNER:

- A. The State of Missouri
Office of Administration,
Division of Facilities Management, Design and Construction
Jefferson City, Missouri

2.0 PROJECT TITLE AND NUMBER:

- A. Wastewater Treatment Facility Improvements
Moberly Correctional Center
Moberly, Missouri
Project No.: C1806-01

3.0 BIDS WILL BE RECEIVED:

- A. Until: 1:30 PM, Thursday, July 28, 2022
- B. **Only electronic bids on MissouriBUYS shall be accepted: <https://missouribuys.mo.gov>. Bidder must be registered to bid.**

4.0 DESCRIPTION:

- A. Scope: The Project consists of providing and installation of a flow control structure, Triplepoint NitrOx equipment, blowers, UV disinfection, flow metering, interconnecting piping, structures, electrical equipment, appurtenances as necessary and as shown on the Construction Plans.
- B. MBE/WBE/SDVE Goals: MBE 10%, WBE 10%, and SDVE 3%. **NOTE: Only MBE/WBE firms certified by the State of Missouri Office of Equal Opportunity as of the date of bid opening, or SDVE(s) meeting the requirements of Section 34.074, RSMo and 1 CSR 30-5.010, can be used to satisfy the MBE/WBE/SDVE participation goals for this project.**
- C. ****NOTE: Bidders are provided new Good Faith Effort (GFE) forms on MissouriBUYS.**

5.0 PRE-BID MEETING:

- A. Place/Time: 10 AM, Wednesday, July, 13, 2022, at the Moberly Correctional Center located at 5201 South Morley St, Moberly, Missouri 65270. All attendees will go through a background check the day of the meeting. You will be required to provide your full name, date of birth and social security number prior to entry.
- B. Access to State of Missouri property requires presentation of a photo ID by all persons.

6.0 HOW TO GET PLANS & SPECIFICATIONS:

- A. View Only Electronic bid sets are available at no cost or paper bid sets for a deposit of \$100 from American Document Solutions (ADS). **MAKE CHECKS PAYABLE TO: American Document Solutions.** Mail to: American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433, <https://www.adsplanroom.net>. NOTE: Prime contractors will be allowed a maximum of two bid sets at the deposit rate shown above. Other requesters will be allowed only one bid set at this rate. Additional bid sets or parts thereof may be obtained by any bidder at the cost of printing and shipping by request to American Document Solutions at the address shown above. **Bidder must secure at least one bid set to become a planholder.**
- B. **Refunds: Return plans and specifications in unmarked condition within 15 working days of bid opening to American Document Solutions, 1400 Forum Blvd., Suite 7A, Columbia, Missouri 65203. Phone 573-446-7768, Fax 573-355-5433. Deposits for plans not returned within 15 working days shall be forfeited.**
- C. Information for upcoming bids, including downloadable plans, specifications, Invitation for Bid, bid tabulation, award, addenda, and access to the ADS planholders list, is available on the Division of Facilities Management, Design and Construction's web site: <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

7.0 POINT OF CONTACT:

- A. Designer: BARTLETT AND WEST, Valerie Holland, phone # (573) 634-3181
- B. Project Manager: Eric Hibdon, phone # (573) 522-0322

8.0 GENERAL INFORMATION:

- A. The State reserves the right to reject any and all bids and to waive all informalities in bids. No bid may be withdrawn for a period of 20 working days subsequent to the specified bid opening time. The contractor shall pay not less than the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed, as determined by the Missouri Department of Labor and Industrial Relations and as set out in the detailed plans and specifications.
- B. Bid results will be available at <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans> after it is verified that at least one bid is awardable and affordable.

Very Important MissouriBUYS Instructions to Help Submit a Bid Correctly

- A. The bidder shall submit his or her bid and all supporting documentation on MissouriBUYS eProcurement System. No hard copy bids shall be accepted. Go to <https://missouribuys.mo.gov> and register. The bidder must register before access is granted to the solicitation details and bidding is possible, however, the bidder can review a summary of the project by selecting "Bid Board" and then checking off "Open" under "Status" and "OA-FMDC-Contracts Chapter 8" under "Organization" in the boxes shown on the left margin.
- B. Once registered, log in.
1. Under "Solicitation" select "View Current Solicitations." A new screen will open.
 2. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8."
 3. Under "Filter by Opp. No." type in the State Project Number. Select "Submit."
 4. Above the dark blue bar, select "Other Active Opportunities."
 5. To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information.
- C. Here are simplified instructions for uploading the bid to MissouriBUYS:
1. Find the solicitation by completing Steps 1 through 4 above.
 2. Select the three dots under "Actions." Select "Add New Response."
 3. When the Quote box opens, give the response a title and select "OK."
 4. The detailed solicitation will open. Select "Check All" for the Original Solicitation Documents, open each document, and select "Accept." If this step is not completed, a bid cannot be uploaded. Scroll to the bottom of the page and select "Add Attachments." If you do not see this command, not all documents have been opened and accepted.
 5. The Supplier Attachments box will open. Select "Add Attachment" again.
 6. The Upload Documents box will open. Read the instructions for uploading. Disregard the "Confidential" check box.
 7. Browse and attach up to 5 files at a time. Scroll to bottom of box and select "Upload." The Supplier Attachments box will open. Repeat Steps 5 through 7 if more than 5 files are to be uploaded.
 8. When the Supplier Attachments box opens again and uploading is complete, select "Done." A message should appear that the upload is successful. If it does not, go to the Bidder Response tab and select "Submit."
 9. The detailed solicitation will open. At the bottom select "Close."
- D. Any time a bidder wants to modify the bid, he or she will have to submit a new one. FMDC will open the last response the bidder submits. The bidder may revise and submit the bid up to the close of the solicitation (bid date and time). Be sure to allow for uploading time so that the bid is successfully uploaded prior to the 1:30 PM deadline; we can only accept the bid if it is uploaded before the deadline.
- E. If you want to verify that you are uploading documents correctly, we encourage you to submit a fake bid early. Label the fake bid as such to distinguish it from the real bid. The contracts person you contact will let you know if your "bid" was received successfully. Please contact Paul Girouard: 573-751-4797, paul.girouard@oa.mo.gov OR Mandy Roberson: 573-522-0074.
- F. If you are experiencing login issues, please contact Web Procure Support (Proactis) at 866-889-8533 anytime from 7:00 AM to 7:00 PM Central Time, Monday through Friday. If you try using a userid or password several times that is incorrect, the system will lock you out. Web Procure Support is the only option to unlock you! If you forget your userid or password, Web Procure Support will provide a temporary userid or password. Also, if it has been a while since your last successful login and you receive an "inactive" message, contact Web Procure (Proactis). If you are having a registration issue, you may contact Cathy Holliday at 573-751-3491 or by email: cathy.holliday@oa.mo.gov.

IMPORTANT REMINDER REGARDING REQUIREMENT FOR OEO CERTIFICATION

A. SECTION 002113 – INSTRUCTIONS TO
BIDDERS: Article 15.0, Section D1:

As of July 1, 2020, all MBE, WBE, and MBE/WBE contractors, subcontractors, and suppliers must be certified by the State of Missouri, Office of Equal Opportunity. No certifications from other Missouri certifying agencies will be accepted.

SECTION 002113 – INSTRUCTIONS TO BIDDERS

1.0 - SPECIAL NOTICE TO BIDDERS

- A. If awarded a contract, the Bidder's employees, and the employees of all subcontractors, who perform the work on the project must adhere to requirements in Section 013513 – Site Security and Health Requirements as applicable per Agency.
- B. The Bidder's prices shall include all city, state, and federal sales, excise, and similar taxes that may lawfully be assessed in connection with the performance of work, and the purchased of materials to be incorporated in the work. THIS PROJECT IS NOT TAX EXEMPT.

2.0 - BID DOCUMENTS

- A. The number of sets obtainable by any one (1) party may be limited in accordance with available supply.
- B. For the convenience of contractors, sub-contractors and suppliers, copies of construction documents are on file at the office of the Director, Division of Facilities Management, Design and Construction and on the Division's web site - <https://oa.mo.gov/facilities/bid-opportunities/bid-listing-electronic-plans>.

3.0 - BIDDERS' OBLIGATIONS

- A. Bidders must carefully examine the entire site of the work and shall make all reasonable and necessary investigations to inform themselves thoroughly as to the facilities available as well as to all the difficulties involved in the completion of all work in accordance with the specifications and the plans. Bidders are also required to examine all maps, plans and data mentioned in the specifications. No plea of ignorance concerning observable existing conditions or difficulties that may be encountered in the execution of the work under this contract will be accepted as an excuse for any failure or omission on the part of the contractor to fulfill in every detail all of the requirements of the contract, nor accepted as a basis for any claims for extra compensation.
- B. Under no circumstances will contractors give their plans and specifications to another contractor. Any bid received from a contractor whose name does not appear on the list of plan holders may be subject to rejection.

4.0 - INTERPRETATIONS

- A. No bidder shall be entitled to rely on oral interpretations as to the meaning of the plans and specifications or the acceptability of alternate products, materials, form or type of construction. Every request for interpretation shall be made in writing and submitted with all supporting documents not less than five (5) working days before opening of bids. Every interpretation made to a bidder will be in the form of an addendum and will be sent as promptly as is practicable to all persons to whom plans and specifications have been issued. All such addenda shall become part of the contract documents.
- B. Approval for an "acceptable substitution" issued in the form of an addendum as per Paragraph 4A above, and as per Article 3.1 of the General Conditions; ACCEPTABLE SUBSTITUTIONS shall constitute approval for use in the project of the product.
- C. An "acceptable substitution" requested after the award of bid shall be approved if proven to the satisfaction of the Owner and the Designer as per Article 3.1, that the product is acceptable in design, strength, durability, usefulness, and convenience for the purpose intended. Approval of the substitution after award is at the sole discretion of the Owner.
- D. A request for "Acceptable Substitutions" shall be made on the Section 006325 Substitution Request Form. The request shall be sent directly to the project Designer. A copy of said request should also be mailed to the Owner, Division of Facilities Management, Design and Construction, Post Office Box 809, Jefferson City, Missouri 65102.

5.0 - BIDS AND BIDDING PROCEDURE

- A. Bidders shall submit all submission forms and accompanying documents listed in SECTION 004113 – BID FORM, Article 5.0, ATTACHMENTS TO BID by the stated time or their bid will be rejected for being non-responsive.

Depending on the specific project requirements, **the following is a GENERIC list** of all possible bid forms that may be due with bid submittals and times when they may be due. Please check for specific project requirements on the proposal form (Section 004113). ***Not all of the following bid forms may be required to be submitted.***

Bid Submittal – due before stated date and time of bid opening (see IFB):

004113	Bid Form (all pages are always required)
004322	Unit Prices Form
004336	Proposed Subcontractors Form
004337	MBE/WBE/SDVE Compliance Evaluation Form
004338	MBE/WBE/SDVE Eligibility Determination for Joint Ventures
004339	MBE/WBE/SDVE GFE Determination
004340	SDVE Business Form
004541	Affidavit of Work Authorization
004545	Anti-Discrimination Against Israel Act Certification form

- B. All bids shall be submitted without additional terms and conditions, modification or reservation on the bid forms with each space properly filled. Bids not on these forms will be rejected.
- C. All bids shall be accompanied by a bid bond executed by the bidder and a duly authorized surety company, certified check, cashier's check or bank draft made payable to the Division of Facilities Management, Design and Construction, State of Missouri, in the amount indicated on the bid form, Section 004113. Failure of the contractor to submit the full amount required shall be sufficient cause to reject his bid. The bidder agrees that the proceeds of the check, draft or bond shall become the property of the State of Missouri, if for any reason the bidder withdraws his bid after closing, or if on notification of award refuses or is unable to execute tendered contract, provide an acceptable performance and payment bond, provide evidence of required insurance coverage and/or provide required copies of affirmative action plans within ten (10) working days after such tender.
- D. The check or draft submitted by the successful bidder will be returned after the receipt of an acceptable performance and payment bond and execution of the formal contract. Checks or drafts of all other bidders will be returned within a reasonable time after it is determined that the bid represented by same will receive no further consideration by the State of Missouri. Bid bonds will only be returned upon request.

6.0 - SIGNING OF BIDS

- A. A bid from an individual shall be signed as noted on the Bid Form.
- B. A bid from a partnership or joint venture shall require only one signature of a partner, an officer of the joint venture authorized to bind the venture or an attorney-in-fact. If the bid is signed by an officer of a joint venture or an attorney-in-fact, a document evidencing the individual's authority to execute contracts should be included with the bid form.
- C. A bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.
- D. A bid from a corporation shall have the correct corporate name thereon and the signature of an authorized officer of the corporation manually written. Title of office held by the person signing for the corporation shall appear, along with typed name of said individual. Corporate license number shall be provided and, if a corporation organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached. In addition, for corporate proposals, the President or Vice-President should sign as the bidder. If the signator is other than the corporate president or vice president, the bidder must provide satisfactory evidence that the signator has the legal authority to bind the corporation.

- E. A bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the bid form should appear as shown in the Secretary of State's records.
- F. The Bidder should include its corporate license number on the Bid Form and, if the corporation is organized in a state other than Missouri, a Certificate of Authority to do business in the State of Missouri shall be attached to the bid form.

7.0 - RECEIVING BID SUBMITTALS

- A. It is the bidder's sole responsibility to assure receipt by Owner of bid submittals by the date and time specified in the Invitation for Bid. Bids received after the date and time specified shall not be considered by the Owner.
- B. Bids must be submitted through the MissouriBUYS statewide eProcurement system (<https://www.missouribuys.mo.gov/>) in accordance with the instructions for that system. The Owner shall only accept bids submitted through MissouriBUYS. Bids received by the Owner through any other means, including hard copies, shall not be considered and will be discarded by the Owner unopened.
- C. To respond to an Invitation for Bid, the Bidder must first register with MissouriBUYS by going through the MissouriBUYS Home Page (<https://www.missouribuys.mo.gov/>), clicking the "Register" button at the top of the page, and completing the Vendor Registration. Once registered, the Bidder accesses its account by clicking the "Login" button at the top of the MissouriBUYS Home Page. Enter your USERID and PASSWORD, which the Bidder will select. Under Solicitations, select "View Current Solicitations." A new screen will open. Under "Filter by Agency" select "OA-FMDC-Contracts Chapter 8." Under "Filter by Opp. No." type in the State Project Number. Select "Submit." Above the dark blue bar, select "Other Active Opportunities." To see the Solicitation Summary, single click the Opp. No. (Project Number) and the summary will open. Single quick click each blue bar to open detailed information. The Bidder must read and accept the Original Solicitation Documents and complete all identified requirements. The Bidder should download and save all of the Original Solicitation Documents on its computer so that the Bidder can prepare its response to these documents. The Bidder should upload its completed response to the downloaded documents as an attachment to the electronic solicitation response.
- D. Step-by-step instructions for how a registered vendor responds to a solicitation electronically are provided in Section 001116 – Invitation For Bid.
- E. The Bidder shall submit its bid on the forms provided by the Owner on MissouriBUYS with each space fully and properly completed, including all amounts required for alternate bids, unit prices, cost accounting data, etc. The Owner may reject bids that are not on the Owner's forms or that do not contain all requested information.
- F. No Contractor shall stipulate in his bid any conditions not contained in the specifications or standard bid form contained in the contract documents. To do so may subject the Contractor's bid to rejection.
- G. The completed forms shall be without interlineations, alterations or erasures.

8.0 - MODIFICATION AND WITHDRAWAL OF BIDS

- A. Bidder may withdraw his bid at any time prior to scheduled closing time for receipt of bids, but no bidder may withdraw his bid for a period of twenty (20) working days after the scheduled closing time for receipt of bids.
- B. The Bidder shall modify his or her original bid by submitting a revised bid on MissouriBUYS.

9.0 - AWARD OF CONTRACT

- A. The Owner reserves the right to reject any and/or all bids and further to waive all informalities in bidding when deemed in the best interest of the State of Missouri.
- B. The Owner reserves the right to let other contracts in connection with the work, including but not by way of limitation, contracts for the furnishing and installation of furniture, equipment, machines, appliances and other apparatus.

- C. In awarding the contract the Owner may take into consideration the bidder's skill, facilities, capacity, experience, responsibility, previous work record, financial standing and the necessity of prompt and efficient completion of work herein described. Inability of any bidder to meet the requirements mentioned above may be cause for rejection of his bid. However, no contract will be awarded to any individual, partnership or corporation, who has had a contract with the State of Missouri declared in default within the preceding twelve months.
- D. Award of alternates, if any, will be made in numerical order unless all bids received are such that the order of acceptance of alternates does not affect the determination of the low bidder.
- E. No bid shall be considered binding upon the Owner until the written contract has been properly executed, a satisfactory bond has been furnished, evidence of required insurance coverage, submittal of executed Section 004541, Affidavit of Work Authorization form, documentation evidencing enrollment and participation in a federal work authorization program has been received and an affirmative action plan submitted. Failure to execute and return the contract and associated documents within the prescribed period of time shall be treated, at the option of the Owner, as a breach of bidder's obligation and the Owner shall be under no further obligation to bidder.
- F. If the successful bidder is doing business in the State of Missouri under a fictitious name, he shall furnish to Owner, attached to the Bid Form, a properly certified copy of the certificate of Registration of Fictitious Name from the State of Missouri, and such certificate shall remain on file with the Owner.
- G. Any successful bidder which is a corporation organized in a state other than Missouri shall furnish to the Owner, attached to the Bid Form, a properly certified copy of its current Certificate of Authority to do business in the State of Missouri, such certificate to remain on file with the Owner. No contract will be awarded by the Owner unless such certificate is furnished by the bidder.
- H. Any successful bidder which is a corporation organized in the State of Missouri shall furnish at its own cost to the Owner, if requested, a Certificate of Good Standing issued by the Secretary of State, such certificate to remain on file with the Owner.
- I. Transient employers subject to Sections 285.230 and 285.234, RSMo, (out-of-state employers who temporarily transact any business in the State of Missouri) may be required to file a bond with the Missouri Department of Revenue. No contract will be awarded by the Owner unless the successful bidder certifies that he has complied with all applicable provisions of Section 285.230-234.
- J. Sections 285.525 and 285.530, RSMo, require business entities to enroll and participate in a federal work authorization program in order to be eligible to receive award of any state contract in excess of \$5,000. Bidders should submit with their bid an Affidavit of Work Authorization (Section 004541) along with appropriate documentation evidencing such enrollment and participation. Section-004541, Affidavit of Work Authorization is located on the MissouriBUYS solicitation for this project. Bidders must also submit an E-Verify Memorandum before the Owner may award a contract to the Bidder. Information regarding a E-Verify is located at <https://www.uscis.gov/e-verify/>. The contractor shall be responsible for ensuring that all subcontractors and suppliers associated with this contract enroll in E-Verify.

10.0 - CONTRACT SECURITY

- A. The successful bidder shall furnish a performance/payment bond as set forth in General Conditions Article 6.1 on a condition prior to the State executing the contract and issuing a notice to proceed.

11.0 - LIST OF SUBCONTRACTORS

- A. If required by "Section 004113 – Bid Form," each bidder must submit as part of their bid a list of subcontractors to be used in performing the work (Section 004336). The list must specify the name of the single designated subcontractor, for each category of work listed in "Section 004336 - Proposed Subcontractors Form." If work within a category will be performed by more than one subcontractor, the bidder must provide the name of each subcontractor and specify the exact portion of the work to be done by each. Failure to list the Bidder's firm, or a subcontractor for each category of work identified on the Bid Form or the listing of more than one subcontractor for any category without designating the portion of work to be performed by each shall be cause for rejection of the bid. If the bidder intends to perform any of the designated subcontract work with the use of his own employees, the bidder shall make that fact

clear, by listing his own firm for the subject category. **If any category of work is left vacant, the bid shall be rejected.**

12.0 - WORKING DAYS

- A. Contract duration time is stated in working days and will use the following definition in determining the actual calendar date for contract completion:
 - 1. Working days are defined as all calendar days except Saturdays, Sundays and the following State of Missouri observed holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday, Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day and Christmas Day.

13.0 - AMERICAN AND MISSOURI - MADE PRODUCTS AND FIRMS

- A. By signing the bid form and submitting a bid on this project, the Bidder certifies that it will use American and Missouri products as set forth in Article 1.7 of the General Conditions. Bidders are advised to review those requirements carefully prior to bidding.
- B. A preference shall be given to Missouri firms, corporations or individuals, or firms, corporations or individuals that maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less.
- C. Pursuant to Section 34.076, RSMo, a contractor or Bidder domiciled outside the boundaries of the State of Missouri shall be required, in order to be successful, to submit a bid the same percent less than the lowest bid submitted by a responsible contractor or Bidder domiciled in Missouri as would be required for such a Missouri domiciled contractor or Bidder to succeed over the bidding contractor or Bidder domiciled outside Missouri on a like contract or bid being let in the person's domiciliary state and, further, the contractor or Bidder domiciled outside the boundaries of Missouri shall be required to submit an audited financial statement as would be required of a Missouri domiciled contractor or Bidder on a like contract or bid being let in the domiciliary state of that contractor or Bidder.

14.0 – ANTI-DISCRIMINATION AGAINST ISRAEL ACT CERTIFICATION:

- A. Pursuant to section 34.600, RSMo, if the Bidder meets the section 34.600, RSMo, definition of a “company” and the Bidder has ten or more employees, the Bidder must certify in writing that the Bidder is not currently engaged in a boycott of goods or services from the State of Israel as defined in section 34.600, RSMo, and shall not engage in a boycott of goods or services from the State of Israel, if awarded a contract, for the duration of the contract. The Bidder is requested to complete and submit the applicable portion of Section 004545 - Anti-Discrimination Against Israel Act Certification with their Bid Form. The applicable portion of the exhibit must be submitted prior to execution of a contract by the Owner and issuance of Notice to Proceed. If the exhibit is not submitted, the Owner shall rescind its Intent to Award and move to the next lowest, responsive, responsible bidder.

15.0 - MBE/WBE/SDVE INSTRUCTIONS

- A. Definitions:
 - 1. “**MBE**” means a Minority Business Enterprise.
 - 2. “**MINORITY**” has the same meaning as set forth in 1 C.S.R. 10-17.010.
 - 3. “**MINORITY BUSINESS ENTERPRISE**” has the same meaning as set forth in section 37.020, RSMo.
 - 4. “**WBE**” means a Women’s Business Enterprise.
 - 5. “**WOMEN’S BUSINESS ENTERPRISE**” has the same meaning as set forth in section 37.020, RSMo.
 - 6. “**SDVE**” means a Service-Disabled Veterans Enterprise.
 - 7. “**SERVICE-DISABLED VETERAN**” has the same meaning as set forth in section 34.074, RSMo.

8. **“SERVICE-DISABLED VETERAN ENTERPRISE”** has the same meaning as “Service-Disabled Veteran Business” set forth in section 34.074, RSMo.

B. MBE/WBE/SDVE General Requirements:

1. For all bids greater than \$100,000, the Bidder shall obtain MBE, WBE and SDVE participation in an amount equal to or greater than the percentage goals set forth in the Invitation for Bid and the Bid Form, unless the Bidder is granted a Good Faith Effort waiver by the Director of the Division, as set forth below. If the Bidder does not meet the MBE, WBE and SDVE goals, or make a good faith effort to do so, the Bidder shall be non-responsive, and its bid shall be rejected.
2. The Bidder should submit with its bid all of the information requested in the MBE/WBE/SDVE Compliance Evaluation Form for every MBE, WBE, or SDVE subcontractor or material supplier the Bidder intends to use for the contract work. The Bidder is required to submit all appropriate MBE/WBE/SDVE documentation before the stated time and date set forth in the Invitation for Bid. If the Bidder fails to provide such information by the specified date and time, the Owner shall reject the bid.
3. The Director reserves the right to request additional information from a Bidder to clarify the Bidder’s proposed MBE, WBE, and/or SDVE participation. The Bidder shall submit the clarifying information requested by the Owner within two (2) Working Days of receiving the request for clarification.
4. Pursuant to section 34.074, RSMo, a Bidder that is a SDVE doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business, shall receive a three-point bonus preference in the contract award evaluation process. The bonus preference will be calculated and applied by reducing the bid amount of the eligible SDVE by three percent of the apparent low responsive bidder’s bid. Based on this calculation, if the eligible SDVE’s evaluation is less than the apparent low responsive bidder’s bid, the eligible SDVE’s bid becomes the apparent low responsive bid. This reduction is for evaluation purposes only, and will have no impact on the actual amount(s) of the bid or the amount(s) of any contract awarded. In order to be eligible for the SDVE preference, the Bidder must complete and submit with its bid the Missouri Service Disabled Veteran Business Form, and any information required by the form. The form is available on the MissouriBUYs solicitation for this project.

C. Computation of MBE/WBE/SDVE Goal Participation:

1. A Bidder who is a MBE, WBE, or SDVE may count 100% of the contract towards the MBE, WBE or SDVE goal, less any amounts awarded to another MBE, WBE or SDVE. (NOTE: A MBE firm that bids as general contractor must obtain WBE and SDVE participation; a WBE firm that bids as a general contractor must obtain MBE and SDVE participation; and a SDVE firm that bids as general contractor must obtain MBE and WBE participation.) In order for the remaining contract amount to be counted towards the MBE, WBE or SDVE goal, the Bidder must complete the MBE/WBE/SDVE Compliance Evaluation Form (Section 004337) identifying itself as an MBE, WBE or SDVE.
2. The total dollar value of the work granted to a certified MBE, WBE or SDVE by the Bidder shall be counted towards the applicable goal.
3. Expenditures for materials and supplies obtained from a certified MBE, WBE, or SDVE supplier or manufacturer may be counted towards the MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE assumes the actual and contractual responsibility for the provision of the materials and supplies.
4. The total dollar value of the work granted to a second or subsequent tier subcontractor or a supplier may be counted towards a Bidder’s MBE, WBE and SDVE goals, if the MBE, WBE, or SDVE properly assumes the actual and contractual responsibility for the work.
5. The total dollar value of work granted to a certified joint venture equal to the percentage of the ownership and control of the MBE, WBE, or SDVE partner in the joint venture may be counted towards the MBE/WBE/SDVE goals.
6. Only expenditures to a MBE, WBE, or SDVE that performs a commercially useful function in the work may be counted towards the MBE, WBE and SDVE goals. A MBE, WBE, or SDVE performs a commercially useful function when it is responsible for executing a distinct element of the work

and carrying out its responsibilities by actually performing, managing and supervising the work or providing supplies or manufactured materials.

D. Certification of MBE/WBE/SDVE Subcontractors:

1. In order to be counted towards the goals, an MBE or WBE must be certified by the State of Missouri Office of Equal Opportunity and an SDVE must be certified by the State of Missouri, Office of Administration, Division of Purchasing and Material Management or by the Department of Veterans Affairs.
2. The Bidder may determine the certification status of a proposed MBE or WBE subcontractor or supplier by referring to the Office of Equal Opportunity (OEO)'s online MBE/WBE directory (<https://apps1.mo.gov/MWBCertifiedFirms/>). The Bidder may determine the eligibility of a SDVE subcontractor or supplier by referring to the Division of Purchasing and Materials Management's online SDVE directory (<https://oa.mo.gov/sites/default/files/sdvelisting.pdf>) or the Department of Veterans Affairs' directory (<https://vetbiz.va.gov/basic-search/>).
3. Additional information, clarifications, etc., regarding the listings in the directories may be obtained by calling the Division at (573)751-3339 and asking to speak to the Contract Specialist of record as shown in the Supplementary Conditions (Section 007300).

E. Waiver of MBE/WBE/SDVE Participation:

1. If a Bidder has made a good faith effort to secure the required MBE, WBE and/or SDVE participation and has failed, the Bidder shall submit with its bid the information requested in MBE/WBE/SDVE Good Faith Effort (GFE) Determination form. The GFE forms are located on the MissouriBUYS solicitation for this project. The Director will determine if the Bidder made a good faith effort to meet the applicable goals. If the Director determines that the Bidder did not make a good faith effort, the bid shall be rejected as being nonresponsive to the bid requirements. Bidders who demonstrate that they have made a good faith effort to include MBE, WBE, and/or SDVE participation will be determined to be responsive to the applicable participation goals, regardless of the percent of actual participation obtained, if the bid is otherwise acceptable.
2. In determining whether a Bidder has made a good faith effort to obtain MBE, WBE and/or SDVE participation, the Director may evaluate the factors set forth in 1 CSR 30-5.010(6)(C) and the following:
 - a. The amount of actual participation obtained;
 - b. How and when the Bidder contacted potential MBE, WBE, and SDVE subcontractors and suppliers;
 - c. The documentation provided by the Bidder to support its contacts, including whether the Bidder provided the names, addresses, phone numbers, and dates of contact for MBE/WBE/SDVE firms contacted for specific categories of work;
 - d. If project information, including plans and specifications, were provided to MBE/WBE/SDVE subcontractors;
 - e. Whether the Bidder made any attempts to follow-up with MBE, WBE or SDVE firms prior to bid;
 - f. Amount of bids received from any of the subcontractors and/or suppliers that the Bidder contacted;
 - g. The Bidder's stated reasons for rejecting any bids;
3. If no bidder has obtained any participation in a particular category (MBE/WBE/SDVE) or made a good faith effort to do so, the Director may waive that goal rather than rebid.

F. Contractor MBE/WBE/SDVE Obligations

1. If awarded a contract, the Bidder will be contractually required to subcontract with or obtain materials from the MBE, WBE, and SDVE firms listed in its bid, in amounts equal to or greater than the dollar amount bid, unless the amount is modified in writing by the Owner.
2. If the Contractor fails to meet or maintain the participation requirements contained in the Contractor's bid, the Contractor must satisfactorily explain to the Director why it cannot comply with the requirement and why failing meeting the requirement was beyond the Contractor's control. If the Director finds the Contractor's explanation unsatisfactory, the Director may take any appropriate action including, but not limited to:
 - a. Declaring the Contractor ineligible to participate in any contracts with the Division for up to twelve (12) months (suspension); and/or
 - b. Declaring the Contractor be non-responsive to the Invitation for Bid, or in breach of contract and rejecting the bid or terminating the contract.
3. If the Contractor replaces an MBE, WBE, or SDVE during the course of this contract, the Contractor shall replace it with another MBE, WBE, or SDVE or make a good faith effort to do so. All MBE, WBE and SDVE substitutions must be approved by the Director.
4. The Contractor shall provide the Owner with regular reports on its progress in meeting its MBE/WBE/SDVE obligations. At a minimum, the Contractor shall report the dollar-value of work completed by each MBE, WBE, or SDVE during the preceding month and the cumulative total of work completed by each MBE, WBE or SDVE to date with each monthly application for payment. The Contractor shall also make a final report, which shall include the total dollar-value of work completed by each MBE, WBE, and SDVE during the entire contract.

STATE OF MISSOURI
DIVISION OF FACILITIES MANAGEMENT,
DESIGN AND CONSTRUCTION
MBE/WBE/SDVE DIRECTORY

The MBE/WBE Directory for goods and services is maintained by the Office of Equal Opportunity (OEO). The current Directory can be accessed at the following web address:

<https://apps1.mo.gov/MWBCertifiedFirms/>

Please note that you may search by MBE, WBE, or both as well as by region, location of the business by city or state, as well as by commodity or service.

The SERVICE DISABLED VETERAN ENTERPRISE (SDVE) Directory (s) may be accessed at the following web addresses:

<https://oa.mo.gov/sites/default/files/sdvelisting.pdf>

<https://vetbiz.va.gov/basic-search/>



State of Missouri Construction Contract

THIS AGREEMENT is made (DATE) by and between:

Contractor Name and Address

hereinafter called the "Contractor,"

and the **State of Missouri**, hereinafter called the "**Owner**", represented by the Office of Administration, Division of Facilities Management, Design and Construction, on behalf of the Department of Corrections.

WITNESSETH, that the Contractor and the Owner, for the consideration stated herein agree as follows:

ARTICLE 1. STATEMENT OF WORK

The Contractor shall furnish all labor and materials and perform all work required for furnishing and installing all labor, materials, equipment and transportation and everything necessarily inferred from the general nature and tendency of the plans and specifications for the proper execution of the work for:

Project Name: **Wastewater Treatment Facility Improvements
Moberly Correctional Center
Moberly, Missouri**

Project Number: **C1806-01**

in strict accordance with the Contract Documents as enumerated in Article 7, all of which are made a part hereof.

ARTICLE 2. TIME OF COMPLETION

The contract performance time is **288 working days** from the transmittal date of this agreement. The contract completion date is **MONTH, DAY, YEAR**. This time includes ten (10) working days for the Contractor to receive, sign and return the contract form along with required bonding and insurance certificates. Failure of the Contractor to provide correct bonding and insurance within the ten (10) working days shall not be grounds for a time extension. Receipt of proper bonding and insurance is a condition precedent to the formation of the contract and if not timely received, may result in forfeiture of the Contractor's bid security. Work may not commence until the Owner issues a written Notice to Proceed and must commence within seven (7) working days thereafter.

ARTICLE 3. LIQUIDATED DAMAGES

Whenever time is mentioned in this contract, time shall be and is of the essence of this contract. The Owner would suffer a loss should the Contractor fail to have the work embraced in this contract fully completed on or before the time above specified. THEREFORE, the parties hereto realize in order to adjust satisfactorily the damages on account of such failure that it might be impossible to compute accurately or estimate the amount of such loss or damages which the Owner would sustain by reason of failure to complete fully said work within the time required by this contract. The Contractor hereby covenants and agrees to pay the Owner, as and for **liquidated damages, the sum of \$1,500** per day for each and every day, Sunday and legal holidays excepted, during which the work remains incomplete and unfinished. Any sum which may be due the Owner for such damages shall be deducted and retained by the Owner from any balance which may be due the Contractor when said work shall have been finished and accepted. But such provisions shall not release the Bond of the Contractor from liability according to its terms. In case of failure to complete, the Owner will be under no obligation to show or prove any actual or specific loss or damage.

ARTICLE 4. CONTRACT SUM

The Owner shall pay the Contractor for the prompt, faithful and efficient performance of the conditions and undertakings of this contract, subject to additions, and deductions as provided herein, in current funds the sum of:

Base Bid: \$
Alternate No. 1: \$
Alternate No. 2: \$

TOTAL CONTRACT AMOUNT: (\$CONTRACT AMOUNT)

ARTICLE 5. PREVAILING WAGE RATE

MISSOURI PREVAILING WAGE LAW (Sections 290.210 to 290.340, RSMo): The Contractor shall pay not less than the specified hourly rate of wages, as set out in the wage order attached to and made part of the specifications for work under this contract, to all workers performing work under the contract, in accordance with sections 290.210 to 290.340, RSMo. The Contractor shall forfeit a penalty to the Owner of one hundred dollars per day (or portion of a day) for each worker that is paid less than the specified rates for any work done under the contract by the Contractor or by any subcontractor, in accordance with section 290.250, RSMo.

ARTICLE 6. MINORITY/WOMEN/SERVICE DISABLED VETERAN BUSINESS ENTERPRISE PARTICIPATION

The Contractor has been granted a waiver of the 10% MBE and 10% WBE and 3% SDVE participation goals. The Contractor agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows: (OR)

The Contractor has met the MBE/WBE/SDVE participation goals and agrees to secure the MBE/WBE/SDVE participation amounts for this project as follows:

MBE/WBE/SDVE Firm: Subcontract Amt:\$
MBE/WBE/SDVE Firm: Subcontract Amt:\$
MBE/WBE/SDVE Firm: Subcontract Amt:\$

Total \$

MBE/WBE/SDVE assignments identified above shall not be changed without a contract change signed by the Owner.

The Director of the Division of Facilities Management, Design and Construction or his Designee shall be the final authority to resolve disputes and disagreements between the Contractor and the MBE/WBE/SDVE firms listed above when such disputes impact the subcontract amounts shown above.

ARTICLE 7. CONTRACT DOCUMENTS

The following documents are hereby incorporated into this contract by reference (all division/section numbers and titles are as utilized in the Project Manual published by the Owner for this Project):

- 1. Division 0 – Procurement and Contracting Information, including, but not limited to:
 - a. Invitation for Bid (Section 001116)
 - b. Instructions to Bidders (Section 002113)
 - c. Supplementary Instructions to Bidders (if applicable) (Section 002213)
 - d. The following documents as completed and executed by the Contractor and accepted by the Owner, if applicable:
 - i. Bid Form (Section 004113)
 - ii. Unit Prices (Section 004322)
 - iii. Proposed Contractors Form (Section 004336)
 - iv. MBE, WBE, SDVE Compliance Evaluation Form(s) (Section 004337)
 - v. MBE, WBE, SDVE Eligibility Determination Form for Joint Ventures (Section 004338)
 - vi. MBE, WBE, SDVE Good Faith Effort (GFE) Determination Form (Section 004339)

- vii. Missouri Service Disabled Veteran Business Form (Section 004340)
- viii. Affidavit of Work Authorization (Section 004541)
- ix. Affidavit for Affirmative Action (Section 005414)
- e. Performance and Payment Bond, completed and executed by the Contractor and surety (Section 006113)
- f. General Conditions (Section 007213)
- g. Supplementary Conditions (Section 007300)
- h. Wage Rate(s) (Section 007346)
- 2. Division 1 – General Requirements
- 3. All Drawings identified in the Project Manual
- 4. All Technical Specifications included in the Project Manual
- 5. Addenda, if applicable

By signature below, the parties hereby execute this contract document.

APPROVED:

Mark Hill, P.E., Director
 Division of Facilities Management,
 Design and Construction

Contractor's Authorized Signature

I, Corporate Secretary, certify that I am Secretary of the corporation named above and that (CONTRACTOR NAME), who signed said contract on behalf of the corporation, was then (TITLE) of said corporation and that said contract was duly signed for and in behalf of the corporation by authority of its governing body, and is within the scope of its corporate powers.

Corporate Secretary



STATE OF MISSOURI
 OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
AFFIDAVIT FOR AFFIRMATIVE ACTION

PROJECT NUMBER

NAME

First being duly sworn on oath states: that

he/she is the sole proprietor partner officer or manager or managing member of

NAME

a sole proprietorship partnership
 limited liability company (LLC)

or corporation, and as such, said proprietor, partner, or officer is duly authorized to make this

affidavit on behalf of said sole proprietorship, partnership, or corporation; that under the contract known as

PROJECT TITLE

Less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in Article 1.4 of the General Conditions of the State of Missouri have been met.

PRINT NAME & SIGNATURE

DATE

--

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSER SEAL	STATE OF	COUNTY (OR CITY OF ST. LOUIS)	USE RUBBER STAMP IN CLEAR AREA BELOW
	SUBSCRIBED AND SWORN BEFORE ME, THIS		
	DAY OF	YEAR	
	NOTARY PUBLIC SIGNATURE	MY COMMISSION EXPIRES	
NOTARY PUBLIC NAME (TYPED OR PRINTED)			

SECTION 006113 - PERFORMANCE AND PAYMENT BOND FORM

KNOW ALL MEN BY THESE PRESENTS, THAT we _____

as principal, and _____

_____ as Surety, are held and firmly bound unto the

STATE OF MISSOURI. in the sum of _____ Dollars (\$ _____)

for payment whereof the Principal and Surety bind themselves, their heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

WHEREAS, the Principal has, by means of a written agreement dated the _____

day of _____, 20_____, enter into a contract with the State of Missouri for

(Insert Project Title and Number)

NOW, THEREFORE, if the Principal shall faithfully perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the State of Missouri, with or without notice to the Surety and during the life of any guaranty required under the contract; and shall also faithfully perform and fulfill all undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made with or without notice to the Surety; and shall also promptly make payment for materials incorporated, consumed or used in connection with the work set forth in the contract referred to above, and all insurance premiums, both compensation and all other kinds of insurance, on said work, and for all labor performed on such work, whether by subcontractor or otherwise, at not less than the prevailing hourly rate of wages for work of a similar character (exclusive of maintenance work) in the locality in which the work is performed and not less than the prevailing hourly rate of wages for legal holiday and overtime work (exclusive of maintenance work) in the locality in which the work is performed both as determined by the Department of Labor and Industrial Relations or determined by the Court of Appeal, as provided for in said contract and in any and all duly authorized modifications of said contract that may be hereafter made, with or without notice to the Surety, then, this obligation shall be void and of no effect, but it is expressly understood that if the Principal should make default in or should fail to strictly, faithfully and efficiently do, perform and comply with any or more of the covenants, agreements, stipulations, conditions, requirements or undertakings, as specified in or by the terms of said contract, and with the time therein named, then this obligation shall be valid and binding upon each of the parties hereto and this bond shall remain in full force and effect; and the same may be sued on at the instance of any material man, laborer, mechanic, subcontractor, individual, or otherwise to whom such payment is due, in the name of the State of Missouri, to the use of any such person.

AND, IT IS FURTHER specifically provided that any modifications which may hereinafter be made in the terms of the contract or in the work to be done under it or the giving by the Owner of any extension of the time for the performance of the contract or any other forbearance on the part of either the Owner or the Principal to the other, shall not in any way release the Principal and the Surety, or either or any of them, their heirs, executors, administrators and successors, from their liability hereunder, notice to the Surety of any such extension, modifications or forbearance being hereby waived.

IN WITNESS WHEREOF, the above bounden parties have executed the within instrument this _____ day of _____, 20 ____.

AS APPLICABLE:

AN INDIVIDUAL

Name: _____

Signature: _____

A PARTNERSHIP

Name of Partner: _____

Signature of Partner: _____

Name of Partner: _____

Signature of Partner: _____

CORPORATION

Firm Name: _____

Signature of President: _____

SURETY

Surety Name: _____

Attorney-in-Fact: _____

Address of Attorney-in-Fact: _____

Telephone Number of Attorney-in-Fact: _____

Signature Attorney-in-Fact: _____

NOTE: Surety shall attach Power of Attorney



STATE OF MISSOURI
 OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
PRODUCT SUBSTITUTION REQUEST

PROJECT NUMBER

PROJECT TITLE AND LOCATION

CHECK APPROPRIATE BOX

- SUBSTITUTION PRIOR TO BID OPENING**
 (Minimum of (5) working days prior to receipt of Bids as per Article 4 – Instructions to Bidders)
- SUBSTITUTION FOLLOWING AWARD**
 (Maximum of (20) working days from Notice to Proceed as per Article 3 – General Conditions)

FROM: BIDDER/CONTRACTOR (PRINT COMPANY NAME)

TO: ARCHITECT/ENGINEER (PRINT COMPANY NAME)

Bidder/Contractor hereby requests acceptance of the following product or systems as a substitution in accordance with provisions of Division One of the Bidding Documents:

SPECIFIED PRODUCT OR SYSTEM

SPECIFICATION SECTION NO.

SUPPORTING DATA

- Product data for proposed substitution is attached (include description of product, standards, performance, and test data)
- Sample Sample will be sent, if requested

QUALITY COMPARISON

	SPECIFIED PRODUCT	SUBSTITUTION REQUEST
NAME, BRAND		
CATALOG NO.		
MANUFACTURER		
VENDOR		

PREVIOUS INSTALLATIONS

PROJECT	ARCHITECT/ENGINEER
LOCATION	DATE INSTALLED

SIGNIFICANT VARIATIONS FROM SPECIFIED PRODUCT

REASON FOR SUBSTITUTION

DOES PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?

YES NO

IF YES, EXPLAIN

SUBSTITUTION REQUIRES DIMENSIONAL REVISION OR REDESIGN OF STRUCTURE OR A/E WORK

YES NO

BIDDER'S/CONTRACTOR'S STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:

We have investigated the proposed substitution. We believe that it is equal or superior in all respects to specified product, except as stated above; that it will provide the same Warranty as specified product; that we have included complete implications of the substitution; that we will pay redesign and other costs caused by the substitution which subsequently become apparent; and that we will pay costs to modify other parts of the Work as may be needed, to make all parts of the Work complete and functioning as a result of the substitution.

BIDDER/CONTRACTOR

DATE

REVIEW AND ACTION

Resubmit Substitution Request with the following additional information:

Substitution is accepted.

Substitution is accepted with the following comments:

Substitution is not accepted.

ARCHITECT/ENGINEER

DATE



STATE OF MISSOURI
 OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
FINAL RECEIPT OF PAYMENT AND RELEASE

PROJECT NUMBER

KNOW ALL MEN BY THESE PRESENT THAT: hereinafter called "Subcontractor" who heretofore entered into an agreement with hereinafter called "Contractor", for the performance of work and/or furnishing of material for the construction of the project entitled

(PROJECT TITLE, PROJECT LOCATION, AND PROJECT NUMBER)

at

 (ADDRESS OF PROJECT)

for the State of Missouri (Owner) which said subcontract is by this reference incorporated herein, in consideration of such final payment by Contractor.

DOES HEREBY:

1. ACKNOWLEDGE that they have been **PAID IN FULL** all sums due for work and materials contracted or done by their Subcontractors, Material Vendors, Equipment and Fixture Suppliers, Agents and Employees, or otherwise in the performance of the Work called for by the aforesaid Contract and all modifications or extras or additions thereto, for the construction of said project or otherwise.
2. RELEASE and fully, finally, and forever discharge the Owner from any and all suits, actions, claims, and demands for payment for work performed or materials supplied by Subcontractor in accordance with the requirements of the above referenced Contract.
1. REPRESENT that all of their Employees, Subcontractors, Material Vendors, Equipment and Fixture Suppliers, and everyone else has been **paid in full** all sums due them, or any of them, in connection with performance of said Work, or anything done or omitted by them, or any of them in connection with the construction of said improvements, or otherwise.

DATED this day of , 20 .

NAME OF SUBCONTRACTOR

BY (TYPED OR PRINTED NAME)

SIGNATURE

TITLE

ORIGINAL: FILE/Closeout Documents



STATE OF MISSOURI
 OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES MANAGEMENT,
 DESIGN AND CONSTRUCTION

MBE/WBE/SDVE PROGRESS REPORT

Remit with **ALL** Progress and Final Payments

(Please check appropriate box) CONSULTANT CONSTRUCTION

PAY APP NO.	PROJECT NUMBER
CHECK IF FINAL <input checked="" type="checkbox"/> FINAL	DATE

PROJECT TITLE

PROJECT LOCATION

FIRM

ORIGINAL CONTRACT SUM (Same as Line Item 1. on Form A of Application for Payment)
\$

TOTAL CONTRACT SUM TO DATE (Same as Line Item 3. on Form A of Application for Payment)
\$

THE TOTAL MBE/WBE/SDVE PARTICIPATION DOLLAR AMOUNT OF THIS PROJECT AS INDICATED IN THE ORIGINAL CONTRACT: \$

SELECT MBE, WBE, SDVE	TOTAL AMOUNT OF SUBCONTRACT	\$ AMOUNT PAID-TO-DATE (include approved contract changes)	CONSULTANT/SUBCONSULTANT OR CONTRACTOR/SUBCONTRACTOR/SUPPLIER COMPANY NAME
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	
<input type="checkbox"/> MBE <input type="checkbox"/> WBE <input type="checkbox"/> SDVE	\$	\$	

INSTRUCTIONS FOR MBE/WBE/SDVE PROGRESS REPORT

CONTRACTOR OR CONSULTANT TO FILL OUT AND REMIT WITH EACH PAY APPLICATION:

The MBE/WBE/SDVE Progress Report for the project is issued with the contract comprising values reported in the consultant's Proposal or on the successful contractor's Section 004337 Compliance Evaluation Forms.

At Initial Pay Application fill in the following:

1. Pay App No. Start with 1.
2. Fill in the Project Number and Date.
3. Enter Project Title, Project Location, and Firm.
4. Fill in the "Original Contract Sum" and "Total Contract Sum To Date" (Reference applicable Line Items on Form A of Application for Payment).
5. Indicate the Total Participation Dollar Amount from the Original Contract.
6. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier.
7. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.

For all subsequent Pay Applications fill in the following:

1. Pay App No.
2. If Final Pay App, check box.
3. Fill in the Project Number and Date.
4. Enter Project Title, Project Location, and Firm
5. At each Pay App fill in the "Original Contract Sum" and "Total Contract Sum To Date" (reference applicable Line Items on Form A of Application for Payment).
6. Indicate the Total Participation Dollar Amount from the Original Contract.
7. Select MBE, WBE, or SDVE for each Consultant/Subconsultant or Contractor/Subcontractor/Supplier
8. Enter the "Total Amount of Subcontract", "\$ Amount (Paid-To-Date)", and Company Name.



STATE OF MISSOURI
 OFFICE OF ADMINISTRATION
 DIVISION OF FACILITIES MANAGEMENT, DESIGN AND CONSTRUCTION
AFFIDAVIT – COMPLIANCE WITH PREVAILING WAGE LAW

PROJECT NUMBER

Before me, the undersigned Notary Public, in and for the County of _____

State of _____ personally came and appeared _____

(NAME)

of the _____

(POSITION)

(NAME OF THE COMPANY)

(a corporation) (a partnership) (a proprietorship) and after being duly sworn did depose and say that all provisions and requirements set out in Chapter 290, Sections 290.210 through and including 290.340, Missouri Revised Statutes, pertaining to the payment of wages to workmen employed on public works project have been fully satisfied and there has been no exception to the full and completed compliance with said provisions and requirements

and with Wage Determination No: _____ issued by the

Department of Labor and Industrial Relations, State of Missouri on the _____ day of _____ 20__

in carrying out the contract and working in connection with _____

(NAME OF PROJECT)

Located at _____ in _____ County

(NAME OF THE INSTITUTION)

Missouri, and completed on the _____ day of _____ 20__

SIGNATURE

NOTARY INFORMATION

NOTARY PUBLIC EMBOSSEER OR BLACK INK RUBBER STAMP SEAL

STATE

COUNTY (OR CITY OF ST. LOUIS)

SUBSCRIBED AND SWORN BEFORE ME, THIS

DAY OF

YEAR

USE RUBBER STAMP IN CLEAR AREA BELOW

NOTARY PUBLIC SIGNATURE

MY COMMISSION EXPIRES

NOTARY PUBLIC NAME (TYPED OR PRINTED)

GENERAL CONDITIONS

INDEX

ARTICLE:

1. General Provisions

- 1.1. Definitions
- 1.2. Drawings and Specifications
- 1.3. Compliance with Laws, Permits, Regulations and Inspections
- 1.4. Nondiscrimination in Employment
- 1.5. Anti-Kickback
- 1.6. Patents and Royalties
- 1.7. Preference for American and Missouri Products and Services
- 1.8. Communications
- 1.9. Separate Contracts and Cooperation
- 1.10. Assignment of Contract
- 1.11. Indemnification
- 1.12. Disputes and Disagreements

2. Owner/Designer Responsibilities

3. Contractor Responsibilities

- 3.1. Acceptable Substitutions
- 3.2. Submittals
- 3.3. As-Built Drawings
- 3.4. Guaranty and Warranties
- 3.5. Operation and Maintenance Manuals
- 3.6. Other Contractor Responsibilities
- 3.7. Subcontracts

4. Changes in the Work

- 4.1. Changes in the Work
- 4.2. Changes in Completion Time

5. Construction and Completion

- 5.1. Construction Commencement
- 5.2. Project Construction
- 5.3. Project Completion
- 5.4. Payments

6. Bond and Insurance

6.1. Bond

6.2. Insurance

7. Termination or Suspension of Contract

7.1. For Site Conditions

7.2. For Cause

7.3. For Convenience

SECTION 007213 - GENERAL CONDITIONS

- A. These General Conditions apply to each section of these specifications. The Contractor is subject to the provisions contained herein.
- B. The General Conditions are intended to define the relationship of the Owner, the Designer and the Contractor thereby establishing certain rules and provisions governing the operation and performance of the work so that the work may be performed in a safe, orderly, expeditious and workmanlike manner.

ARTICLE 1 – GENERAL PROVISIONS

ARTICLE 1.1 - DEFINITIONS

As used in these contract documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

- 1. **"COMMISSIONER"**: The Commissioner of the Office of Administration.
- 2. **"CONSTRUCTION DOCUMENTS"**: The "Construction Documents" shall consist of the Project Manual, Drawings and Addenda.
- 3. **"CONSTRUCTION REPRESENTATIVE:"** Whenever the term "Construction Representative" is used, it shall mean the Owner's Representative at the work site.
- 4. **"CONTRACTOR"**: Party or parties who have entered into a contract with the Owner to furnish work under these specifications and drawings.
- 5. **"DESIGNER"**: When the term "Designer" is used herein, it shall refer to the Architect, Engineer, or Consultant of Record specified and defined in Paragraph 2.0 of the Supplemental Conditions, or his duly authorized representative. The Designer may be either a consultant or state employee.
- 6. **"DIRECTOR"**: Whenever the term "Director" is used, it shall mean the Director of the Division of Facilities Management, Design and Construction or his Designee, representing the Office of Administration, State of Missouri. The Director is the agent of the Owner.
- 7. **"DIVISION"**: Shall mean the Division of Facilities Management, Design and Construction, State of Missouri.

- 8. **"INCIDENTAL JOB BURDENS"**: Shall mean those expenses relating to the cost of work, incurred either in the home office or on the job-site, which are necessary in the course of doing business but are incidental to the job. Such costs include office supplies and equipment, postage, courier services, telephone expenses including long distance, water and ice and other similar expenses.
- 9. **"JOINT VENTURE"**: An association of two (2) or more businesses to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills and knowledge.
- 10. **"OWNER"**: Whenever the term "Owner" is used, it shall mean the State of Missouri.
- 11. **"PROJECT"**: Wherever the term "Project" is used, it shall mean the work required to be completed by the construction contract.
- 12. **"PROJECT MANUAL"**: The "Project Manual" shall consist of Introductory Information, Invitation for Bid, Instructions to Bidders, Bid Documents, Additional Information, Standard Forms, General Conditions, Supplemental General Conditions, General Requirements and Technical Specifications.
- 13. **"SUBCONTRACTOR"**: Party or parties who contract under, or for the performance of part or this entire Contract between the Owner and Contractor. The subcontract may or may not be direct with the Contractor.
- 14. **"WORK"**: Labor, material, supplies, plant and equipment required to perform and complete the service agreed to by the Contractor in a safe, expeditious, orderly and workmanlike manner so that the project shall be complete and finished in the best manner known to each respective trade.
- 15. **"WORKING DAYS"**: are all calendar days except Saturdays, Sundays and the following holidays: New Year's Day, Martin Luther King, Jr. Day, Lincoln Day, Washington's Birthday (observed), Truman Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day (observed), Thanksgiving Day, Christmas Day.

ARTICLE 1.2 DRAWINGS AND SPECIFICATIONS

- A. In case of discrepancy between drawings and specifications, specifications shall govern. Should discrepancies in architectural drawings, structural drawings and mechanical drawings occur,

architectural drawings shall govern and, in case of conflict between structural and mechanical drawings, structural drawings shall govern.

- B. Specifications are separated into titled divisions for convenience of reference only and to facilitate letting of contracts and subcontracts. The Contractor is responsible for establishing the scope of work for subcontractors, which may cross titled divisions. Neither the Owner nor Designer will establish limits and jurisdiction of subcontracts.
- C. Figured dimensions take precedence over scaled measurements and details over smaller scale general drawings. In the event of conflict between any of the documents contained within the contract, the documents shall take precedence and be controlling in the following sequence: addenda, supplementary general conditions, general conditions, division 1 specifications, technical division specifications, drawings, bid form and instructions to bidders.
- D. Anything shown on drawings and not mentioned in these specifications or vice versa, as well as any incidental work which is obviously necessary to complete the project within the limits established by the drawings and specifications, although not shown on or described therein, shall be performed by the Contractor at no additional cost as a part of his contract.
- E. Upon encountering conditions differing materially from those indicated in the contract documents, the Contractor shall promptly notify the Designer and Construction Representative in writing before such conditions are disturbed. The Designer shall promptly investigate said conditions and report to the Owner, with a recommended course of action. If conditions do materially differ and cause an increase or decrease in contract cost or time required for completion of any portion of the work, a contract change will be initiated as outlined in Article 4 of these General Conditions.
- E. Only work included in the contract documents is authorized, and the Contractor shall do no work other than that described therein or in accordance with appropriately authorized and approved contract changes.

ARTICLE 1.3 - COMPLIANCE WITH LAWS, PERMITS, REGULATIONS AND INSPECTIONS

- A. Since the Owner is the State of Missouri, municipal or political subdivisions, zoning ordinances, construction codes (other than licensing of trades), and other like ordinances are not applicable to construction on Owner's property, and Contractor will not be required to submit drawings and specifications to any municipal or political subdivision, authority, obtain

construction permits or any other licenses (other than licensing of trades) or permits from or submit to inspections by any municipality or political subdivision relating to the construction for this project. All permits or licenses required by municipality or political subdivision for operation on property not belonging to Owner shall be obtained by and paid for by Contractor. Each Contractor shall comply with all applicable laws, ordinances, rules and regulations that pertain to the work of this contract.

- B. Contractors, subcontractors and their employees engaged in the businesses of electrical, mechanical, plumbing, carpentry, sprinkler system work, and other construction related trades shall be licensed to perform such work by the municipal or political subdivision where the project is located, if such licensure is required by local code. Local codes shall dictate the level (master, journeyman, and apprentice) and the number, type and ratio of licensed tradesmen required for this project within the jurisdiction of such municipal or political subdivision.
- C. Equipment and controls manufacturers and their authorized service and installation technicians that do not maintain an office within the jurisdiction of the municipal or political subdivision but are a listed or specified contractor or subcontractor on this project are exempt from Paragraph 1.3 B above.
- D. The Contractor shall post a copy of the wage determination issued for the project and included as a part of the contract documents, in a prominent and easily accessible location at the site of construction for the duration of the project.
- E. Any contractor or subcontractor to such contractor at any tier signing a contract to work on this project shall provide a ten-hour Occupational Safety and Health Administration (OSHA) construction safety program for their on-site employees which includes a course in construction safety and health approved by OSHA or a similar program approved by the Department of Labor and Industrial Relations which is at least as stringent as an approved OSHA program. The contractor shall forfeit as a penalty to the public body on whose behalf the contract is made or awarded, two thousand five hundred dollars plus one hundred dollars for each employee employed by the contractor or subcontractor, for each calendar day, or portion thereof, such employee is employed without the required training.

ARTICLE 1.4 - NONDISCRIMINATION IN EMPLOYMENT

- A. The Contractor and his subcontractors will not discriminate against individuals based on race,

color, religion, national origin, sex, disability, or age, but may use restrictions which relate to bona fide occupational qualifications. Specifically, the Contractor and his subcontractors shall not discriminate:

1. Against recipients of service on the basis of race, color, religion, national origin, sex, disability or age.
2. Against any employee or applicant, for employment on the basis of race, color, religion, national origin, sex or otherwise qualified disability status.
3. Against any applicant for employment or employee on the basis of age, where such applicant or employee is between ages 40 and 70 and where such Contractor employs at least 20 persons.
4. Against any applicant for employment or employee on the basis of that person's status as a disabled or Vietnam-era veteran.

The Contractor and his Subcontractors will take affirmative action to insure applicants for employment and employees are treated equally without regard to race, color, religion, national origin, sex, disability, or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion and transfer; recruitment or recruitment advertising; and selection for training, including apprenticeship. The Contractor and his Subcontractors will give written notice of their commitments under this clause to any labor union with which they have bargaining or other agreements.

- B. The Contractor and his subcontractors shall develop, implement, maintain and submit in writing to the Owner an affirmative action program if at least fifty (50) persons in the aggregate are employed under this contract. If less than fifty (50) persons in the aggregate are to be employed under this contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed Affidavit for Affirmative Action in the form included in the contract specifications. For the purpose of this section, an "affirmative action program" means positive action to influence all employment practices (including, but not limited to, recruiting, hiring, promoting and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between age 40 and 70), disabled and Vietnam-era veteran status, and disability. Such "affirmative action program" shall include:

1. A written policy statement committing the total organization to affirmative action and

assigning management responsibilities and procedures for evaluation and dissemination;

2. The identification of a person designated to handle affirmative action;
3. The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion and discipline;
4. The exclusion of discrimination from all collective bargaining agreements; and
5. Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

In the enforcement of this non-discrimination clause, the Owner may use any reasonable procedures available, including, but not limited to: requests, reports, site visits and inspection of relevant documents of contractors and subcontractors.

- C. In the event of the Contractor's or his subcontractor's noncompliance with any provisions of this Article of the Contract, the Owner may cancel this contract in whole or in part or require the Contractor to terminate his contract with the subcontractor.

ARTICLE 1.5 - ANTI-KICKBACK

No employee of the division, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract or in any part hereof. No officer, employee, designer, attorney, or administrator of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall have or acquire any pecuniary interest, whether direct or indirect, in this contract, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

ARTICLE 1.6 - PATENTS AND ROYALTIES

- A. The Contractor shall hold and save the Owner and its officers, agents, servants and employees harmless from liabilities of any nature or kind, including cost and expenses, for, or on account of, any patented or unpatented invention, process, article or appliance manufactured or used in the performance of this contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.
- B. If the Contractor uses any design, device or materials covered by letters, patent or copyright,

the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, without exception, that the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract and shall indemnify the Owner for any cost, expense or damage it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after completion of the work.

ARTICLE 1.7 - PREFERENCE FOR AMERICAN AND MISSOURI PRODUCTS AND SERVICES

- A. By virtue of statutory authority a preference will be given to Missouri labor and to products of mines, forests and quarries of the state of Missouri when they are found in marketable quantities in the state, and all such materials shall be of the best quality and suitable character that can be obtained at reasonable market prices, all as provided for in Section 8.280, Missouri Revised Statutes and Cumulative Supplements.
- B. Furthermore, pursuant to Section 34.076 Missouri Revised Statutes and Cumulative Supplements, a preference shall be given to those persons doing business as Missouri firms, corporations, or individuals, or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less. In addition, in order for a non-domiciliary bidder to be successful, his bid must be that same percentage lower than a domiciliary Missouri bidder's bid, as would be required for a Missouri bidder to successfully bid in the non-domiciliary state.
- C. In accordance with the Missouri Domestic Products Procurement Act Section 34.350 RSMo and Cumulative Supplements any manufactured goods or commodities used or supplied in the performance of this contract or any subcontract thereto shall be manufactured, assembled or produced in the United States, unless the specified products are not manufactured, assembled or produced in the United States in sufficient quantities to meet the agency's requirements or cannot be manufactured, assembled or produced in the United States within the necessary time in sufficient quantities to meet the contract requirements, or if obtaining the specified products manufactured, assembled or produced in the

United States would increase the cost of this contract for purchase of the product by more than ten percent.

ARTICLE 1.8 - COMMUNICATIONS

- A. All notices, requests, instructions, approvals and claims must be in writing and shall be delivered to the Designer and copied to the Construction Representative for the project except as required by Article 1.12 Disputes and Disagreements, or as otherwise specified by the Owner in writing as stated in Section 012600. Any such notice shall be deemed to have been given as of the time of actual receipt.
- B. The Contractor shall attend on-site progress and coordination meetings, as scheduled by the Construction Representative, no less than once a month.
- C. The Contractor shall ensure that major subcontractors and suppliers shall attend monthly progress meetings as necessary to coordinate the work, and as specifically requested by the Construction Representative.

ARTICLE 1.9 - SEPARATE CONTRACTS AND COOPERATION

- A. The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.
- B. The Contractor shall consult the drawings for all other contractors in connection with this work. Any work conflicting with the above shall be brought to the attention of the Owner's Representative before the work is performed. If the Contractor fails to do this, and constructs any work which interferes with the work of another contractor, the Contractor shall remove any part so conflicting and rebuild same, as directed by the Owner's Representative at no additional cost to the Owner.
- C. Each contractor shall be required to coordinate his work with other contractors so as to afford others reasonable opportunity for execution of their work. No contractor shall delay any other contractor by neglecting to perform contract work at the proper time. If any contractor causes delay to another, they shall be liable directly to that contractor for such delay in addition to any liquidated damages which might be due the Owner.
- D. Should the Contractor or project associated subcontractors refuse to cooperate with the instructions and reasonable requests of other Contractors or other subcontractors in the overall

coordinating of the work, the Owner may take such appropriate action and issue directions, as required, to avoid unnecessary and unwarranted delays.

- E. Each Contractor shall be responsible for damage done to Owner's or other Contractor's property by him/her or workers in his employ through their fault or negligence.
- F. Should a Contractor sustain any damage through any act or omission of any other Contractor having a contract with the Owner, the Contractor so damaged shall have no claim or cause of action against the Owner for such damage, but shall have a claim or cause of action against the other Contractor to recover any and all damages sustained by reason of the acts or omissions of such Contractor. The phrase "acts or omissions" as used in this section shall be defined to include, but not be limited to, any unreasonable delay on the part of any such contractors.

ARTICLE 1.10 - ASSIGNMENT OF CONTRACT

- A. No assignment by Contractor of any amount or any part of this contract or of the funds to be received there under will be recognized unless such assignment has had the written approval of the Director and the surety has been given due notice of such assignment and has furnished written consent thereto. In addition to the usual recitals in assignment contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of this contract and to claims or liens for services rendered or materials supplied for the performance of the work called for in said contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

ARTICLE 1.11 - INDEMNIFICATION

- A. Contractor agrees to indemnify and save harmless Owner and its respective commissioners, officers, officials, agents, consultants and employees and Designer, their agents, servants and employees, from and against any and all liability for damage arising from injuries to persons or damage to property occasioned by any acts or omissions of Contractor, any subcontractors, agents, servants or employees, including any and all expense, legal or otherwise, which may be incurred by Owner or Designer, its agents, servants or employees, in defense of any claim, action or suit.
- B. The obligations of the Contractor under this paragraph shall not extend to the liability of the Designer, his agents or employees, arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, contract changes, design or specifications, or (2) giving of or the failure to

give directions or instructions by the Designer, his agents or employees as required by this contract documents provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 1.12 - DISPUTES AND DISAGREEMENTS

It is hereby expressly agreed and understood that in case any controversy or difference of opinion arises during construction, best efforts will be given to resolution at the field level. Should those efforts be unsuccessful, the Contractor has the right to appeal in writing, the decision of the Director's Designee to the Director at Room 730 Truman Building, P.O. Box 809, Jefferson City, Missouri 65102. The decision of the Director shall be final and binding on all parties.

ARTICLE 2 -- OWNER/DESIGNER RESPONSIBILITIES

- A. The Owner shall give all orders and directions contemplated under this contract relative to the execution of the work. During progress of work the Owner will be represented at the project site by the Construction Representative and/or Designer, whose responsibilities are to see that this contract is properly fulfilled.
- B. The Owner shall at all times have access to the work whenever it is in preparation or progress. The Contractors shall provide proper facilities for such access and for inspection and supervision.
- C. All materials and workmanship used in the work shall be subject to the inspection of the Designer and Construction Representative, and any work which is deemed defective shall be removed, rebuilt or made good immediately upon notice. The cost of such correction shall be borne by the Contractor. Contractor shall not be entitled to an extension of the contract completion date in order to remedy defective work. All rejected materials shall be immediately removed from the site of the work.
- D. If the Contractor fails to proceed at once with the correction of rejected defective materials or workmanship, the Owner may, by separate contract or otherwise, have the defects remedied or rejected. Materials removed from the site and charge the cost of the same against any monies which may be due the Contractor, without prejudice to any other rights or remedies of the Owner.
- E. Failure or neglect on the part of Owner to observe faulty work, or work done which is not in accordance with the drawings and specifications shall not relieve the Contractor from responsibility

for correcting such work without additional compensation.

- F. The Owner shall have the right to direct the Contractor to uncover any completed work.
 - 1. If the Contractor fails to adequately notify the Construction Representative and/or Designer of an inspection as required by the Contract Documents, the Contractor shall, upon written request, uncover the work. The Contractor shall bear all costs associated with uncovering and again covering the work exposed.
 - 2. If the Contractor is directed to uncover work, which was not otherwise required by the Contract Documents to be inspected, and the work is found to be defective in any respect, no compensation shall be allowed for this work. If, however, such work is found to meet the requirements of this contract, the actual cost of labor and material necessarily involved in the examination and replacement plus 10% shall be allowed the Contractor.
- G. The Designer shall give all orders and directions contemplated under this contract relative to the scope of the work and shall give the initial interpretation of the contract documents.
- H. The Owner may file a written notice to the Contractor to dismiss immediately any subcontractors, project managers, superintendents, foremen, workers, watchmen or other employees whom the Owner may deem incompetent, careless or a hindrance to proper or timely execution of the work. The Contractor shall comply with such notice as promptly as practicable without detriment to the work or its progress.
- I. If in the Owner's judgment it becomes necessary at any time to accelerate work, when ordered by the Owner in writing, the Contractor shall redirect resources to such work items and execute such portions of the work as may be required to complete the work within the current approved contract schedule.

ARTICLE 3 -- CONTRACTOR RESPONSIBILITIES

The Contractor shall register and utilize the Owner's eBuilder digital project management system for submission of documents described in the following sections. This includes but is not limited to submittals as required by designer, payment applications, Request for Information (RFI), construction change orders, Request for Proposals (RFP), Designer Supplemental Instructions (DSI), etc.

ARTICLE 3.1 -- ACCEPTABLE SUBSTITUTIONS

- A. The Contractor may request use of any article, device, product, material, fixture, form or type of construction which in the judgment of the Owner and Designer is equal in all respects to that named. Standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner and Designer that they are equal in design, strength, durability, usefulness and convenience for the purpose intended.
- B. Any changes required in the details and dimensions indicated on the drawings for the substitution of products other than those specified shall be properly made at the expense of the Contractor requesting the substitution or change.
- C. The Contractor shall submit a request for such substitutions in writing to the Owner and Designer within twenty (20) working days after the date of the "Notice to Proceed." Thereafter no consideration will be given to alternate forms of accomplishing the work. This Article does not preclude the Owner from exercising the provisions of Article 4 hereof.
- D. Any request for substitution by the Contractor shall be submitted in accordance with SECTION 002113 - INSTRUCTIONS TO BIDDERS.
- E. When a material has been approved, no change in brand or make will be permitted unless:
 - 1. Written verification is received from the manufacturer stating they cannot make delivery on the date previously agreed, or
 - 2. Material delivered fails to comply with contract requirements.

ARTICLE 3.2 -- SUBMITTALS

- A. The Contractor's submittals must be submitted with such promptness as to allow for review and approval so as not to cause delay in the work. The Contractor shall coordinate preparation and processing of submittals with performance of construction activities.

Coordinate each submittal with fabrication, = purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

Submit four (4) copies to the Designer and additional copies as required for the subcontractors and material suppliers. Also provide copies to meet the requirements for maintenance manuals.

- B. All subcontractors' shop drawings and schedules shall be submitted by the Contractor and shall bear evidence that Contractor has received, reviewed, and approved them. Any shop drawings and

schedules submitted without this evidence will be returned to the Contractor for resubmission.

- C. The Contractor shall include with the shop drawing, a letter indicating any and all deviations from the drawings and/or specifications. Failure to notify the Designer of such deviations will be grounds for subsequent rejection of the related work or materials. If, in the opinion of the Designer, the deviations are not acceptable, the Contractor will be required to furnish the item as specified and indicated on the drawings.
- D. The Designer shall check shop drawings and schedules with reasonable promptness and approve them only if they conform to the design concept of the project and comply with the information given in the contract documents. The approval shall not relieve the Contractor from the responsibility to comply with the drawings and specifications, unless the Contractor has called the Designer's attention to the deviation, in writing, at the time of submission and the Designer has knowingly approved thereof. An approval of any such modification will be given only under the following conditions:
 - 1. It is in the best interest of the Owner
 - 2. It does not increase the contract sum and/or completion time
 - 3. It does not deviate from the design intent
 - 4. It is without prejudice to any and all rights under the surety bond.
- E. No extension of time will be granted because of the Contractor's failure to submit shop drawings and schedules in ample time to allow for review, possible resubmission, and approval. Fabrication of work shall not commence until the Contractor has received approval. The Contractor shall furnish prints of approved shop drawings and schedules to all subcontractors whose work is in any way related to the work under this contract. Only prints bearing this approval will be allowed on the site of construction
- F. The Contractor shall maintain a complete file on-site of approved shop drawings available for use by the Construction Representative.

ARTICLE 3.3 – AS-BUILT DRAWINGS

- A. The Contractor shall update a complete set of the construction drawings, shop drawings and schedules of all work monthly by marking changes, and at the completion of their work (prior to submission of request for final payment) note all changes and turn the set over to the Construction Representative. The updates shall show all addenda, all field changes that were made to adapt to field conditions, changes resulting from contract

changes or supplemental instructions, and all locations of structures, buried installations of piping, conduit, and utility services. All buried and concealed items both inside and outside shall be accurately located as to depth and referenced to permanent features such as interior or exterior wall faces and dimensions shall be given in a neat and legible manner in a contrasting colored pencil or ink. If approved by the Designer, an electronic file format may be provided.

ARTICLE 3.4 – GUARANTY AND WARRANTIES

A. General Guaranty

- 1. Neither the final certificate of payment nor any provision in the contract documents nor partial use or occupancy of the premises by the Owner shall constitute an acceptance of work not done in accordance with contract requirements.
- 2. The Contractor or surety shall remedy any defects in the work and pay for any damage to property resulting there from which shall appear within a period of one (1) year from the date of substantial completion unless a longer period is otherwise specified or a differing guaranty period has been established in the substantial completion certificate. The Owner will give notice of observed defects with reasonable promptness.
- 3. In case of default on the part of the Contractor in fulfilling this part of this contract, the Owner may correct the work or repair the damage and the cost and expense incurred in such event shall be paid by or recoverable from the Contractor or surety.
- 4. The work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment

B. Extended Warranty

Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year. Where a longer

period is offered at no additional cost or called for in the specific equipment specifications, the longer period shall govern.

ARTICLE 3.5 -- OPERATION AND MAINTENANCE MANUALS

A. Immediately after equipment submittals are approved and no later than ten (10) working days prior to the substantial completion inspection, the Contractor shall provide to the Designer three (3) copies of operating instructions and service manuals, containing the following:

1. Start-up and Shut-down Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available; they may be incorporated into the operating manual for reference.
2. Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
3. Equipment List: List of all major equipment as installed shall be prepared to include model number, capacities, flow rate, name place data, shop drawings and air and water balance reports.
4. Service Instructions: Provide the following information for all pieces of equipment.
 - a. Recommended spare parts including catalog number and name of local supplier or factory representative.
 - b. Belt sizes, types, and lengths.
 - c. Wiring diagrams.
5. Manufacturer's Certificate of Warranty as described in Article 3.4.
6. Prior to the final payment, furnish to the Designer three (4) copies of parts catalogs for each piece of equipment furnished by him/her on the project with the components identified by number for replacement ordering.

B. Submission of operating instructions shall be done in the following manner.

1. Manuals shall be in quadruplicate, and all materials shall be bound into volumes of standard 8½" x 11" hard binders. Large drawings too bulky to be folded into 8½" x 11" shall be separately bound or folded and in envelopes, cross referenced and indexed with the manuals.
2. The manuals shall identify project name, project number, and include the name and

address of the Contractor, subcontractors and manufacturers who were involved with the activity described in that particular manual.

3. Internally subdivide the binder contents with permanent page dividers, logically organized with tab titles clearly printed under reinforced laminated plastic tabs.
4. Contents: Prepare a Table of Contents for each volume, with each product or system description identified.

ARTICLE 3.6 – OTHER CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall keep on site, during progress of the work, a competent superintendent satisfactory to the Construction Representative. The superintendent shall represent the Contractor and all agreements made by the superintendent shall be binding. The superintendent shall carefully study and compare all drawings, specifications and other instructions and shall promptly notify the Construction Representative and Designer, in writing, any error, inconsistency or omission which may be discovered. The superintendent shall coordinate all work on the project. Any change of the superintendent shall be approved by the Construction Representative.
- B. Contractor shall, at all times, enforce strict discipline and good order among his employees, and shall not employ on the work any unfit person or anyone not skilled in the work assigned to him/her.
- C. The Contractor shall supply sufficient labor, material, plant and equipment and pay when due any laborer, subcontractor or supplier for supplies furnished and otherwise prosecute the work with diligence to prevent work stoppage and insure completion thereof within the time specified.
- D. The Contractor and each of his subcontractors shall submit to the Construction Representative, through the Designer such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the Owner may request concerning work performed or to be performed under this contract.
- E. The Contractor, subcontractors, and material suppliers shall upon written request, give the Owner access to all time cards, material invoices, payrolls, estimates, profit and loss statements, and all other direct or indirect costs related to this work.
- F. The Contractor shall be responsible for laying out all contract work such as layout of architectural, structural, mechanical and electrical work, which shall be coordinated with layouts of subcontractors

for general construction work. The Contractor is also responsible for unloading, uncrating and handling of all materials and equipment to be erected or placed by him/her, whether furnished by Contractor or others. No extra charges or compensation will be allowed as a result of failure to verify dimensions before ordering materials or fabricating items.

- G. The Contractor must notify the Construction Representative at least one working day before placing concrete or burying underground utilities, pipelines, etc.
- H. Contractors shall prearrange time with the Construction Representative for the interruption of any facility operation. Unless otherwise specified in these documents, all connections, alterations or relocations as well as all other portions of the work will be performed during normal working hours.
- I. The Contractor shall coordinate all work so there will not be prolonged interruptions of existing equipment operation. Any existing plumbing, heating, ventilating, air conditioning or electrical disconnections necessary for the project, which affect portions of this construction or building or any other building must be scheduled with the Construction Representative to minimize or avoid any disruption of facility operations. In no case, unless previously approved in writing by the Construction Representative, shall utilities be left disconnected at the end of a work day or over a weekend. Any interruption of utilities either intentionally or accidentally shall not relieve the Contractor responsible for the interruption from the responsibility to repair and restore the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.
- J. Contractors shall limit operations and storage of materials to the area within the project, except as necessary to connect to existing utilities, and shall not encroach on neighboring property. The Contractor shall be responsible for repair of their damage to property on or off the project site occurring during construction of project. All such repairs shall be made to the satisfaction of the property owner.
- K. Unless otherwise permitted, all materials shall be new and both workmanship and materials shall be of the best quality.
- L. Unless otherwise provided and stipulated within these specifications, the Contractor shall furnish, construct, and/or install and pay for materials, devices, mechanisms, equipment, all necessary personnel, utilities including, but not limited to water, heat, light and electric power, transportation

services, applicable taxes of every nature, and all other facilities necessary for the proper execution and completion of the work.

- M. Contractor shall carefully examine the plans and drawings and shall be responsible for the proper fitting of his material, equipment and apparatus into the building.
- N. The Contractor or subcontractors shall not overload, or permit others to overload, any part of any structure during the performance of this contract.
- O. All temporary shoring, bracing, etc., required for the removal of existing work and/or for the installation of new work shall be included in this contract. The Contractor shall make good, at no cost to the Owner, any damage caused by improper support or failure of shoring in any respect. Each Contractor shall be responsible for shoring required to protect his work or adjacent property and improvements of Owner and shall be responsible for shoring or for giving written notice to adjacent property owners. Shoring shall be removed only after completion of permanent supports.
- P. The Contractor shall provide at the proper time such material as is required for support of the work. If openings are required, whether shown on drawings or not, the Contractor shall see that they are properly constructed.
- Q. During the performance of work the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences and other devices appropriately located on site which will give proper and understandable warning to all persons of danger of entry onto land, structure or equipment.
- R. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials.
- S. The Contractor shall be responsible for care of the finished work and shall protect same from damage or defacement until substantial completion by the Owner. If the work is damaged by any cause, the Contractor shall immediately begin to make repairs in accordance with the drawings and specifications. Contractor shall be liable for all damage or loss unless attributable to the acts or omissions of the Owner or Designer. Any claim for reimbursement shall be submitted in accordance with Article 4. After substantial completion the Contractor will only be responsible for damage resulting from acts or omissions of the Contractor or subcontractors through final warranty.
- T. In the event the Contractor encounters an unforeseen hazardous material, the Contractor

shall immediately stop work in the area affected and report the condition to the Owner and Designer in writing. The Contractor shall not be required, pursuant to Article 4, to perform, any work relating to hazardous materials.

- U. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 4.
- V. Before commencing work, Contractors shall confer with the Construction Representative and facility representative and review any facility rules and regulations which may affect the conduct of the work.
- W. Project signs will only be erected on major projects and only as described in the specifications. If no sign is specified, none shall be erected.

ARTICLE 3.7 -- SUBCONTRACTS

- A. Subcontractor assignments as identified in the bid form shall not be changed without written approval of the Owner. The Owner will not approve changes of a listed subcontractor unless the Contractor documents, to the satisfaction of the Owner that the subcontractor cannot or will not perform the work as specified.
- B. The Contractor is fully responsible to the Owner for the acts and omissions of all subcontractors and of persons either directly or indirectly employed by them.
- C. Every subcontractor shall be bound by the applicable terms and provisions of these contract documents, but no contractual relationship shall exist between any subcontractor and the Owner unless the right of the Contractor to proceed with the work is suspended or this contract is terminated as herein provided, and the Owner in writing elects to assume the subcontract.
- D. The Contractor shall upon receipt of "Notice to Proceed" and prior to submission of the first payment request, notify the Designer and Construction Representative in writing of the names of any subcontractors to be used in addition to those identified in the bid form and all major material suppliers proposed for all parts of the work.

ARTICLE 4 -- CHANGES IN THE WORK

4.1 CHANGES IN THE WORK

- A. The Construction Representative, without giving notice to the surety and without invalidating this contract, may order extra work or make changes by

altering, adding to or deducting from the work, this contract sum being adjusted accordingly. All such work shall be executed under the conditions of the original contract. A claim for extension of time caused by any change must be adjusted at the time of ordering such change. No future request for time will be considered.

- B. Each Contract Change shall include all costs required to perform the work including all labor, material, equipment, overheads and profit, delay, disruptions, or other miscellaneous expenses. No subsequent requests for additional compensation including claims for delay, disruption, or reduced efficiency as a result of each change will be considered. Values from the Schedule of Values will not be binding as a basis for additions to or deductions from the contract price.
- C. The amount of any adjustment in this contract price for authorized changes shall be agreed upon before such changes become effective and shall be determined, through submission of a request for proposal, as follows:
 - 1. By an acceptable fixed price proposal from the Contractor. Breakdowns shall include all takeoff sheets of each Contractor and subcontractor. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
 - 2. By a cost-plus-fixed-fee (time and material) basis with maximum price, total cost not to exceed said maximum. Breakdown shall include a listing of each item of material with unit prices and number of hours of labor for each task. Labor costs per hour shall be included with labor burden identified, which shall be not less than the prevailing wage rate, etc. Overhead and profit shall be shown separately for each subcontractor and the Contractor.
 - 3. By unit prices contained in Contractor's original bid form and incorporated in the construction contract.
- D. Overhead and Profit on Contract Changes shall be applied as follows:

- 1. The overhead and profit charge by the Contractor and all subcontractors shall be considered to include, but is not limited to: incidental job burdens, small truck (under 1 ton) expense, mileage, small hand tools,

warranty costs, company benefits and general office overhead. Project supervision including field supervision and job site office expense shall be considered a part of overhead and profit unless a compensable time extension is granted.

2. The percentages for overhead and profit charged on Contract Changes shall be negotiated, and may vary according to the nature, extent, and complexity of the work involved. However, the overhead and profit for the Contractor or subcontractor actually performing the work shall not exceed 14%. When one or more tiers of subcontractors are used, in no event shall any Contractor or subcontractor receive as overhead and profit more than 3% of the cost of the work performed by any of his subcontractors. In no case shall the total overhead and profit paid by the Owner on any Contract Changes exceed twenty percent (20%) of the cost of materials, labor and equipment (exclusive of Contractor or any Subcontractor overhead and profit) necessary to put the contract change work in place.
 3. The Contractor will be allowed to add the cost of bonding and insurance to their cost of work. This bonding and insurance cost shall not exceed 2% and shall be allowed on the total cost of the added work, including overhead and profit.
 4. On proposals covering both increases and decreases in the amount of this contract, the application of overhead and profit shall be on the net change in the cost of the work.
 5. The percentage for overhead and profit to be credited to the Owner on Contract Changes that are solely decreases in the quantity of work or materials shall be negotiated, and may vary according to the nature, extent and complexity of the work involved, but in no case shall be less than ten percent (10%). If the percentage for overhead and profit charged for work added by Contract Changes for this contract has been negotiated to less than 10%, the negotiated rate shall then apply to credits as well.
- E. No claim for an addition to this contract sum shall be valid unless authorized as aforesaid in writing by the Owner. In the event that none of the foregoing methods are agreed upon, the Owner may order the Contractor to perform work on a time and material basis. The cost of such work shall be determined by the Contractor's actual labor and material cost to perform the work plus overhead and profit as outlined herein. The

Designer and Construction Representative shall approve the Contractor's daily time and material invoices for the work involved.

- F. If the Contractor claims that any instructions involve extra cost under this contract, the Contractor shall give the Owner's Representative written notice thereof within a reasonable time after the receipt of such instructions, and in any event before proceeding to execute the work. No such claim shall be valid unless so made and authorized by the Owner, in writing.
- G. In an emergency affecting the safety of life or of the structure or of adjoining property, the Contractor, without special instruction or authorization from the Construction Representative, is hereby permitted to act at their discretion to prevent such threatened loss or injury. The Contractor shall submit a claim for compensation for such emergency work in writing to the Owner's Representative.

ARTICLE 4.2 – CHANGES IN COMPLETION TIME

- A. Extension of the number of work days stipulated in the Contract for completion of the work with compensation may be made when:
 1. The contractor documents that proposed Changes in the work, as provided in Article 4.1, extends construction activities critical to contract completion date, OR
 2. The Owner suspends all work for convenience of the Owner as provided in Article 7.3, OR
 3. An Owner caused delay extends construction activities critical to contract completion (except as provided elsewhere in these General Conditions). The Contractor is to review the work activities yet to begin and evaluate the possibility of rescheduling the work to minimize the overall project delay.
- B. Extension of the number of work days stipulated in the Contract for completion of the work without compensation may be made when:
 1. Weather-related delays occur, subject to provisions for the inclusion of a specified number of "bad weather" days when provided for in Section 012100-Allowances, OR
 2. Labor strikes or acts of God occur, OR
 3. The work of the Contractor is delayed on account of conditions which were beyond the control of the Contractor, subcontractors or suppliers, and were not the result of their fault or negligence.
- C. No time extension or compensation will be provided for delays caused by or within the control

of the Contractor, subcontractors or suppliers and for concurrent delays caused by the Owner.

- D. The Contractor shall notify the Owner promptly of any occurrence or conditions which in the Contractor's opinion results in a need for an extension of time. The notice shall be in writing and shall include all necessary supporting materials with details of any resultant costs and be submitted in time to permit full investigation and evaluation of the Contractor's claim. The Owner shall promptly acknowledge the Contractor's notice and, after recommendation from the Owner's Representative and/or Designer, shall provide a decision to the Contractor. Failure on the part of the Contractor to provide such notice and to detail the costs shall constitute a waiver by the Contractor of any claim. Requests for extensions of time shall be for working days only.

ARTICLE 5 - CONSTRUCTION AND COMPLETION

ARTICLE 5.1 – CONSTRUCTION COMMENCEMENT

- A. Upon receipt of the "Intent to Award" letter, the Contractor must submit the following properly executed instruments to the Owner:
1. Contract;
 2. Performance/payment bond as described in Article 6.1;
 3. Certificates of Insurance, or the actual policies themselves, showing that the Contractor has obtained the insurance coverage required by Article 6.2.
 4. Written Affirmative Action Plans as required in Article 1.4.

Above referenced items must be received by the Owner within ten (10) working days after the effective date of the contract. If not received, the Owner may treat the failure to timely submit them as a refusal by the Contractor to accept a contract for this work and may retain as liquidated damages the Contractor's bid bond, cashier's check or certified check as provided in the Instructions to Bidders. Upon receipt the Owner will issue a "Notice to Proceed" with the work to the Contractor.

- B. Within the time frame noted in Section 013200 - Schedules, following receipt of the "Notice to Proceed", the Contractor shall submit to the Owner a progress schedule and schedule of values, showing activities through the end of the contract period. Should the Contractor not receive written notification from the Owner of the disapproval of the schedule of values within fifteen (15) working

days, the Contractor may consider it approved for purpose of determining when the first monthly Application and Certification for Payment may be submitted.

- C. The Contractor may commence work upon receipt of the Division of Facilities Management, Design and Construction's "Notice to Proceed" letter. Contractor shall prosecute the work with faithfulness and energy, and shall complete the entire work on or before the completion time stated in the contract documents or pay to the Owner the damages resulting from the failure to timely complete the work as set out within Article 5.4.

ARTICLE 5.2 -- PROJECT CONSTRUCTION

- A. Each Contractor shall submit for the Owner's approval, in reproducible form, a progress schedule showing the rate of progress and the order of the work proposed to carry on various phases of the project. The schedule shall be in conformance with the requirements outlined in Section 013200 – Schedules.
- B. Contractor shall employ and supply a sufficient force of workers, material, and equipment and shall pay when due, any worker, subcontractor or supplier and otherwise prosecute the work with such diligence so as to maintain the rate of progress indicated on the progress schedule, prevent work stoppage, and insure completion of the project within the time specified.

ARTICLE 5.3 -- PROJECT COMPLETION

- A. Substantial Completion. A Project is substantially complete when construction is essentially complete and work items remaining to be completed can be done without interfering with the Owner's ability to use the Project for its intended purpose.
1. Once the Contractor has reached what they believe is Substantial Completion, the Contractor shall notify the Designer and the Construction Representative of the following:
 - a. That work is essentially complete with the exception of certain listed work items. The list shall be referred to as the "Contractor's Punch."
 - b. That all Operation and Maintenance Manuals have been assembled and submitted in accordance with Article 3.5A.
 - c. That the Work is ready for inspection by the Designer and Construction Representative. The Owner shall be entitled to a minimum of ten working

days notice before the inspection shall be performed.

2. If the work is acceptable, the Owner shall issue a Certificate of Substantial Completion, which shall set forth the responsibilities of the Owner and the Contractor for utilities, security, maintenance, damage to the work and risk of loss. The Certificate shall also identify those remaining items of work to be performed by the Contractor. All such work items shall be complete within 30 working days of the date of the Certificate, unless the Certificate specifies a different time. If the Contractor shall be required to perform tests that must be delayed due to climatic conditions, it is understood that such tests and affected equipment will be identified on the Certificate and shall be accomplished by the Contractor at the earliest possible date. Performance of the tests may not be required before Substantial Completion can be issued. The date of the issuance of the Certificate of Substantial Completion shall determine whether or not the work was completed within the contract time and whether or not Liquidated Damages are due.
 3. If the work is not acceptable, and the Owner does not issue a Certificate of Substantial Completion, the Owner shall be entitled to charge the Contractor with the Designer's and Owner's costs of re-inspection, including time and travel.
- B. Partial Occupancy. Contractor agrees that the Owner shall be permitted to occupy and use any completed or partially completed portions of the Project, when such occupancy and use is in the Owner's best interest. Owner shall notify Contractor of its desire and intention to take Partial Occupancy as soon as possible but at least ten (10) working days before the Owner intends to occupy. If the Contractor believes that the portion of the work the Owner intends to occupy is not ready for occupancy, the Contractor shall notify the Owner immediately. The Designer shall inspect the work in accordance with the procedures above. If the Contractor claims increased cost of the project or delay in completion as a result of the occupancy, he shall notify the Owner immediately but in all cases before occupancy occurs.
- C. Final Completion. The Project is finally complete when the Certificate of Substantial Completion has been issued and all work items identified therein as incomplete have been completed, and when all administrative items required by the contract have been completed. Final Completion entitles the Contractor to payment of the outstanding balance of the contract amount including all change orders

and retainage. Within five (5) working days of the date of the Certificate of Substantial Completion, the Contractor shall identify the cost to complete any outstanding items of work. The Designer shall review the Contractor's estimate and either approve it or provide an independent estimate for all such items. If the Contractor fails to complete the remaining items within the time specified in the Certificate, the Owner may terminate the contract and go to the surety for project completion in accordance with Article 7.2 or release the contract balance to the Contractor less 150% of the approved estimate to complete the outstanding items. Upon completion of the outstanding items, when a final cost has been established, any monies remaining shall be paid to the Contractor. Failure to complete items of work does not relieve the Contractor from the obligation to complete the administrative requirements of the contract, such as the provisions of Article 5.3 FAILURE TO COMPLETE ALL ITEMS OF WORK UNDER THE CONTRACT SHALL BE CONSIDERED A DEFAULT AND BE GROUNDS FOR CONTRACT TERMINATION AND DEBARMENT.

- D. Liquidated Damages. Contractor agrees that the Owner may deduct from the contract price and retain as liquidated damages, and not as penalty or forfeiture, the sum stipulated in this contract for each work day after the Contract Completion Day on which work is not Substantially Complete. Assessment of Liquidated Damages shall not relieve the Contractor or the surety of any responsibility or obligation under the Contract. In addition, the Owner may, without prejudice to any other rights, claims, or remedies the Owner may have including the right to Liquidated Damages, charge the Contractor for all additional expenses incurred by the Owner and/or Designer as the result of the extended contract period through Final Completion. Additional Expenses shall include but not be limited to the costs of additional inspections.
- E. Early Completion. The Contractor has the right to finish the work before the contract completion date; however, the Owner assumes no liability for any hindrances to the Contractor unless Owner caused delays result in a time extension to the contract completion date. The Contractor shall not be entitled to any claims for lost efficiencies or for delay if a Certificate of Substantial Completion is given on or before the Contract Completion Date.

ARTICLE 5.4 -- PAYMENT TO CONTRACTOR

- A. Payments on account of this contract will be made monthly in proportion to the work which has been completed. Request for payment must be submitted on the Owner's forms. No other pay request will

be processed. Supporting breakdowns must be in the same format as Owner's forms and must provide the same level of detail. The Designer will, within 5 working days from receipt of the contractor's request for payment either issue a Certificate for Payment to the Owner, for such amount as the Designer determines is properly due, or notify the Contractor in writing of reasons for withholding a Certificate. The Owner shall make payment within 30 calendar days after the "Application and Certification for Payment" has been received and certified by the Designer. The following items are to be attached to the contractor's pay request:

1. Updated construction schedule
 2. Certified payrolls consisting of name, occupation and craft, number of hours worked and actual wages paid for each individual employee, of the Contractor and all subcontractors working on the project
- B. The Owner shall retain 5 percent of the amount of each such payment application, except as allowed by Article 5.4, until final completion and acceptance of all work covered by this contract.
- C. Each payment made to Contractor shall be on account of the total amount payable to Contractor and all material and work covered by paid partial payment shall thereupon become the sole property of Owner. This provision shall not be construed as relieving Contractor from sole responsibility for care and protection of materials and work upon which payments have been made or restoration of any damaged work or as a waiver of the right of Owner to require fulfillment of all terms of this contract.
- D. Materials delivered to the work site and not incorporated in the work will be allowed in the Application and Certification for Payment on the basis of one hundred (100%) percent of value, subject to the 5% retainage providing that they are suitably stored on the site or in an approved warehouse in accordance with the following requirements:
1. Material has previously been approved through submittal and acceptance of shop drawings conforming to requirements of Article 3.2 of General Conditions.
 2. Delivery is made in accordance with the time frame on the approved schedule.
 3. Materials, equipment, etc., are properly stored and protected from damage and deterioration and remain so - if not, previously approved amounts will be deleted from subsequent pay applications.

4. The payment request is accompanied by a breakdown identifying the material equipment, etc. in sufficient detail to establish quantity and value.
- E. The Contractor shall be allowed to include in the Application and Certification for Payment, one hundred (100%) of the value, subject to retainage, of major equipment and material stored off the site if all of the following conditions are met:
1. The request for consideration of payment for materials stored off site is made at least 15 working days prior to submittal of the Application for Payment including such material. Only materials inspected will be considered for inclusion on Application for Payment requests.
 2. Materials stored in one location off site are valued in excess of \$25,000.
 3. That a Certificate of Insurance is provided indicating adequate protection from loss, theft conversion or damage for materials stored off site. This Certificate shall show the State of Missouri as an additional insured for this loss.
 4. The materials are stored in a facility approved and inspected, by the Construction Representative.
 5. Contractor shall be responsible for, Owner costs to inspect out of state facilities, and any delays in the completion of the work caused by damage to the material or for any other failure of the Contractor to have access to this material for the execution of the work.
- F. The Owner shall determine the amount, quality and acceptability of the work and materials which are to be paid for under this contract. In the event any questions shall arise between the parties, relative to this contract or specifications, determination or decision of the Owner or the Construction Representative and the Designer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected in any manner or to any extent by such question.
- G. Payments Withheld: The Owner may withhold or nullify in whole or part any certificate to such extent as may be necessary to protect the Owner from loss on account of:
1. Defective work not remedied. When a notice of noncompliance is issued on an item or items, corrective action shall be undertaken immediately. Until corrective action is completed, no monies will be paid and no additional time will be allowed for the item or

items. The cost of corrective action(s) shall be borne by the Contractor.

2. A reasonable doubt that this contract can be completed for the unpaid balance.
3. Failure of the Contractor to update as-built drawings monthly for review by the Construction Representative.
4. Failure of the Contractor to update the construction schedule.

When the Construction Representative is satisfied the Contractor has remedied above deficiencies, payment shall be released.

H. Final Payment: Upon receipt of written notice from the Contractor to the Designer and Project Representative that the work is ready for final inspection and acceptance, the Designer and Project Representative, with the Contractor, shall promptly make such inspection. If the work is acceptable and the contract fully performed, the Construction Representative shall complete a final acceptance report and the Contractor will be directed to submit a final Application and Certification for Payment. If the Owner approves the same, the entire balance shall be due and payable, with the exception of deductions as provided for under Article 5.4.

1. Where the specifications provide for the performance by the Contractor of (certain tests for the purpose of balancing and checking the air conditioning and heating equipment and the Contractor shall have furnished and installed all such equipment in accordance with the specifications, but said test cannot then be made because of climatic conditions, such test shall may be considered as required under the provisions of the specifications, Section 013300 and this contract may be substantial Full payment will not be made until the tests have been made and the equipment and system is finally accepted. If the tests are not completed when scheduled, the Owner may deduct 150% of the value of the tests from the final payment.
2. The final payment shall not become due until the Contractor delivers to the Construction Representative:
 - a) A complete file of releases, on the standard form included in the contract documents as "Final Receipt of Payment and Release Form", from subcontractors and material suppliers evidencing payment in full for services, equipment and materials, as the case may require, if the Owner approves, or a consent from

the Surety to final payment accepting liability for any unpaid amounts.

- b) An Affidavit of Compliance with Prevailing Wage Law, in the form as included in this contract specifications, properly executed by each subcontractor, and the Contractor
 - c) Certified copies of all payrolls
 - d) As-built drawings
3. If any claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such a claim including all costs and a reasonable attorney's fee.
 4. Missouri statute requires prompt payment from the Owner to the Contractor within thirty calendar days and from the Contractor to his subcontractors within fifteen calendar days. Failure to make payments within the required time frame entitles the receiving party to charge interest at the rate of one and one half percent per month calculated from the expiration of the statutory time period until paid.
 5. The value of all unused unit price allowances and/or 150% of the value of the outstanding work items, and/or liquidated damages may be deducted from the final pay request without executing a Contract Change. Any unit price items which exceed the number of units in the contract may be added by Contract Change.

ARTICLE 6 -- INSURANCE AND BONDS

ARTICLE 6.1 -- BOND

- A. Contractor shall furnish a performance/payment bond in an amount equal to 100% of the contract price to guarantee faithful performance of the contract and 100% of the contract price to guarantee the payment of all persons performing labor on the project and furnishing materials in connection therewith under this contract as set forth in the standard form of performance and payment bond included in the contract documents. The surety on such bond shall be issued by a surety company authorized by the Missouri Department of Insurance to do business in the state of Missouri.
- B. All Performance/Payment Bonds furnished in response to this provision shall be provided by a bonding company with a rating of B+ or higher as established by A.M. Best Company, Inc. in their most recent publication.

ARTICLE 6.2 – INSURANCE

- A. The successful Contractor shall procure and maintain for the duration of the contract issued a policy or policies of insurance for the protection of both the Contractor and the Owner and their respective officers, officials, agents, consultants and employees. The Owner requires certification of insurance coverage from the Contractor prior to commencing work.
- B. Minimum Scope and Extent of Coverage
 - 1. General Liability
Commercial General Liability, ISO coverage form number or equivalent CG 00 01 ("occurrence" basis), or I-SO coverage form number CG 00 02, or ISO equivalent.

If ISO equivalent or manuscript general liability coverage forms are used, minimum coverage will be as follows: Premises/Operations; Independent Contractors; Products/Completed Operations; personal Injury; Broad Form Property Damage including Completed Operations; Broad Form Contractual Liability Coverage to include Contractor's obligations under Article 1.11 Indemnification and any other Special Hazards required by the work of the contract.
 - 2. Automobile Liability
Business Automobile Liability Insurance, ISO Coverage form number or equivalent CA 00 01 covering automobile liability, code 1 "ANY AUTO".
 - 3. Workers' Compensation and Employer's Liability
Statutory Workers' Compensation Insurance for Missouri and standard Employer's Liability Insurance, or the authorization to self-insure for such liability from the Missouri Division of Workers' Compensation.
 - 4. Builder's Risk or Installation Floater Insurance
Insurance upon the work and all materials, equipment, supplies, temporary structures and similar items which may be incident to the performance of the work and located at or adjacent to the site, against loss or damage from fire and such other casualties as are included in extended coverage in broad "All Risk" form, including coverage for Flood and Earthquake, in an amount not less than the replacement cost of the work or this contract price, whichever is greater, with loss payable to Contractor and Owner as their respective interests may appear.

Contractor shall maintain sufficient insurance to cover the full value of the work and materials as the work progresses, and shall furnish Owner copies of all endorsements. If Builder's Risk Reporting- Form of Endorsement is used, Contractor shall make all reports as required therein so as to keep in force an amount of insurance which will equal the replacement cost of the work, materials, equipment, supplies, temporary structures, and other property covered thereby; and if, as a result of Contractor's failure to make any such report, the amount of insurance so recoverable shall be less than such replacement cost, Contractor's interest in the proceeds of such insurance, if any, shall be subordinated to Owner's interest to the end that Owner may receive full reimbursement for its loss.

- C. Minimum Limits of Insurance
 - 1. General Liability
Contractor
\$2,000,000 combined single limit per occurrence for bodily injury, personal injury, and property damage
\$2,000,000 annual aggregate
 - 2. Automobile Liability
\$2,000,000 combined single limit per occurrence for bodily injury and property damage
 - 3. Workers' Compensation and Employers Liability
Workers' Compensation limits as required by applicable State Statutes (generally unlimited) and minimum of \$1,000,000 limit per accident for Employer's Liability.

General Liability and Automobile Liability insurance may be arranged under individual policies for the full limits required or by a combination of underlying policies with the balance provided by a form-following Excess or Umbrella Liability policy.
- D. Deductibles and Self-Insured Retentions
All deductibles, co-payment clauses, and self-insured retentions must be declared to and approved by the Owner. The Owner reserves the right to request the reduction or elimination of unacceptable deductibles or self-insured retentions, as they would apply to the Owner, and their respective officers, officials, agents, consultants and employees. Alternatively, the Owner may request Contractor to procure a bond guaranteeing

payment of losses and related investigations, claims administration, and defense expenses.

E. Other Insurance Provisions and Requirements

The respective insurance policies and coverage, as specified below, must contain, or be endorsed to contain the following conditions or provisions:

1. General Liability

The Owner, and its respective commissioners, officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 Additional Insured - Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance of self-insurance programs maintained by the designated additional -insured's shall be excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's general liability insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner, or for any of their officers, officials, agents, consultants or employees.

2. Automobile Insurance

The Owner, and their respective officers, officials, agents, consultants and employees shall be endorsed as additional insured's by ISO form CG 20 26 - Additional Insured Designated Person or Organization. As additional insured's, they shall be covered as to work performed by or on behalf of the Contractor or as to liability which arises out of Contractor's activities or resulting from the performance of services or the delivery of goods called for by the Contract.

Contractor's insurance coverage shall be primary with respect to all additional insured's. Insurance or self-insurance

programs maintained by the designated additional insured's shall be in excess of the Contractor's insurance and shall not contribute with it.

Additionally, the Contractor and Contractor's automobile insurer shall agree to waive all rights of subrogation against the Owner and any of their respective officers, officials, agents, consultants or employees for claims, losses, or expenses which arise out of Contractor's activities or result from the performance of services or the delivery of goods called for by the Contract.

Contractor's failure to comply with the terms and conditions of these insurance policies shall not affect or abridge coverage for the Owner or for any of its officers, officials, agents, consultants or employees.

3. Workers' Compensation/Employer's Liability

Contractor's workers' compensation insurance shall be endorsed with NCCI form WC 00 03 01 A - Alternative Employer Endorsement. The Alternative Employer Endorsement shall designate the Owner as "alternate employers."

4. All Coverages

Each insurance policy required by this section of the Contract shall contain a stipulation, endorsed if necessary, that the Owner will receive a minimum of a thirty (30) calendar day advance notice of any policy cancellation. Ten (10) calendar days advance notice is required for policy cancellation due to non-payment of premium.

F. Insurer Qualifications and Acceptability

Insurance required hereunder shall be issued by an A.M. Best, "B+" rated, Class IX insurance company approved to conduct insurance business in the state of Missouri.

G. Verification of Insurance Coverage

Prior to Owner issuing a Notice to Proceed, the Contractor shall furnish the Owner with Certificate(s) of Insurance and with any applicable original endorsements evidencing the required insurance coverage. The insurance certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. All certificates and endorsements received by the Owner are subject to review and approval by the Owner. The Owner reserves the right to require certified copies of all required policies at any time. If the scope of this contract will exceed one (1) year - or, if any of Contractor's applicable insurance coverage expires prior to completion of the work or services required under this contract -

the Contractor will provide a renewal or replacement certificate before continuing work or services hereunder. If the Contractor fails to provide documentation of required insurance coverage, the Owner may issue a stop work order and no additional contract completion time and/or compensation shall be granted as a result thereof.

ARTICLE 7 – SUSPENSION OR TERMINATION OF CONTRACT

ARTICLE 7.1 - FOR SITE CONDITIONS

When conditions at the site of the proposed work are considered by the Owner to be unsatisfactory for prosecution of the work, the Contractor may be ordered in writing to suspend the work or any part thereof until reasonable conditions exist. When such suspension is not due to fault or negligence of the Contractor, time allowed for completion of such suspended work will be extended by a period of time equal to that lost due to delay occasioned by ordered suspension. This will be a no cost time extension.

ARTICLE 7.2 - FOR CAUSE

A. Termination or Suspension for Cause:

1. If the Contractor shall file for bankruptcy, or should make a general assignment for the benefit of the creditors, or if a receiver should be appointed on account of insolvency, or if the contractor should persistently or repeatedly refuse or fail to supply enough properly skilled workers or proper materials, or if the contractor should fail to make prompt payment to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Owner, or otherwise be guilty of a substantial violation of any provision of this contract, then the Owner may serve notice on the Contractor and the surety setting forth the violations and demanding compliance with this contract. Unless within ten (10) consecutive calendar days after serving such notice, such violations shall cease and satisfactory arrangements for correction be made, the Owner may suspend the Contractor's right to proceed with the work or terminate this contract.
2. In the event the Owner suspends Contractor's right to proceed with the work or terminates the contract, the Owner may demand that the Contractor's surety take over and complete the work on this contract, after the surety submits a written proposal to the Owner and receives written approval and upon the surety's failure or refusal to do so within ten (10) consecutive

calendar days after demand therefore, the Owner may take over the work and prosecute the same to completion by bid or negotiated contract, or the Owner may elect to take possession of and utilize in completing the work such materials, supplies, appliances and plant as may be on the site of the work, and all subcontractors, if the Owner elects, shall be bound to perform their contracts.

- B. The Contractor and its surety shall be and remain liable to the Owner for any excess cost or damages occasioned to the Owner as a result of the actions above set forth.
- C. The Contractor in the event of such suspension or termination shall not be entitled to receive any further payments under this contract until the work is wholly finished. Then if the unpaid balance under this contract shall exceed all expenses of the Owner as certified by the Director, such excess shall be paid to the Contractor; but, if such expenses shall exceed the unpaid balance as certified by the Director, the Contractor and their surety shall be liable for and shall pay the difference and any damages to the Owner.
- D. In exercising Owner's right to secure completion of the work under any of the provisions hereof, the Director shall have the right to exercise Owner's sole discretion as to the manner, methods and reasonableness of costs of completing the work.
- E. The rights of the Owner to suspend or terminate as herein provided shall be cumulative and not exclusive and shall be in addition to any other remedy provided by law.
- F. The Contractor in the event of such suspension or termination may be declared ineligible for Owner contracts for a minimal period of twelve (12) months. Further, no contract will be awarded to any Contractor who lists in their bid form any subcontractor whose prior performance has contributed, as determined by the Owner, to a breach of a contract. In order to be considered for state-awarded contracts after this period, the Contractor/subcontractor will be required to forward acceptance reports to the Owner regarding successful completion of non-state projects during the intervening twelve (12) months from the date of default. No contracts will be awarded to a subcontractor/Contractor until the ability to perform responsibly in the private sector has been proven to the Owner.

ARTICLE 7.3 -- FOR CONVENIENCE

- A. The Owner may terminate or suspend the Contract or any portion of the Work without cause at any time, and at the Owner's convenience. Notification of a termination or suspension shall be in writing

and shall be given to the Contractor and their surety. If the Contract is suspended, the notice will contain the anticipated duration of the suspension or the conditions under which work will be permitted to resume. If appropriate, the Contractor will be requested to demobilize and re-mobilize and will be reimbursed time and costs associated with the suspension.

B. Upon receipt of notification, the Contractor shall:

1. Cease operations when directed.
2. Take actions to protect the work and any stored materials.
3. Place no further subcontracts or orders for material, supplies, services or facilities except as may be necessary to complete the portion of the Contract that has not been terminated. No claim for payment of materials or supplies ordered after the termination date shall be considered.
4. Terminate all existing subcontracts, rentals, material, and equipment orders.

5. Settle all outstanding liabilities arising from termination with subcontractors and suppliers.

6. Transfer title and deliver to the Owner, work in progress, completed work, supplies and other material produced or acquire for the work terminated, and completed or partially completed plans, drawings information and other property that, if the Contract had been completed, would be required to be furnished to the Owner.

C. For termination without cause and at the Owner's convenience, in addition to payment for work completed prior to date of termination, the Contractor may be entitled to payment of other documented costs directly associated with the early termination of the contract. Payment for anticipated profit and unapplied overhead will not be allowed.

SECTION 007300 - SUPPLEMENTARY CONDITIONS

1.0 GENERAL:

- A. These Supplementary General Conditions clarify, add, delete, or otherwise modify standard terms and conditions of DIVISION 0, BIDDING AND CONTRACTING REQUIREMENTS.

2.0 CONTACTS:

Designer: Valerie Holland
BARTLETT AND WEST
1719 Southridge Dr., Suite 100
Jefferson City, Mo 65109
Telephone: 573-634-3181
Email: valerie.holland@bartwest.com

Construction Representative: Carl Haley
Division of Facilities Management, Design and Construction
709 Missouri BLVD
Jefferson City, MO 65101
Telephone: 573-526-0473
Email: Carl.Haley@oa.mo.gov

Project Manager: Eric Hibdon
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, Missouri 65102
Telephone: 573-522-0322
Email: Eric.Hibdon@oa.mo.gov

Contract Specialist: Mandy Roberson
Division of Facilities Management, Design and Construction
301 West High Street, Room 730
Jefferson City, Missouri 65102
Telephone: 573-522-0074
Email: Mandy.Roberson@oa.mo.gov

3.0 NOTICE: ALL BID MATERIALS ARE DUE AT THE TIME OF BID SUBMITTAL. THERE IS NO SECOND SUBMITTAL FOR THIS PROJECT.

4.0 FURNISHING CONSTRUCTION DOCUMENTS:

- A. The Owner will furnish the Contractor with approximately 3 complete sets of drawings and specifications at no charge.
- B. The Owner will furnish the Contractor with approximately 3 sets of explanatory or change drawings at no charge.
- C. The Contractor may make copies of the documents as needed with no additional cost to the Owner.

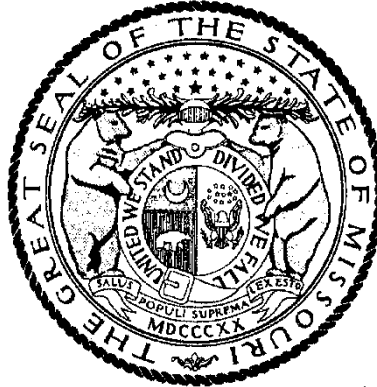
5.0 SAFETY REQUIREMENTS

Contractor and subcontractors at any tier shall comply with RSMo 292.675 and Article 1.3, E, of Section 007213, General Conditions.

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

Annual Wage Order No. 28

Section 088
RANDOLPH COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by

Taylor Burks, Director
Division of Labor Standards

Filed With Secretary of State: March 10, 2021

Last Date Objections May Be Filed: April 8, 2021

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$65.99
Boilermaker	*\$23.45
Bricklayer	*\$23.45
Carpenter	\$46.17
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	*\$23.45
Plasterer	
Communications Technician	*\$23.45
Electrician (Inside Wireman)	\$61.76
Electrician Outside Lineman	*\$23.45
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	*\$23.45
Glazier	*\$23.45
Ironworker	\$62.72
Laborer	*\$23.45
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	*\$23.45
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	*\$23.45
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	*\$23.45
Plumber	\$62.14
Pipe Fitter	
Roofer	\$50.01
Sheet Metal Worker	*\$23.45
Sprinkler Fitter	*\$23.45
Truck Driver	*\$23.45
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

*The Division of Labor Standards received less than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

Heavy Construction Rates for
RANDOLPH County

Section 088

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	*\$23.45
Millwright	
Pile Driver	
Electrician (Outside Lineman)	*\$23.45
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	*\$23.45
General Laborer	
Skilled Laborer	
Operating Engineer	\$61.37
Group I	
Group II	
Group III	
Group IV	
Truck Driver	*\$23.45
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

*The Division of Labor Standards received less than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

**The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.

OVERTIME and HOLIDAYS

OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

HOLIDAYS

January first;
The last Monday in May;
July fourth;
The first Monday in September;
November eleventh;
The fourth Thursday in November; and
December twenty-fifth;

If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

SECTION 011000
SUMMARY OF WORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of Wastewater Treatment Facility Improvements.
 - 1. Project Location: Moberly Correctional Center, 5201 S Morley Street, Moberly, Missouri, 65270.
 - 2. Owner: State of Missouri, Office of Administration, Division of Facilities Management, Design and Construction, Harry S Truman State Office Building, Post Office Box 809, 301 West High Street, Jefferson City, Missouri 65102.
- B. Contract Documents, dated May 4, 2022 were prepared for the Project by Bartlett & West, 1719 Southridge Dr., Suite 100, Jefferson City, MO 65109.
- C. The Work consists of providing and installation of a flow control structure, Triplepoint NitrOx equipment, blowers, UV disinfection, flow metering, interconnecting piping, structures, electrical equipment, appurtenances as necessary and as shown on the Construction Plans.
 - 1. The Work includes providing all labor, equipment, and materials necessary for complete, functioning facility and commissioning of work. Sludge removal and demolition is as shown on the Construction Plans.
- D. The Work will be constructed under a single prime contract.

1.3 WORK UNDER OTHER CONTRACTS (Not Applicable)

1.4 FUTURE WORK (Not Applicable)

1.5 WORK SEQUENCE

- A. The Work will be conducted in 3 phases.
- B. Total project duration shall be 424 calendar days and 288 working days.
 - 1. Phase 1: This Phase will consist of the installation of the flow control structure, Triplepoint NitrOx Tanks, blower equipment, aeration equipment, UV equipment, flow meter and structures, and associated piping, valves, and appurtenances. Site working and grading, repair to lagoon cell 2, and sludge removal shall also take place in lagoon cell 3 prior to Phase 1 commencing. Work of this phase shall be substantially complete, ready for occupancy within **184 working days** of commencement of the phase, which will be **184 total working days** from issuance of Notice of Intent to Award.
 - 2. Phase 2: This Phase will consist of abandonment and removal of all piping and facilities as shown on the Construction Plans that are no longer in use as a result of Phase 1, commissioning, startup, and punch list. Work of this phase shall be substantially complete, ready for occupancy within **82 working days** of commencement of the phase, which will be **266 total working days** from issuance of Notice of Intent to Award.
 - 3. Phase 3: This Phase will consist of final cleanup and restoration of all areas disturbed as a result of Phases 1 and 2. Work of this phase shall be substantially complete, ready for occupancy within **22 working days** of commencement of the phase, which will be **288 total working days** from the commencement of Project construction. Therefore, final of the Project shall be **288 total working days** from the date the Notice of Intent to Award is issued. This is the total Project duration.

1.6 CONTRACTOR USE OF PREMISES

- A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises limited

only by the Owner's right to perform work or to retain other contractors on portions of the Project.

- B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage cause by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period..

1.7 OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate owner usage. Perform the Work so as not to interfere with the Owner's operations.
- B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.
 - 1. The Designer will prepare a Certificate of Partial Occupancy for each specific portion of the Work to be occupied prior to substantial completion.
 - 2. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions for the building.
 - 3. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions for the building.

1.8 OWNER-FURNISHED PRODUCTS (Not Applicable)

1.9 MISCELLANEOUS PROVISIONS (Not Applicable)

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

**SECTION 012100
ALLOWANCES**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Weather allowances.
- C. Related Sections include the following:
 - 1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
 - 2. Division 1 Section "Unit Prices" for procedures for using unit prices.

1.3 WEATHER ALLOWANCE

- A. Included within the completion period for this project are a specified number of "bad weather" days (see Schedule of Allowances).
- B. The Contractor's progress schedule shall clearly indicate the bad weather day allowance as an "activity" or "activities". In the event weather conditions preclude performance of critical work activities for 50% or more of the Contractor's scheduled workday, that day shall be declared unavailable for work due to weather (a "bad weather" day) and charged against the above allowance. Critical work activities will be determined by review of the Contractor's current progress schedule.
- C. The Contractor's Representative and the Construction Representative shall agree monthly on the number of "bad weather" days to be charged against the allowance. This determination will be documented in writing and be signed by the Contractor and the Construction Representatives. If there is a failure to agree on all or part of the "bad weather" days for a particular month, that disagreement shall be noted on this written document and signed by each party's representative. Failure of the Contractor's representative to sign the "bad weather" day documentation after it is presented, with or without the notes of disagreement, shall constitute agreement with the "bad weather" day determination contained in that document.
- D. There will be no modification to the time of contract performance due solely to the failure to deplete the "bad weather" day allowance.
- E. Once this allowance is depleted, a no cost Change Order time extension will be executed for "bad weather" days, as defined above, encountered during the remainder of the Project.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, Designer of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Designer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Designer from the designated supplier.

1.5 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 ALLOWANCES

- A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Weather Allowance: Included within the completion period for this Project 20 "bad weather" days.

END OF SECTION

SECTION 012300

ALTERNATES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Bid Form and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing Alternates.

1.3 DEFINITIONS

- A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents..
 - 1. The cost for each alternate is the net addition to the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
- B. No additional time will be allowed for alternate work unless the number of work days is so stated on the bid form.

1.4 PROCEDURES

- A. Coordination: Modify or adjust affected adjacent Work as necessary to completely and fully integrate the Alternate Work into the Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.
- B. Notification: The award of the Contract will indicate whether alternates have been accepted or rejected.
- C. Execute accepted alternates under the same conditions as other Work of this Contract.
- D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials necessary to achieve the Work described under each alternate.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Add drainage improvements as shown on Drawing C-104. This alternate includes the following:
 - 1. Relocate existing ditch and regrade ditch to bottom of storm inlet.
 - 2. Raise the drive by adding surface rock.
 - 3. Add storm inlet with wing wall improvements.
 - 4. Demo existing road culvert pipe and end sections and add RCP with end sections and associated improvements.
 - 5. Install end section and rock blanket on existing CMP.
- B. Alternate No. 2: Add seeding and mulching in accordance with specification Section 329219 "Seeding". Includes complete product and execution requirements for the final seeding of lawns and non-maintained vegetation areas disturbed by construction operations.

END OF SECTION

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract Modifications.
- B. Related Sections include the following:
 - 1. Division 1, Section 012100 "Allowances" for procedural requirements for handling and processing Allowances.
 - 2. Division 1, Section 013115 "Project Management Communications" for administrative requirements for communications.
 - 3. Division 0, Section 007213, Article 3.1 "Acceptable Substitutions" for administrative procedures for handling Requests for Substitutions made after Contract award.
 - 4. Division 0, Section 007213, Article 4.0 "Changes in the Work" for Change Order requirements.

1.3 REQUESTS FOR INFORMATION

- A. In the event that the Contractor or Subcontractor, at any tier, determines that some portion of the Drawings, Specifications, or other Contract Documents requires clarification or interpretation, the Contractor shall submit a "Request for Information" (RFI) in writing to the Designer. A RFI may only be submitted by the Contractor and shall only be submitted on the RFI forms provided by the Owner. The Contractor shall clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response is needed. In the RFI, the Contractor shall set forth an interpretation or understanding of the requirement along with reasons why such an understanding was reached.
- B. Responses to RFI shall be issued within ten (10) working days of receipt of the Request from the Contractor unless the Designer determines that a longer time is necessary to provide an adequate response. If a longer time is determined necessary by the Designer, the Designer will, within five (5) working days of receipt of the request, notify the Contractor of the anticipated response time. If the Contractor submits a RFI on a time sensitive activity on the current project schedule, the Contractor shall not be entitled to any time extension due to the time it takes the Designer to respond to the request provided that the Designer responds within the ten (10) working days set forth above.
- C. Responses from the Designer will not change any requirement of the Contract Documents. In the event the Contractor believes that a response to a RFI will cause a change to the requirements of the Contract Document, the Contractor shall give written notice to the Designer requesting a Change Order for the work. Failure to give such written notice within ten (10) working days, shall waive the Contractor's right to seek additional time or cost under Article 4, "Changes in the Work" of the General Conditions.

1.4 MINOR CHANGES IN THE WORK

- A. Designer will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Amount or the Contract Time, on "Designer's Supplemental Instructions" (DSI).

1.5 PROPOSAL REQUESTS

- A. The Designer or Owner Representative will issue a detailed description of proposed Changes in the Work that may require adjustment to the Contract Amount or the Contract Time. The

proposed Change Description will be issued using the "Request for Proposal" (RFP) form. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by the Designer or Owner Representative are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within ten (10) working days after receipt of Proposal Request, submit a proposal for the cost adjustments to the Contract Amount and the Contract Time necessary to execute the Change. The Contractor shall submit his proposal on the appropriate Change Order Detailed Breakdown form. Subcontractors may use the appropriate Change Order Detailed Breakdown form or submit their proposal on their letterhead provided the same level of detail is included. All proposals shall include:
 - a. A detailed breakdown of costs per Article 4.1 of the General Conditions.
 - b. If requesting additional time per Article 4.2 of the General Conditions, include an updated Contractor's Construction Schedule that indicates the effect of the Change including, but not limited to, changes in activity duration, start and finish times, and activity relationship.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, the Designer or Owner Representative will issue a Change Order for signatures of Owner and Contractor on the "Change Order" form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 013100
COORDINATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Projects including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
- B. Each Contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific Contractor.
- C. Related Sections include the following:
 - 1. Division 1, Section 013200 "Schedules" for preparing and submitting Contractor's Construction Schedule.
 - 2. Articles 1.8.B and 1.8.C of Section 007213 "General Conditions" for coordinating meetings onsite.
 - 3. Article 5.4.H of Section 007213 "General Conditions" for coordinating Closeout of the Contract.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections, which depend on each other for proper installation, connection, and operation.
- B. Coordination: Each Contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each Contractor shall coordinate its operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components including mechanical and electrical.
- C. Prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate Contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.

3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Startup and adjustment of systems.
 8. Project Closeout activities.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
- B. Key Personnel Names: Within fifteen (15) work days of starting construction operations, submit a list of key personnel assignments including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 PROJECT MEETINGS

- A. The Owner's Construction Representative will schedule a Pre-Construction Meeting prior to beginning of construction. The date, time, and exact place of this meeting will be determined after Contract Award and notification of all interested parties. The Contractor shall arrange to have the Job Superintendent and all prime Subcontractors present at the meeting. During the Pre-Construction Meeting, the construction procedures and information necessary for submitting payment requests will be discussed and materials distributed along with any other pertinent information.
1. Minutes: Designer will record and distribute meeting minutes.
- B. Progress Meetings: The Owner's Construction Representative will conduct Monthly Progress Meetings as stated in Articles 1.8.B and 1.8.C of Section 007213 "General Conditions".
1. Minutes: Designer will record and distribute to Contractor the meeting minutes.
- C. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of Manufacturers and Fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Designer and Construction Representative of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration including requirements for the following:
 - a. Contract Documents
 - b. Options
 - c. Related RFIs
 - d. Related Change Orders
 - e. Purchases
 - f. Deliveries
 - g. Submittals
 - h. Review of mockups

- i. Possible conflicts
 - j. Compatibility problems
 - k. Time schedules
 - l. Weather limitations
 - m. Manufacturer's written recommendations
 - n. Warranty requirements
 - o. Compatibility of materials
 - p. Acceptability of substrates
 - q. Temporary facilities and controls
 - r. Space and access limitations
 - s. Regulations of authorities having jurisdiction
 - t. Testing and inspecting requirements
 - u. Installation procedures
 - v. Coordination with other Work
 - w. Required performance results
 - x. Protection of adjacent Work
 - y. Protection of construction and personnel
3. Contractor shall record significant conference discussions, agreements, and disagreements including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
 6. Revise paragraph below if Project requires holding progress meetings at different intervals. Insert special intervals such as "every third Tuesday" to suit special circumstances.
 7. Project name
 8. Name and address of Contractor
 9. Name and address of Designer
 10. RFI number including RFIs that were dropped and not submitted
 11. RFI description
 12. Date the RFI was submitted
 13. Date Designer's response was received
 14. Identification of related DSI or Proposal Request, as appropriate

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 013115
PROJECT MANAGEMENT COMMUNICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013300.10 - Submittals
- C. Division 1, Section 012600 – Contract Modification Procedures

1.2 SUMMARY

- A. Project Management Communications: The Contractor shall use the Internet web based project management communications tool, E-Builder® ASP software, and protocols included in that software during this project. The use of project management communications as herein described does not replace or change any contractual responsibilities of the participants.
 - 1. Project management communications is available through E-Builder® as provided by "e-Builder®" in the form and manner required by the Owner.
 - 2. The project communications database is on-line and fully functional. User registration, electronic and computer equipment, and Internet connections are the responsibility of each project participant. The sharing of user accounts is prohibited
- B. Support: E-Builder® will provide on-going support through on-line help files.
- C. Copyrights and Ownership: Nothing in this specification or the subsequent communications supersedes the parties' obligations and rights for copyright or document ownership as established by the Contract Documents. The use of CAD files, processes or design information distributed in this system is intended only for the project specified herein.
- D. Purpose: The intent of using E-Builder® is to improve project work efforts by promoting timely initial communications and responses. Secondly, to reduce the number of paper documents while providing improved record keeping by creation of electronic document files
- E. Authorized Users: Access to the web site will be by individuals who are authorized users.
 - 1. Individuals shall complete the E-Builder New Company/User Request Form located at the following web site: <https://oa.mo.gov/facilities/vendor-links/contractor-forms>. Completed forms shall be emailed to the following email address:
OA.FMDCE-BuilderSupport@oa.mo.gov.
 - 2. Authorized users will be contacted directly and assigned a temporary user password.
 - 3. Individuals shall be responsible for the proper use of their passwords and access to data as agents of the company in which they are employed.
- F. Administrative Users: Administrative users have access and control of user licenses and all posted items. DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE! Improper or abusive language toward any party or repeated posting of items intended to deceive or disrupt the work of the project will not be tolerated and will result in deletion of the offensive items and revocation of user license at the sole discretion of the Administrative User(s).
- G. Communications: The use of fax, email and courier communication for this project is discouraged in favor of using E-Builder® to send messages. Communication functions are as follows:
 - 1. Document Integrity and Revisions:
 - a. Documents, comments, drawings and other records posted to the system shall remain for the project record. The authorship time and date shall be recorded for each document submitted to the system. Submitting a new document or record with a unique ID, authorship, and time stamp shall be the method used to make modifications or corrections.

- b. The system shall make it easy to identify revised or superseded documents and their predecessors.
 - c. Server or Client side software enhancements during the life of the project shall not alter or restrict the content of data published by the system. System upgrades shall not affect access to older documents or software.
- 2. Document Security:
 - a. The system shall provide a method for communication of documents. Documents shall allow security group assignment to respect the contractual parties communication except for Administrative Users. DO NOT POST PRIVATE OR YOUR COMPANY CONFIDENTIAL ITEMS IN THE DATABASE!
- 3. Document Integration:
 - a. Documents of various types shall be logically related to one another and discoverable. For example, requests for information, daily field reports, supplemental sketches and photographs shall be capable of reference as related records.
- 4. Reporting:
 - a. The system shall be capable of generating reports for work in progress, and logs for each document type. Summary reports generated by the system shall be available for team members.
- 5. Notifications and Distribution:
 - a. Document distribution to project members shall be accomplished both within the extranet system and via email as appropriate. Project document distribution to parties outside of the project communication system shall be accomplished by secure email of outgoing documents and attachments, readable by a standard email client.
- 6. Required Document Types:
 - a. RFI, Request for Information.
 - b. Submittals, including record numbering by drawing and specification section.
 - c. Transmittals, including record of documents and materials delivered in hard copy.
 - d. Meeting Minutes.
 - e. Application for Payments (Draft or Pencil).
 - f. Review Comments.
 - g. Field Reports.
 - h. Construction Photographs.
 - i. Drawings.
 - j. Supplemental Sketches.
 - k. Schedules.
 - l. Specifications.
 - m. Request for Proposals
 - n. Designer's Supplemental Instructions
 - o. Punch Lists
- H. Record Keeping: Except for paper documents, which require original signatures and large format documents (greater than 8½ x 11 inches), all other 8½ x 11 inches documents shall be submitted by transmission in electronic form to the E-Builder® web site by licensed users.
 - 1. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier shall respond to documents received in electronic form on the web site, and consider them as if received in paper document form.
 - 2. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall reply or respond by transmissions in electronic form on the web site to documents actually received in paper document form.
 - 3. The Owner and his representatives, the Designer and his consultants, and the Contractor and his Sub Contractors and suppliers at every tier reserves the right to and shall copy any paper document into electronic form and make same available on the web site.

- I. Minimum Equipment and Internet Connection: In addition to other requirements specified in this Section, the Owner and his representatives, the Construction Manager and his representatives, the Architect and his consultants, and the Contractor and his sub-contractors and suppliers at every tier required to have a user license(s) shall be responsible for the following:
 1. Providing suitable computer systems for each licensed user at the users normal work location with high-speed Internet access, i.e. DSL, local cable company's Internet connection, or T1 connection.
 2. Each of the above referenced computer systems shall have the following minimum system and software requirements:
 - a. Desktop configuration (Laptop configurations are similar and should be equal to or exceed desktop system.)
 - 1) Operating System: Windows XP or newer
 - 2) Internet Browser: Internet Explorer 6.01SP2+ (Recommend IE7.0+)
 - 3) Minimum Recommend Connection Speed: 256K or above
 - 4) Processor Speed: 1 Gigahertz and above
 - 5) RAM: 512 mb
 - 6) Operating system and software shall be properly licensed.
 - 7) Internet Explorer version 7 (current version is a free distribution for download). This specification is not intended to restrict the host server or client computers provided that industry standard HTTP clients may access the published content.
 - 8) Adobe Acrobat Reader (current version is a free distribution for download).
 - 9) Users should have the standard Microsoft Office Suite (current version must be purchased) or the equivalent.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE.)

END OF SECTION

SECTION 013200
SCHEDULE BAR CHART

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for a Bar Chart Schedule for the project construction activities, schedule of submittals, and schedule for testing.

PART 2 PRODUCTS – (NOT APPLICABLE)

PART 3 EXECUTION

3.1 SUBMITTAL PROCEDURES

- A. The Contractor shall submit to the Designer, within ten (10) working days following the Notice to Proceed, a Progress Schedule including Schedule of Values showing the rate of progress the Contractor agrees to maintain and the order in which he proposed to carry out the various phases of Work. No payments shall be made to the Contractor until the Progress Schedule has been approved by the Owner.
 - 1. The Schedule of Values must have the following line items included with the value of the item as indicated below:
 - a. O&M's (Owner's Manual)
 - 1) \$1,000,000.00 (One million) and under – 2% of the total contract amount
 - 2) Over \$1,000,000.00 (One million) – 1% of the total contract amount
 - b. Close Out Documents
 - 1) \$1,000,000.00 (One million) and under – 2% of the total contract amount
 - 2) Over \$1,000,000.00 (One million) – 1% of the total contract amount
 - c. General Conditions
 - 1) No more than 10%
- B. The Contractor shall submit an updated Schedule for presentation at each Monthly Progress Meeting. The Schedule shall be updated by the Contractor as necessary to reflect the current Schedule and its relationship to the original Schedule. The updated Schedule shall reflect any changes in the logic, sequence, durations, or completion date. Payments to the Contractor shall be suspended if the Progress Schedule is not adequately updated to reflect actual conditions.
- C. The Contractor shall submit Progress Schedules to Subcontractors to permit coordinating their Progress Schedules to the general construction Work. The Contractor shall coordinate preparation and processing of Schedules and reports with performance of other construction activities.

3.2 CONSTRUCTION PROGRESS SCHEDULE – BAR CHART SCHEDULE

- A. Bar-Chart Schedule: The Contractor shall prepare a comprehensive, fully developed, horizontal bar chart-type Contractor's Construction Schedule. The Contractor for general construction shall prepare the Construction Schedule for the entire Project. The Schedule shall show the percentage of work to be completed at any time, anticipated monthly payments by Owner, as well as significant dates (such as completion of excavation, concrete foundation work, underground lines, superstructure, rough-ins, enclosure, hanging of fixtures, etc.) which shall serve as check points to determine compliance with the approved Schedule. The Schedule shall also include an activity for the number of "bad" weather days specified in Section 012100 – Allowances.
 - 1. The Contractor shall provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week.
 - a. If practical, use the same Schedule of Values breakdown for schedule time bars.

2. The Contractor shall provide a base activity time bar showing duration for each construction activity. Each bar is to indicate start and completion dates for the activity. The Contractor is to place a contrasting bar below each original schedule activity time for indicating actual progress and planned remaining duration for the activity.
 3. The Contractor shall prepare the Schedule on a minimal number of separate sheets to readily show the data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on schedule with other construction activities. Include minor elements involved in the overall sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
 5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other required schedules and reports.
 6. Indicate the Intent to Award and the Contract Substantial Completion dates on the schedule.
- B. Phasing: Provide notations on the schedule to show how the sequence of the Work is affected by the following:
1. Requirement for Phased completion
 2. Work by separate Contractors
 3. Work by the Owner
 4. Pre-purchased materials
 5. Coordination with existing construction
 6. Limitations of continued occupancies
 7. Un-interruptible services
 8. Partial Occupancy prior to Substantial Completion
 9. Site restrictions
 10. Provisions for future construction
 11. Seasonal variations
 12. Environmental control
- C. Work Stages: Use crosshatched bars to indicate important stages of construction for each major portion of the Work. Such stages include, but are not necessarily limited to, the following:
1. Subcontract awards
 2. Submittals
 3. Purchases
 4. Mockups
 5. Fabrication
 6. Sample testing
 7. Deliveries
 8. Installation
 9. Testing
 10. Adjusting
 11. Curing
 12. Startup and placement into final use and operation
- D. Area Separations: Provide a separate time bar to identify each major area of construction for each major portion of the Work. For the purposes of this Article, a "major area" is a story of construction, a separate building, or a similar significant construction element.
1. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure
 - c. Completion of mechanical installation
 - d. Completion of the electrical portion of the Work

- e. Substantial Completion

3.3 SCHEDULE OF SUBMITTALS

- A. Upon acceptance of the Construction Progress Schedule, prepare and submit a complete schedule of submittals. Coordinate the submittal schedule with Section 013300.10 SUBMITTALS, the approved Construction Progress Schedule, list of subcontracts, Schedule of Values and the list of products.
- B. Prepare the schedule in chronological order. Provide the following information
 1. Scheduled date for the first submittal
 2. Related Section number
 3. Submittal category
 4. Name of the Subcontractor
 5. Description of the part of the Work covered
 6. Scheduled date for resubmittal
 7. Scheduled date for the Designer's final release or approval
- C. Distribution: Following the Designer's response to the initial submittal schedule, print and distribute copies to the Designer, Owner, subcontractors, and other parties required to comply with submittal dates indicated.
 1. Post copies in the Project meeting room and temporary field office.
 2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.
- D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

3.4 SCHEDULE OF INSPECTIONS AND TESTS

- A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule with (15) days of the date established for commencement of the Contract Work. The Contractor is to notify the testing agency at least (5) working days in advance of the required tests unless otherwise specified.
- B. Form: This schedule shall be in tabular form and shall include, but not be limited to, the following:
 1. Specification Section number
 2. Description of the test
 3. Identification of applicable standards
 4. Identification of test methods
 5. Number of tests required
 6. Time schedule or time span for tests
 7. Entity responsible for performing tests
 8. Requirements for taking samples
 9. Unique characteristics of each service
- C. Distribution: Distribute the schedule to the Owner, Architect, and each party involved in performance of portions of the Work where inspections and tests are required.

END OF SECTION

SECTION 013300.10

SUBMITTALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.
- B. Division 1, Section 013115 "Project Management Communications" for administrative requirements for communications.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for submittals required for performance of the Work including the following:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Samples
 - 4. Quality Assurance Submittals
 - 5. Construction Photographs
 - 6. Operating and Maintenance Manuals
 - 7. Warranties
- B. Administrative Submittals: Refer to General and Supplementary Conditions other applicable Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:
 - 1. Construction Progress Schedule including Schedule of Values
 - 2. Performance and Payment Bonds
 - 3. Insurance Certificates
 - 4. Applications for Payment
 - 5. Certified Payroll Reports
 - 6. Partial and Final Receipt of Payment and Release Forms
 - 7. Affidavit – Compliance with Prevailing Wage Law
 - 8. Record Drawings
 - 9. Notifications, Permits, etc.
- C. The Contractor is obliged and responsible to check all shop drawings and schedules to assure compliance with contract plans and specifications. The Contractor is responsible for the content of the shop drawings and coordination with other contract work. Shop drawings and schedules shall indicate, in detail, all parts of an Item or Work including erection and setting instructions and integration with the Work of other trades.
- D. The Contractor shall at all times make a copy, of all approved submittals, available on site to the Construction Representative.

1.3 SUBMITTAL PROCEDURES

- A. The Contractor shall comply with the General and Supplementary Conditions and other applicable sections of the Contract Documents. The Contractor shall submit, with such promptness as to cause no delay in his work or in that of any other contractors, all required submittals indicated in Part 3.1 of this section and elsewhere in the Contract Documents. Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

- a. The Designer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- B. Each drawing and/or series of drawings submitted must be accompanied by a letter of transmittal giving a list of the titles and numbers of the drawings. Each series shall be numbered consecutively for ready reference and each drawing shall be marked with the following information:
 1. Date of Submission
 2. Name of Project
 3. Location
 4. Section Number of Specification
 5. State Project Number
 6. Name of Submitting Contractor
 7. Name of Subcontractor
 8. Indicate if Item is submitted as specified or as a substitution

1.4 SHOP DRAWINGS

- A. Comply with the General Conditions, Article 3.2.
- B. The Contractor shall submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
- C. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings including the following information:
 1. Dimensions
 2. Identification of products and materials included by sheet and detail number
 3. Compliance with specified standards
 4. Notation of coordination requirements
 5. Notation of dimensions established by field measurement
 6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8½"x11" but no larger than 36"x48".

1.5 PRODUCT DATA

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.
 1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information including the following information:
 - a. Manufacturer's printed recommendations
 - b. Compliance with Trade Association standards
 - c. Compliance with recognized Testing Agency standards
 - d. Application of Testing Agency labels and seals
 - e. Notation of dimensions verified by field measurement
 - f. Notation of coordination requirements
 2. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.

1.6 SAMPLES

- A. The Contractor shall comply with the General Conditions, Article 3.2.
- B. The Contractor shall submit full-size, fully fabricated samples, cured and finished as specified, and physically identical with the material or product proposed. Samples include partial sections

of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. The Contractor shall mount or display samples in the manner to facilitate review of qualities indicated. Prepare samples to match the Designer's sample including the following:
 - a. Specification Section number and reference
 - b. Generic description of the Sample
 - c. Sample source
 - d. Product name or name of the Manufacturer
 - e. Compliance with recognized standards
 - f. Availability and delivery time
2. The Contractor shall submit samples for review of size, kind, color, pattern, and texture. Submit samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.
 - a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
 - b. Refer to other Specification Sections for requirements for samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - c. Refer to other Sections for samples to be returned to the Contractor for incorporation in the Work. Such samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of sample submittals.
 - d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
3. Field samples are full-size examples erected onsite to illustrate finishes, coatings, or finish materials and to establish the Project standard.
 - a. The Contractor shall comply with submittal requirements to the fullest extent possible. The Contractor shall process transmittal forms to provide a record of activity.

1.7 QUALITY ASSURANCE DOCUMENTS

- A. The Contractor shall comply with the General Conditions, Article 3.2
- B. The Contractor shall submit quality control submittals including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
- C. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the Manufacturer certifying compliance with specified requirements.
 1. Signature: Certification shall be signed by an officer of the Manufacturer or other individual authorized to contractually bind the Company.
- D. Inspection and Test Reports: The Contractor shall submit the required inspection and test reports from independent testing agencies as specified in this Section and in other Sections of the Contract Documents.
- E. Construction Photographs: The Contractor shall submit record construction photographs as specified in this Section and in other Sections of the Contract Documents.
 1. The Contractor shall submit digital photographs. The Construction Administrator shall determine the quantity and naming convention at the preconstruction meeting.
 2. The Contractor shall identify each photograph with project name, location, number, date, time, and orientation.
 3. The Contractor shall submit progress photographs monthly unless specified otherwise. Photographs shall be taken one (1) week prior to submitting.

4. The Contractor shall take four (4) site photographs from differing directions and a minimum of five (5) interior photographs indicating the relative progress of the Work.

1.8 OPERATING AND MAINTENANCE MANUALS AND WARRANTIES

- A. The Contractor shall submit all required manufacturer's operating instructions, maintenance/service manuals, and warranties in accordance with the General Conditions, Article 3.5, and Supplementary Conditions along with this and other Sections of the Contract Documents.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 REQUIRED SUBMITTALS

- A. Contractor shall submit information for materials and equipment to be provided under this contract. Section 013300.20 provides a table with required submittals.

END OF SECTION

SPEC SECTION	TITLE	CATEGORY
013200	Schedules	Construction Schedule
013200	Schedules	Schedule of Values
013200	Schedules	List of Subcontractors
013200	Schedules	Major Material Suppliers
024100	Demolition	Shop Drawings
033000	Cast-In-Place Concrete	Product Data
034100	Precast Structural Concrete	Shop Drawings
055000	Metal Fabrications	Shop Drawings
055100	Metal Stairs, Handrails, and Railing	Shop Drawings
055300	Metal Gratings, Cover Plates and Access Hatches	Shop Drawings
099000	Painting and Coatings	Product Data
099761	Fusion-Bonded Epoxy Linings and Coatings	Product Data
260010	Supplemental Requirements for Electrical	Shop Drawings
260510	Common Motor Requirements	Warranty
260519	Low-Voltage Electrical Power Conductors and Cables	Product Data
260523	Control-Voltage Electrical Power Cables	Product Data
260526	Grounding and Bonding for Electrical Systems	Product Data
260529	Hangers and Supports for Electrical Systems	Shop Drawings
260533	Raceway and Boxes for Electrical Systems	Shop Drawings
260544	Sleeves and Sleeve Seals for Electrical Raceways and Cabling	Product Data
260553	Identification for Electrical Systems	Product Data
262200	Low-Voltage Transformers	Shop Drawings
262200	Low-Voltage Transformers	Product Data
262416	Panelboards	Shop Drawings
262416	Panelboards	Product Data
262713	Electricity Metering	Shop Drawings
262726	Wiring Devices	Product Data
262813	Fuses	Product Data
262816	Enclosed Switches and Circuit Breakers	Product Data
263213	Engine Generators	Product Data
263213	Engine Generators	Certification
263600	Transfer Switches	Shop Drawings
264313	Surge Protection Devices for Low-Voltage Electrical Power Circuits	Product Data
265619	LED Exterior Lighting	Product Data
310000	Earthwork	Test Report
312333	Trenching and Backfilling	Test Report
313219	Filter Fabric	Product Data

313700	Riprap	Product Data
321540	Crushed Stone Paving	Product Data
321540	Crushed Stone Paving	Test Report
329219	Seeding	Certification
330516	Precast Concrete Utility Structures	Shop Drawings
333817	Repairs at Clay Lined Lagoons	Shop Drawings
333817	Repairs at Clay Lined Lagoons	Test Report
400500	General Piping Requirements	Product Data
400515	Pressure Testing of Piping	Test Report
400561	Gate Valves	Product Data
400563	Ball Valves	Product Data
400565	Check Valves	Product Data
400713	Polyethylene Sheet Encasement	Product Data
400722	Flexible Pipe Couplings and Expansion Joints	Product Data
400762	Wall Pipes, Seep Rings, and Penetrations	Product Data
400764	Pipe Hangers and Supports	Product Data
400775	Equipment, Piping, and Valve Identification	Product Data
402040	Ductile-Iron Process Pipe	Product Data
402076	Stainless Steel Pipe	Product Data
402090	PVC & CPVC Pipe	Product Data
409721	Magnetic Flowmeters	Product Data
465332	Lagoon Aeration System	Shop Drawings
465332	Lagoon Aeration System	Product Data
465333	Lagoon Integrated Nitrification Reactor	Shop Drawings
465333	Lagoon Integrated Nitrification Reactor	Product Data

SECTION 013513.16

SITE SECURITY AND HEALTH REQUIREMENTS (DOC)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUBMITTALS

- A. List of required submittals:
 1. Materials Safety Data Sheets for all hazardous materials to be brought onsite.
 2. Schedule of proposed shutdowns, if applicable.
 3. Revise list to include all required submittals.
 4. A list of the names of all employees who will submit fingerprints for a background check, and the signed privacy documents identified below for each employee.
 5. Tuberculin skin test results for all employees required to be tested as set forth below.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 ACCESS TO THE SITE

- A. The Contractor shall arrange with Facility Representatives to establish procedures for the controlled entry of workers and materials into the work areas at the Facility.
- B. The Contractor shall establish regular working hours with Facility Representatives. The Contractor must report changes in working hours or overtime to Facility Representatives and obtain approval twenty-four (24) hours ahead of time. The Contractor shall report emergency overtime to Facility Representatives as soon as it is evident that overtime is needed. The Contractor must obtain approval from Facility Representatives for all work performed after dark.
- C. The Contractor shall provide the name and phone number of the Contractor's employee or agent who is in charge onsite; this individual must be able to be contacted in case of emergency. The Contractor must be able to furnish names and address of all employees upon request.
- D. The Contractor shall provide Facility Representatives notice twenty-four (24) hours prior to any possible vehicle entry and/or required escort. The Contractor shall maintain a time log of any delays in gaining entrance to the Facility due to lack of an escort, which is to be submitted monthly with the Contractor's pay request materials. The purpose of this log is to establish a basis for a contract change, if required. The log shall contain the date and time of delay, date and time of request of entry, workers delayed (name and occupation), and name of the Facility Representative to whom the request was made, if possible. Any delay in entry must be validated by sallyport and pass office personnel at the Facility. Only delays greater than thirty (30) minutes will be considered for a contract change. A 30-minute delay upon arrival with a vehicle to enter the sallyport should be expected.

3.2 RULES OF THE FACILITY

- A. The Contractor and its workers shall observe the following rules:
 1. There shall be no fraternization with inmates.
 2. No intoxicating beverages or illegal drugs shall be brought onto Facility grounds.
 3. No firearms, other weapons, or explosives shall be carried onto Facility grounds.
 4. No prescription drugs above one day's dosage shall be carried on Facility grounds.
 5. Any vehicle or individual is subject to search at any time while on Facility grounds.
 6. The vehicles of the Contractor and its workers shall be locked whenever unattended.
 7. All tools and equipment shall be tightly secured during non-working hours in the Contractor's storage trailer or assigned area.

8. The Facility will not be responsible for the Contractor's tools, equipment, or materials. The Contractor shall keep and maintain a current tool inventory. The tool inventory shall be made available to Facility Representatives and the Owner upon request.
9. The Contractor shall report any missing tools to Facility Representatives immediately.
10. Smoking shall be permitted only in accordance with the regulations of the Facility.
11. Possession or use of smokeless tobacco or smokeless non-tobacco alternatives is strictly prohibited.

B. All workers shall be required to sign an acknowledgement of receipt of these rules.

3.3 SECURITY CLEARANCES AND RESTRICTIONS

A. DOC SECURITY CLEARANCE REQUIREMENTS

1. (Security restrictions may vary between different Facilities. Verify and revise paragraph below if Facility requirement for construction personnel differ.) Prior to the commencement of any onsite work, the Contractor shall submit a list containing the name, date of birth, and Missouri driver's license number or social security number of all construction personnel to the Missouri Department of Corrections for the purpose of obtaining security clearances. The required information shall be submitted at the pre-construction meeting, or as otherwise directed by Department of Corrections' personnel. Any construction personnel with pending warrants or felony convictions within the last five (5) years or other offenses deemed to create a security risk by Department of Corrections shall not be allowed onsite. The Department of Corrections reserves the right to refuse admission to any individual they feel may be detrimental to the security of the Facility.

3.4 FIRE PROTECTION, SAFETY, AND HEALTH CONTROLS

- A. The Contractor shall take all necessary precautions to guard against and eliminate possible fire hazards.
 1. Onsite burning is prohibited.
 2. The Contractor shall store all flammable or hazardous materials in proper containers located outside the buildings or offsite, if possible.
 3. The Contractor shall provide and maintain, in good order, during construction fire extinguishers as required by the National Fire Protection Association. In areas of flammable liquids, asphalt, or electrical hazards, 15-pound carbon dioxide or 20-pound dry chemical extinguishers shall be provided.
- B. The Contractor shall not obstruct streets or walks without permission from the Owner's Construction Representative and Facility Representatives.
- C. The Contractor's personnel shall not exceed the speed limit of 15 mph while at the Facility unless otherwise posted.
- D. The Contractor shall take all necessary, reasonable measures to reduce air and water pollution by any material or equipment used during construction. The Contractor shall keep volatile wastes in covered containers, and shall not dispose of volatile wastes or oils in storm or sanitary drains.
- E. The Contractor shall keep the project site neat, orderly, and in a safe condition at all times. The Contractor shall immediately remove all hazardous waste, and shall not allow rubbish to accumulate. The Contractor shall provide onsite containers for collection of rubbish and shall dispose of it at frequent intervals during the progress of the Work.
- F. Fire exits, alarm systems, and sprinkler systems shall remain fully operational at all times, unless written approval is received from the Owner's Construction Representative and the appropriate Facility Representative at least twenty-four (24) hours in advance. The Contractor shall submit a written time schedule for any proposed shutdowns.
- G. For all hazardous materials brought onsite, Material Safety Data Sheets shall be on site and readily available upon request at least a day before delivery.
- H. The Contractor's workers shall not be under the influence of any intoxicating substances while on the Facility premises.

3.5 TUBERCULOSIS TESTING REQUIREMENTS

- A. All workers who will be in the confines of the Facility for more than ten (10) consecutive working days must provide proof of a negative tuberculin skin test. The test results must be no more than six (6) months old at the commencement of construction. The Contractor or the worker, not the Owner, shall pay the cost of the test.
- B. The Contractor shall submit to Facility Representatives current tuberculin skin test results for all workers who are required to have such a test in accordance with paragraph A above. If the contract period extends for more than twelve (12) months, the Contractor must provide new test results for all workers prior to the anniversary of the contract commencement date.
- C. Any worker required to have a tuberculin skin test under paragraph A above who fails or refuses to do so will be denied admission to the facility until such time as proof of the test results are provided.
- D. If any worker has a tuberculin skin test with positive results, the worker shall be denied access to the facility until the worker produces a certification from a physician licensed to practice in the State of Missouri that the worker does not have infectious tuberculosis.
- E. The Contractor shall not be entitled to any additional time or compensation if any of its workers are denied access to the facility because of failure to produce negative tuberculin skin test results.
- F. Failure or refusal of the Contractor to maintain and produce the required tuberculin skin test records shall be a material breach of this contract, which shall subject the Contractor to a declaration of default.

3.6 PREA FOR CONTRACTORS AND EMPLOYEES

- A. The contractor and all of the contractor's employees and agents providing services in any Department of Corrections institution must be at least 18 years of age. A Missouri Uniform Law Enforcement System (MULES) check or other background investigation may be required on the contractor, the contractor's employees and agents before they are allowed entry into the institution. The contractor, its employees and agents understand and agree that the Department may complete criminal background records checks annually for the contractor and the contractor's employees and agents that have the potential to have contact with inmates.
- B. The institution shall have the right to deny access into the institution for the contractor and any of the contractor's employees and agents for any reason, at the discretion of the institution.
- C. The contractor, its employees and agents under active federal or state felony or misdemeanor supervision must receive written division director approval prior to providing services pursuant to a Department contract. Similarly, contractors/employees/agents with prior felony convictions and not under active supervision must receive written division director approval in advance.
- D. The contractor, its employees and agents shall at all times observe and comply with all applicable state statutes, Department rules, regulations, guidelines, internal management policies and procedures, and general orders of the Department that are applicable, regarding operations and activities in and about all Department property. Furthermore, the contractor, its employees and agents, shall not obstruct the Department or any of its designated officials from performing their duties in response to court orders or in the maintenance of a secure and safe correctional environment. The contractor shall comply with the Department's policies and procedures relating to employee conduct.
 - 1. The Department has a zero tolerance policy for any form of sexual misconduct to include staff/contractor/volunteer on offender, or offender on offender, sexual harassment, sexual assault, sexual abuse and consensual sex.
 - a. Any contractor or contractor's employee or agent who witnesses any form of sexual misconduct must immediately report it to the warden of the institution. If a contractor or contractor's employee or agent fails to report or knowingly condones sexual harassment or sexual contact with or between offenders, the Department may cancel

the contract, or at the Department's sole discretion, require the contractor to remove the employee/agent from providing services under the contract.

- b. Any contractor or contractor's employee or agent who engages in sexual abuse shall be prohibited from entering the institution and shall be reported to law enforcement agencies and licensing bodies, as appropriate.
- E. The contractor, its employees and agents shall not interact with the offenders except as is necessary to perform the requirements of the contract. The contractor, its employees and agents shall not give anything to nor accept anything from the offenders except in the normal performance of the contract.
- F. If any contractor or contractor's employee or agent is denied access into the institution for any reason or is denied approval to provide service to the Department for any reason stated herein, it shall not relieve the contractor of any requirements of the contract. If the contractor is unable to perform the requirements of the contract for any reason, the contractor shall be considered in breach.

3.7 DISRUPTION OF UTILITIES

- A. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and the Facility Representative before disconnecting electric, gas, water, fire protection, or sewer service to any building.
- B. The Contractor shall give a minimum of seventy-two (72) hours written notice to the Construction Representative and Facility Representative before closing any access drives, and shall make temporary access available, if possible. The Contractor shall not obstruct streets, walks, or parking.

3.8 CELL PHONES AND ELECTRONIC DEVICES

- A. Cell phones, pagers, smart watches (that can send/receive messages), fitness wrist bands (that can send/receive messages) or other electronic devices are not permitted.
 - 1. Contractors, repairpersons, or information technology services department staff may be permitted to bring in a cell phone and portable wireless router (Wi-Fi, MiFi, etc.) if approved by the Chief Administrative Officer (CAO) when the phone is necessary to complete job duties relating to repairs on a case by case basis.
 - 2. Tablets (iPad, etc.) are not allowed with the exception of for re-entry purposes and approved via the division of adult institutions (DAI) director and the re-entry manager.
 - 3. Lap top computers may be permitted by the CAO on a case by case basis.

END OF SECTION

SECTION 014126

PERMITS

PART 1 GENERAL

1.1 REQUIREMENTS

- A. It shall be the Contractor's responsibility to secure all permits of every description required to initiate and complete the work under this contract, except permits obtained by the Owner. The Contractor shall be responsible for complying with all permit and approval requirements including Owner obtained.
- B. No separate or direct payment will be made to the Contractor for permits and inspection requirements, but all such costs shall be included in the applicable items in the Schedule of Prices. The Owner will furnish signed and sealed sets of Contract Documents for permit use as required.
- C. The Contractor shall furnish to the Engineer copies of all permits and/or agreements prior to commencement of work requiring permits.
- D. The Contractor shall obtain permits for MODOT temporary access drive.
- E. Permits/approval obtained by the Owner or his authorized representative, include responses from the following entities. Authorizations and approvals are found after this specification section.
 1. Missouri Department of Natural Resources - Construction Permit. See attached construction permit. The Contractor shall meet all requirements of the construction permit, which is attached to this section.
 2. Missouri Department of Natural Resources - Land Disturbance Permit. A land disturbance permit has been received from MDNR for the land disturbance construction activities. The Contractor shall meet all requirements of the land disturbance permit, including using the plan sheet to produce and maintain a SWPPP throughout the duration of the construction activities on that site. Installation and maintenance of erosion control BMPs shall meet plans, details, specifications, and the land disturbance permit. Record keeping associated with the SWPPP shall meet requirements of the plans, specifications, and LD permit. Reference the land disturbance permit attached to this section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 015000

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls including temporary utilities, support facilities, security, and protection.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Water service and distribution
 - 2. Temporary electric power and light
 - 3. Temporary heat
 - 4. Ventilation
 - 5. Telephone service
 - 6. Sanitary facilities, including drinking water
 - 7. Storm and sanitary sewer
- C. Support facilities include, but are not limited to, the following:
 - 1. Field offices and storage sheds
 - 2. Temporary roads and paving
 - 3. Dewatering facilities and drains
 - 4. Temporary enclosures
 - 5. Hoists and temporary elevator use
 - 6. Temporary project identification signs and bulletin boards
 - 7. Waste disposal services
 - 8. Rodent and pest control
 - 9. Construction aids and miscellaneous services and facilities
- D. Security and protection facilities include, but are not limited to, to following:
 - 1. Temporary fire protection
 - 2. Barricades, warning signs, and lights
 - 3. Sidewalk bridge or enclosure fence for the site
 - 4. Environmental protection

1.3 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within (15) days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations including, but not limited to, the following:
 - 1. Building code requirements
 - 2. Health and safety regulations
 - 3. Utility company regulations
 - 4. Police, fire department, and rescue squad rules
 - 5. Environmental protection regulations
- B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations". ANSI A10 Series standards for "Safety Requirements for Construction and Demolition", and NECA Electrical Design Library "Temporary Electrical Facilities".

1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code".
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist onsite.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. If acceptable to the Designer, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry".
1. For job-built temporary office, shops, and sheds within the construction area, provide UL-labeled, fire-treated lumber and plywood for framing, sheathing, and siding.
 - a. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sized and thicknesses indicated.
 - b. For fences and vision barriers, provide minimum 3/9" (9.5mm) thick exterior plywood.
 - c. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8" (16mm) thick exterior plywood.
 - d. Gypsum Wallboard: Provide gypsum wallboard on interior walls of temporary offices.
- C. Roofing Materials: Provide UL Class A standard-weight asphalt shingles or UL Class C mineral-surfaced roll roofing on roofs of job-built temporary office, shops, and shed.
- D. Paint: Comply with requirements of Division 9 Section "Painting".
- E. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.
1. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
 2. For interior walls of temporary offices, provide two (2) quarts interior latex-flat wall paint.
- F. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of (15) or less. For temporary enclosures, provide translucent, nylon-reinforced laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- G. Water: Provide potable water approved by local health authorities.
- H. Open-Mesh Fencing: Provide 0.120" (3mm) thick, galvanized 2" (50mm) chainlink fabric fencing 6' (2m) high with galvanized steel pipe posts, 1½" (38mm) ID for line posts and 2½" (64mm) ID for corner posts.

2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the Designer, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Water Hoses: Provide ¾" (19mm), heavy-duty, abrasion-resistant, flexible rubber hoses 100' (30m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110 to 120V plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage rating.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixture where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
- H. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated re-circulation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers, or a combination of extinguishers of NFPA-recommended classes for the exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each Facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with company recommendations.
 - 1. Arrange with company and existing users for a time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to the site where the Owner's easements cannot be used for that purpose.
 - 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Designer. Neither the Owner nor Designer will accept cost or use charges as a basis of claims for Change Order.
- B. Temporary Electric Power Service: The Owner will provide electric power for construction lighting and power tools. Contractors using such services shall pay all costs of temporary services, circuits, outlet, extensions, etc.
- C. Temporary Toilets: Install self-contained toilet units. Use of pit-type privies will not be permitted. Comply with regulations and health codes for the type, number, location, operation,

and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

1. Shield toilets to ensure privacy.
2. Provide separate facilities for male and female personnel.
3. Provide toilet tissue materials for each facility.

- D. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.
1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.
- B. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip office as follows:
1. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table, plan rack, and a 6-shelf bookcase.
 2. Equip with a water cooler and private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.
- C. Storage Facilities: The Owner will provide storage onsite as designated by the Facility Representative or the Construction Representative. Areas for use by the Contractor for storage will be identified at the Pre-Bid Meeting.
- D. Construction Parking: Parking at the site will be provided in the areas designated at the Pre-Construction Meeting.
- E. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.
- F. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and materials drying or curing requirements to avoid dangerous conditions and effects.
 2. Install tarpaulins securely with incombustible wood framing and other materials. Close openings of 25SqFt (2.3SqM) or less with plywood or similar materials.
 3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 4. Where temporary wood or plywood enclosure exceeds 100SqFt (9.2SqM) in area, use UL-labeled, fire-retardant-treated material for framing and main sheathing.
- G. Temporary Lifts and Hoists: Provide facilities for hoisting materials and employees. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.
1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.

2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- I. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.
- J. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.
- K. Rodent Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures are regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the Designer.
- B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonable predictable and controllable fire losses. Comply with NFPA 10 “Standard for Portable Fire Extinguishers” and NFPA 241 “Standard for Safeguarding Construction, Alterations, and Demolition Operations”.
 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one (1) extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire-exposure areas.
 4. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- C. Permanent Fire Protection: At the earliest feasible date in each area of the Project complete installation of the permanent fire-protection facility including connected services and place into operation and use. Instruct key personnel on use of facilities.
- D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting including flashing red or amber lights.
- E. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.
 1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.
 2. Provide plywood fence, 8' (2.5m) high, framed with (4) 2"x4" (50mm x 100mm) rails, and preservative-treated wood posts spaced not more than 8' (2.5m) apart.
- F. Covered Walkway: Erect a structurally adequate, protective covered walkway for passage of persons along the adjacent public street. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing. Provide wood plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage. Extend the back wall beyond the structure to complete the enclosure fence. Paint and maintain in a manner acceptable to the Owner and the Designer.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
 1. Storage: Where materials and equipment must be stored and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- H. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Designer requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are the Contractor's property. The Owner reserves the right to take possession of project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at the temporary entrances as required by the governing authority.
 3. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
 - a. Replace air filters and clean inside of ductwork and housing.
 - b. Replace significantly worn parts and parts subject to unusual operating conditions.
 - c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION

SECTION 015713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SUMMARY

- A. Stormwater Pollution Prevention Plan (SWPPP)
- B. Erosion Control Measures
- C. Velocity and Flow Control Measures
- D. Sediment Control Measures
- E. Application/Installation of Measures
- F. Removal/Replacement of Measures

1.2 DESCRIPTION OF WORK

- A. Furnish all materials; install, construct, maintain, and remove specified erosion control devices; at locations specified in the contract documents, or where specified by the Engineer.
- B. Complete the required construction work on this project, while minimizing soil erosion and controlling water pollution. Maintain these features as specified, from initial construction stages to final completion of the project.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.

1.4 SCHEDULING AND CONFLICTS

- A. Comply with Division 1 General Conditions as well as the following:
 - 1. Implement erosion and sediment control measures at the appropriate time(s). See Section 015723 for specific requirements.
 - 2. Coordinate construction to minimize damage to erosion and sediment control devices.

1.5 SPECIAL REQUIREMENTS

- A. Permit
 - 1. Comply with the DNR Land Disturbance Permit, applicable to the site.
- B. Protection of Property: Prevent accumulation of soil, sediment, or debris from project site onto adjoining public or private property. Remove any accumulation of soil or debris immediately, and take remedial actions for prevention.

PART 2 PRODUCTS

2.1 COMPOST BLANKETS

- A. Derived from a well-decomposed source of organic matter.
- B. Produced using an aerobic composting process, meeting Code of Federal Regulations (CFR) 503 for time, temperature, and heavy metal concentrations.
- C. No visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
- D. Certified by the U.S. Composting Council's Seal of Testing Assurance (STA) program.
- E. Conforms to chemical, physical, and biological parameters of AASHTO MP 10-03, with the following additional requirements:
 - 1. Follow U.S. Composting Council's TMECC guidelines for all testing.
 - 2. Organic Matter Content: 30% minimum.
 - 3. pH: between 6.0 and 8.0.
 - 4. Maturity (growth screening): Minimum 90% emergence for all compost to be vegetated.

2.2 COMPOST BLANKET AND FILTER BERM TACKIFIER

- A. Use a biodegradable, organic binding agent or polyacrylamide that can be mixed with, or injected into, compost or filter material as it is placed, which is not detrimental to the establishment of vegetation.
- B. Use in filter berms or compost blankets when specified in the contract documents.
- C. Apply at the rate recommended by the manufacturer.

2.3 FILTER MATERIAL

- A. Material for use in filter socks, filter berms, and other areas, as specified in the contract documents.
- B. Use material derived from wood, bark, or other, non-toxic vegetative feedstocks.
- C. Use material with no visible admixture of refuse or other physical contaminants, nor any material toxic to plant growth.
- D. Use material meeting the following particle sizes:

Sieve Size	Percent Passing*
2"	100
1"	90-100
3/8"	0-30

*The target flow rate of in-place material is 10/gal/min/lf. The Engineer may approve use of alternate materials meeting the target flow rate.

2.4 FILTER SOCK

- A. For slope and sediment control applications, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 5 mil thickness, photodegradable HDPE.
- B. For inlet protection, use a continuous, tubular, knitted, mesh netting with 3/8 inch openings, constructed of 500 denier polypropylene.
- C. Use 1 inch by 2 inch (minimum) hardwood stakes or stakes of equivalent strength.

2.5 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

- A. Use temporary rolled erosion control products that are classified and have material properties according to the Erosion Control Technology Council's (ECTC) guidelines as follows:
- B. Material Classification:
 - 1. RECP Type 1 (Ultra Short-term): Functional longevity of 3 months or less and classified as follows:
 - a. RECP Type 1.A: Mulch control net, consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. RECP Type 1.B: Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
 - c. RECP Type 1.C: Single-net erosion control blankets and open weave textiles, consisting of processed degradable natural and/or polymer fibers, mechanically bound together by a single rapidly-degrading, synthetic or natural fiber netting, or an open weave textile of processed rapidly-degrading natural or polymer yarns or twines woven into a continuous matrix.
 - d. RECP Type 1.D: Double-net erosion control blankets, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two rapidly-degrading, synthetic or natural fiber nettings.
 - 2. RECP Type 2 (Short-term): Functional longevity between 3 and 12 months and classified as follows:

- a. RECP Type 2.A: Mulch control net, consisting of a photodegradable synthetic mesh or woven biodegradable natural fiber netting.
 - b. RECP Type 2.B: Netless rolled erosion control blankets, consisting of natural and/or polymer fibers, mechanically interlocked and/or chemically adhered together to form a RECP.
 - c. RECP Type 2.C: Single-net erosion control blankets and open weave textiles, consisting of an erosion control blanket composed of processed degradable natural or polymer fibers, mechanically bound together by a single degradable synthetic or natural fiber netting to form a continuous matrix, or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.
 - d. RECP Type 2.D: Double-net erosion control blanket, consisting of processed degradable natural and/or polymer fibers, mechanically bound together between two degradable synthetic or natural fiber nettings.
3. RECP Type 3 (Extended Term): Functional longevity between 12 and 24 months and classified as follows:
 - a. RECP Type 3.A: Mulch control nets, consisting of a slow-degrading synthetic mesh or woven natural fiber netting.
 - b. RECP Type 3.B: Erosion control blankets and open weave textiles, consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow-degrading synthetic or natural fiber nettings to form a continuous matrix, or an open weave textile composed of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.
 4. RECP Type 4 (Long Term): Functional longevity of 36 months and classified as follows: Erosion control blankets and open weave textiles, consisting of processed slow-degrading natural or polymer fibers, mechanically bound together between two slow degrading synthetic or natural fiber nettings to form a continuous matrix, or an open weave textile composed of processed slow-degrading natural or polymer yarns or twines woven into a continuous matrix.
- C. Properties and Performance:
1. Testing performed according to the ECTC's Testing Procedures for Rolled Erosion Control Products. Verify manufacturer's test results by independent testing.
 2. Material properties meeting the Erosion Control Technology Council's (ECTC) Standard Specifications for Rolled Erosion Control Products as follows:

Classification	Slope Application	Channel Application	Min. Tensile Strength
	Max. Grade*	Permissible Shear Stress	
RECP Type 1.A	5:1 (H:V)	0.25 lb/ft ²	5 lb/ft
RECP Type 1.B	4:1 (H:V)	0.50 lb/ft ²	5 lb/ft
RECP Type 1.C	3:1 (H:V)	1.50 lb/ft ²	50 lb/ft
RECP Type 1.D	2:1 (H:V)	1.75 lb/ft ²	75 lb/ft
RECP Type 2.A	5:1 (H:V)	0.25 lb/ft ²	5 lb/ft
RECP Type 2.B	4:1 (H:V)	0.50 lb/ft ²	5 lb/ft
RECP Type 2.C	3:1 (H:V)	1.50 lb/ft ²	50 lb/ft
RECP Type 2.D	2:1 (H:V)	1.75 lb/ft ²	75 lb/ft
RECP Type 3.A	5:1 (H:V)	0.25 lb/ft ²	25 lb/ft
RECP Type 3.B	1.5:1 (H:V)	2.00 lb/ft ²	100 lb/ft
RECP Type 4	1:1 (H:V)	2.25 lb/ft ²	125 lb/ft

*Product tested according to ECTC Test Method No. 2 and meeting the ECTC Standard Specifications for "C" factor.

- D. RECP Anchors: Stakes or staples as recommended by manufacturer, with a minimum length of 6 inches.

2.6 WATTLES

- A. Netting: Open weave, degradable netting. Nominal diameter of 9 inches, or as specified.
- B. Fill Material: Straw, wood excelsior, coir, or other natural materials approved by the Engineer.
- C. Stakes: 1 inch by 1 inch (minimum) wooden stakes, or stakes of equivalent strength.

2.7 CHECK DAMS

- A. Synthetic Permeable Check Dam (HDPE):
 - 1. Ditch Berm:
 - a. Installed height of 9 to 10 inches.
 - b. Manufactured check dam constructed from sheets of perforated, UV-stabilized High Density Polyethylene (HDPE).
 - c. Perforations of 30 to 40% open area.
 - 2. RECP for Permeable Check Dam (when specified): RECP Type 4, 4 feet wide.
 - 3. Anchors: As recommended by the manufacturer.
- B. Triangular Foam Check Dam: Triangular-shaped device with a height of 8 to 10 inches and a base of 16 to 20 inches.
 - 1. Inner Support Material: Urethane foam.
 - 2. Outer Cover: Woven geotextile material shaped to fit around the inner support material, extending 2 to 3 feet beyond the bottom edge of the triangular-shaped inner support.
 - 3. Length: 7 feet.
- C. Rock Check Dam:
 - 1. Aggregate: Engineer will determine gradation compliance by visual inspection. After visual inspection and prior to loading, the Engineer may designate material as too fine or too coarse.
 - a. Nominal 6 inch size.
 - b. 100% passing the 9 inch screen.
 - c. 100% retained on the 3 inch screen
 - 2. Engineering Fabric: Is capable of withstanding normal installation stresses, and has the properties listed in Table below.

Fabric for use as Embankment Erosion Control

Property	Value	Test Method
Grab strength, dry, minimum average value in either principal direction	150 lbs.	ASTM D4632/D4632M
Elongation, dry, minimum average value in either principal direction	20%	ASTM D4632/D4632M
Permittivity	0.02 - 0.30	ASTM D4491
Apparent Opening Size, maximum	US Sieve No. 40	ASTM D4751

2.8 LEVEL SPREADERS

- A. Provide 2 inch by 8 inch (minimum) pressure-treated timber of the length specified.
- B. Use timbers that are relatively straight and have a minimum length of 5 feet each.

2.9 RIP RAP

- A. Class A Rip Rap:
 - 1. Nominal top size of 400 pounds.
 - 2. At least 75% of the stones are to weigh more than 75 pounds.
 - 3. None less than 50 pounds.

- 4. Stones are to have at least one flat face with one dimension at least 15 inches.
- B. Class B Rip Rap:
 - 1. Nominal top size of 650 pounds.
 - 2. Nominal top size of 650 pounds.
 - 3. At least 50% of the stones are to weigh more than 275 pounds.
 - 4. At least 90% of the stones are to weigh more than 25 pounds.
- C. Class C Rip Rap:
 - 1. Nominal top size of 450 pounds.
 - 2. At least 50% of the stones weighing more than 275 pounds.
 - 3. At least 90% of the stones weighing more than 75 pounds.
- D. Class D and E Revetment:
 - 1. Nominal top size of 250 pounds.
 - 2. At least 50% of the stones are to weigh more than 90 pounds.
 - 3. At least 90% of the stones are to weigh more than 5 pounds.
 - 4. The Engineer may approve using revetment containing material larger than 250 pounds.
- E. Erosion Stone:
 - 1. Nominal 6 inch (150 mm) size.
 - 2. 100% passing the 9 inch (225 mm) screen.
 - 3. 100% retained on the 3 inch (75 mm) screen.

2.10 TEMPORARY PIPE SLOPE DRAINS

- A. PVC, HDPE, and metal pipes as specified in Section 334111 Part 2.

2.11 hSEDIMENT BASIN OUTLET STRUCTURES

- A. Base: Class C concrete unless otherwise specified in the contract documents.
- B. Riser: CMP complying with Section 334111 Part 2; diameter as specified in the contract documents.
- C. Dewatering Device:
 - 1. Drill holes in the riser of the number, diameter, and at the elevation specified in the contract documents.
 - 2. 1/4 inch by 1/4 inch or 1/2 inch by 1/2 inch wire mesh for hardware cloth.
- D. Barrel: CMP complying with Section 334111 Part 2; diameter as specified in the contract documents.
- E. Anti-Vortex Device: CMP complying with 334111 Part 2; diameter according to contract documents and riser diameter as specified in the contract documents.
- F. Anti-Seep Collar:
 - 1. Corrugated metal sheet of same material and gauge as barrel section.
 - 2. Size according to project plans.

2.12 SEDIMENT TRAPS

- A. Erosion Stone: Broken limestone, dolomite, quartzite, granite, or broken concrete with steel removed.
 - 1. Nominal 6 inch size.
 - 2. 100% passing the 9 inch screen.
 - 3. 100% retained on the 3 inch screen.
- B. Engineering Fabric: Is capable of withstanding normal installation stresses, and has the properties listed in Table below.

Fabric for use as Embankment Erosion Control

Property	Value	Test Method
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Grab strength, dry, minimum average value in either principal direction	150 lbs.	ASTM D4632/D4632M
Elongation, dry, minimum average value in either principal direction	20%	ASTM D4632/D4632M
Permittivity	0.02 - 0.30	ASTM D4491
Apparent Opening Size, maximum	US Sieve No. 40	ASTM D4751

2.13 SILT FENCE

- A. Fabric: Meet the following requirements:
1. Woven material with a minimum width of 36 inches.
 2. Top edge of the fabric hemmed or modified otherwise so that a braided cord or woven belt can be suitably attached for loop tying to fence posts.
 3. The cord or belt of minimum tensile strength of 150 pounds.
 4. Fabric and any reinforcing plastic netting contains or is treated with ultraviolet stabilizers, sufficient to prevent damaging deterioration for 2 years of outdoor exposure.
 5. Has the properties listed in Table below.
- The fabric may be reinforced with plastic netting of nominal 3/4 inch strand spacing and a minimum three strand grab strength of 40 pounds and 15 pounds after the same accelerated weathering as required for the fabric. Fabric that is reinforced in this manner may have lower grab strengths as indicated.

Silt Fencing Fabric Properties

Property	Value	Test Method No.
Grab Strength, dry, minimum average fill direction run direction ^(a)	100 lbs. 150 lbs.	ASTM D 4632
Ultraviolet Stability (Retained Strength)	70%	ASTM D 4355
Permittivity	0.05	ASTM D 4491
Apparent Opening Size, maximum	US Sieve No. 30	ASTM D 4751
(a) When plastic net reinforcing is used, ensure the minimum average grab strength requirement for fabric, before and after accelerated weathering, is 100 pounds and 35 pounds, respectively. Apply the grab strength to both the fill and run direction.		

- B. Posts: 4 foot minimum steel (T-section) weighing at least 1.25 pounds per foot, exclusive of anchor plate. Painted posts are not required.
- C. Fastener: Wire or plastic ties with a minimum tensile strength of 50 pounds.

2.14 STABILIZED CONSTRUCTION ENTRANCE

- A. Entrance Stone: Crushed stone meeting the following requirements.
1. Produce Macadam Crushed Stone with a nominal maximum size of 3 inches. Screen over a 3/4 inch screen, or when specified in the contract documents, a 1 inch screen.
 2. The aggregate passing the 3/4 inch or 1 inch screen may be furnished as the Choke Stone material; however, 6% to 16% of the material shall pass the No. 200 sieve.

3. Subgrade Stabilization Material: Use woven, UV-stabilized geotextile with a minimum tensile strength of 135 lb/ft.

2.15 DUST CONTROL

- A. Water: Use potable water or water from a source approved by the engineer.
- B. Calcium Chloride: Meet the requirements of AASHTO M 144. Unless provided otherwise in the contract documents, at the Contractor's option, the calcium chloride may be furnished in either solid or liquid form.
 1. Solid Form - Furnish as a flake, pellet, or other granular calcium chloride containing no less than 77% calcium chloride.
 2. Liquid Form - Furnish as a water solution of calcium chloride containing no less than 32% calcium chloride.
- C. Lignosulfonate (Tree Sap): Use a commercially-available product with known lignin content.
- D. Soapstock (Soybean Oil):
 1. Use a commercially-available, undiluted, soybean oil soapstock emulsion.
 2. Comply with manufacturer's recommendations for storage, transportation, temperature, and application equipment requirements.

2.16 EROSION CONTROL MULCH

- A. Conventional Mulch:
 1. Use dry cereal straw (oats, wheat, barley, or rye) or native grass straw.
 2. Use material that is free of noxious weeds, seed-bearing stalks, or roots, and will be inspected and approved by the Engineer prior to use.
 3. Other materials, subject to the approval of the Engineer, may be used.
- B. Hydromulch:
 1. Wood Cellulose Mulch:
 - a. Use material that is a natural or cooked cellulose fiber processed from whole wood chips, or a combination of up to 50% of cellulose fiber produced from whole wood chips, recycled fiber from sawdust, or recycled paper (by volume).
 - b. Product contains a colloidal polysaccharide tackifier adhered to the fiber to prevent separation during shipment and avoid chemical co-agglomeration during mixing.
 - c. Form a homogeneous slurry of material, tackifier, and water.
 - d. Use a slurry that can be applied with standard hydraulic mulching equipment.
 - e. Dye the slurry green to facilitate visual metering during application.
 - f. Do not use materials that have growth or germination-inhibiting factors or any toxic effect on plant or animal life when combined with seed or fertilizer.
 2. Bonded Fiber Matrix (BFM):
 - a. Produced from long-strand wood fibers, held together by organic tackifiers and bonding agents that, when dry, become insoluble and non-dispersible.
 - b. Upon curing 24 to 48 hours, form a continuous, 100% coverage, flexible, absorbent, erosion-resistant blanket that encourages seed germination.
 - c. Manufactured to be applied hydraulically.
 - d. Physical Properties:
 - 1) Fibers: Virgin wood, greater than 88% of total volume.
 - 2) Organic Material: Greater than 96% of total volume.
 - 3) Tackifier: 8-10%.
 - 4) pH: 4.8 minimum.
 - 5) Moisture Content: 12% +/- 3%.
 - 6) Water-holding Capacity: 1.2 gal/lb.
 - e. Dyed green to facilitate visual metering.
 - f. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.

- g. Other products not meeting the requirements of the physical properties listed in item d above may be approved if they meet the following requirements:
 - 1) Contain non-toxic tackifiers that upon drying become insoluble and nondispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
 - 2) Contain no germination or growth inhibiting factors and do not form a waterresistant crust that can inhibit plant growth.
 - 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
 - 4) Contain a minimum of 90% organic material according to ASTM D 2974.
 - 5) Have a rainfall event (R-factor) of $140 < R$ according to ASTM D 6459.
 - 6) Have a cover factor of $C \leq 0.03$ according to ASTM D 6459.
 - 7) Vegetation Establishment of 400% minimum according to ASTM D 7322.
 - 8) Vegetation Establishment of 400% minimum according to ASTM D 7322.
- 3. Mechanically Bonded Fiber Matrix (MBFM):
 - a. Produced from long-strand wood fibers and crimped, interlocking synthetic fibers.
 - b. Within two hours of application, form a continuous, 100% coverage, flexible, absorbent, porous, erosion-resistant blanket that encourages seed germination.
 - c. Manufactured to be applied hydraulically.
 - d. Physical Properties:
 - 1) Wood Fibers: 73% minimum.
 - 2) Tackifier: 10% +/- 1%.
 - 3) Crimped, Interlocking Synthetic Fibers: 5% +/- 1%.
 - 4) Moisture Content: 12% +/- 3%.
 - 5) Water holding capacity: 1.2 gal/lb.
 - 6) Minimum pH: 4.8.
 - e. Dyed green to facilitate visual metering.
 - f. All components pre-packaged by manufacturer to ensure material performance and compliance. Field mixing of additives or any components will not be allowed.
 - g. Other products not meeting the requirements of the physical properties listed in item d above may be approved if they meet the following requirements:
 - 1) Contain non-toxic tackifiers that upon drying become insoluble and nondispersible to eliminate direct raindrop impact on soil according to ASTM D 7101 and EPA 2021.0-1.
 - 2) Contain no germination or growth inhibiting factors and do not form a waterresistant crust that can inhibit plant growth.
 - 3) Hydraulic mulch that is completely photo-degradable or biodegradable.
 - 4) Contain a minimum of 90% organic material according to ASTM D 2974.
 - 5) Have a rainfall event (R-factor) of $175 < R$ according to ASTM D 6459.
 - 6) Have a cover factor of $C \leq 0.01$ according to ASTM D 6459.
 - 7) Vegetation establishment of 500% minimum according to ASTM D 7322.
 - 8) Water holding capacity of 700% minimum according to ASTM D 7367.

2.17 TURF REINFORCEMENT MATS (TRM)

- A. Material Classification:
 - 1. TRM Type 1: Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of synthetic fibers between two high-strength, biaxially-oriented nets, mechanically bound by parallel stitching with polyolefin thread. Products may contain a degradable component.
 - 2. TRM Type 2 and 3: Use a TRM that is constructed of a web of mechanically or melt-bonded polymer netting, monofilaments, or fibers that are entangled or woven to form a strong and dimensionally stable mat. Non-woven bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between two high-strength, biaxially

oriented nets, mechanically bound by parallel stitching with polyolefin thread. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation.

3. TRM Type 4: Use a high performance/survivability TRM that is composed of monofilament yarns woven into a resilient uniform configuration. Use a mat that has a matrix that exhibits very high interlock and reinforcement capacities with both soil and root systems and demonstrate a high tensile modulus. TRMs manufactured from discontinuous or loosely held together by stitched or glued, netting, or composites are not allowed in this category. Use only components that are 100% synthetic and resistant to biological, chemical, and ultraviolet degradation. Use this category when field conditions exist with high loading and/or high survivability requirements.

- B. Properties and Performance: Meet the minimum material and performance requirements contained in the following table:

Property ¹		Test Method	Type 1	Type 2	Type 3	Type 4
Material	Thickness	ASTM D 6525	0.25 in	0.25 in	0.25 in	0.25 in
	Tensile Strength ²	ASTM D 6818	125 lb/ft	240 lb/ft	750 lb/ft	3,000 lb/ft
	UV Resistance ³	ASTM D 4355	80% @ 500 hrs	80% @ 1,000 hrs	80% @ 1,000 hrs	90% @ 3,000 hrs
Performance	Maximum Shear Stress ⁴ (Channel Applications)	ASTM D 6460	7 lb/ft ²	10 lb/ft ²	12 lb/ft ²	15 lb/ft ²
	Maximum Slope Gradient (Slope Applications)	N/A	1:1 (H:V) or flatter	1:1 (H:V) or flatter	1:1 (H:V) or greater	1:1 (H:V) or greater

- 1 For TRMs containing degradable components, all values must be obtained on the non-degradable portion of the matting.
- 2 Minimum Average Roll Values, machine direction only.
- 3 Tensile strength of structural components retained after UV exposure.
- 4 Minimum shear stress that fully-vegetated TRM can sustain without physical damage or excess erosion (0.5 in soil loss) during a 30 minute flow event in large scale testing. Acceptable large scale testing protocol includes ASTM D 6460 or independent testing conducted by the Texas Transportation Institute, Colorado State University, Utah State University, or other approved testing facility. Bench scale testing is not acceptable.

2.18 INLET PROTECTION

- A. Drop-in Intake Protection:
1. Use a manufactured device that is inserted into the intake and is capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
 2. All components must be contained entirely below the surface of the intake grate.
 3. Incorporate means of emergency outflow to prevent flooding if plugged with sediment.
- B. Surface-applied Intake Protection:
1. Use devices or filter socks, placed around or over the intake, that are capable of trapping or filtering sediment from runoff prior to entering the storm sewer.
 2. Do not allow the device to completely block or plug the intake, preventing inflow.

2.19 FLOW TRANSITION MATS

- A. Mat:
1. Constructed of 85% minimum UV resistant material with a maximum ground cover of 80%.
 2. Meet the requirements of the following table:

Property	Test Method	Value
Mass/Unit Area (max.)	ASTM D 6566	3 lbs/SF
Minimum Thickness	ASTM D 6525	0.4 inch
Maximum Thickness	ASTM D 6525	1.1 inch

Tensile Strength	ASTM D 6818	550 lbs/ft
Minimum Percent Open Area	ASTM D 6567	20%
UV Stability	ASTM D 4355	85%

- B. Anchoring Devices:
1. Furnish bullet tip style anchors made of a metal alloy attached to a wire rope.
 2. Anchors capable of withstanding a minimum 300 pounds (136 kg) of pull out resistance in cohesive soils.
 3. Wire rope a minimum of 30 inches (762 mm) in length with a minimum breaking strength of at least 300 pounds (136 kg).
 4. The top washer a minimum of 3 inches (76 mm) in diameter and constructed of a UV resistant plastic.
 5. Each anchor equipped to allow the retightening of the anchor when deemed necessary by the Engineer.

PART 3 EXECUTION

3.1 SWPPP PREPARATION

- A. Prepare a SWPPP according to the requirements of Section 015723.
- B. Have the SWPPP prepared by an individual experienced in erosion and sediment control.
- C. Ensure that controls utilized in the SWPPP conform to the type and quantity of erosion and sediment controls specified in the contract documents.

3.2 COMPOST BLANKETS

- A. Loosen the ground surface to a minimum depth of 1 inch.
- B. Evenly spread compost, as specified in the contract documents, or as directed by the Engineer.
- C. Divert concentrated flows away from the slope.
- D. Do not operate heavy equipment over the compost blanket after placement, or throughout the required period of protection.
- E. Inspect the ground under the blanket at regular intervals for signs of erosion.

3.3 FILTER BERMS

- A. Install filter berm along the contour as specified in the contract documents, or as directed by the Engineer.
- B. Turn the ends of the filter berm uphill to prevent runoff from flowing around the end of the berm.
- C. When a vegetated berm is specified, apply seed to the surface of the berm.
- D. Replace the berm when sediment accumulation reaches one-half of the height of the berm.

3.4 FILTER SOCKS

- A. Installation:
 1. Pneumatically fill mesh filter sock of size and length specified in the contract documents, or as directed by the Engineer. Alternative methods of filling the sock may be allowed upon approval of the Engineer.
 2. Fill socks with filter material.
 3. Place the filter sock along the contour as specified in the contract documents, or as directed by the Engineer.
 4. Place additional filter material or soil from the site, on the upstream side of the sock, in the seam between the tube and the ground.
 5. Construct a "J-hook" at each end of a continuous run of filter sock, by turning the end of the sock uphill, as necessary to prevent runoff from flowing around the ends when water behind the sock ponds up to a level even with the top of the sock.

6. Drive stakes into the ground at a maximum spacing of 10 feet, and as required to secure the sock and prevent movement.
 7. Repair or replace non-functioning filter socks that allow water to flow under the sock, are torn, or are otherwise damaged, due to inadequate installation.
 8. Remove filter material from damaged socks that are located along streambanks, around intakes, in ditches, or in other locations where the material may be carried to surface waters.
- B. Removal: When specified in the contract documents, or as directed by the Engineer; remove the filter sock upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.
1. Upon completion of the project, completely remove socks and filter material that are located along streambanks, around intakes, in ditches, or in other locations where the filter material may be carried to surface waters if the sock degrades and/or tears.
 2. Slice the sock longitudinally. Remove and dispose of the filter sock material and stakes.
 3. Spread the filter material and accumulated sediment to match finished grade and to ensure proper drainage.
 4. If the site has been brought to finished grade and prepared for permanent seeding, spread and incorporate the filter material into the surface by tilling, or as required to break up any large particles and provide a finished surface suitable for permanent seeding.
- C. Replacement:
1. When accumulated sediment reaches a level one-half the height of the sock, or when the sock becomes clogged with sediment and no longer allows runoff to flow through, remove the sock as described above, and replace according to the installation instructions above.
 2. At the Engineer's option, the existing filter sock and accumulated sediment may be left in place, and a new filter sock installed up-slope from the existing filter sock.

3.5 TEMPORARY ROLLED EROSION CONTROL PRODUCTS (RECP)

Install temporary RECPs according to the manufacturer's published installation recommendations, subject to the following minimum requirements:

- A. Slope Application:
1. Grade and smooth surface. Remove all rocks, clods, vegetation, or other obstructions that will prevent direct contact between the RECP and the soil surface.
 2. When specified, prepare seedbed and place seed and fertilizer according to Section 329219 prior to placing RECP.
 3. Install anchor trench at top of slope. Seed and fertilize trench after backfill and compaction, if seeding is specified.
 4. Unroll the RECP down or horizontally across the slope.
 5. Place consecutive blankets down the slope end-over-end, shingle style.
 6. Overlap ends of consecutive rolls a minimum of 3 inches, and install anchors at a maximum spacing of 18 inches along all overlaps.
 7. Overlap edges of adjacent rolls a minimum of 2 inches.
 8. Install anchors at edge seams between rows.
- B. Channel/Ditch Application:
1. When specified, prepare seedbed and place seed and fertilizer according to Section 329219, prior to placing RECP.
 2. Place end of first roll in the anchor slot at the center of the upstream channel and secure with anchors.
 3. Position adjacent rolls in the anchor slot, overlapping adjacent rolls a minimum of 3 inches.
 4. Place backfill material in anchor slot and compact. Unroll RECP over compacted slot and secure with anchors.
 5. Unroll RECP downstream. Maintain a minimum 3 inch overlap between adjacent rolls. Secure edge lap with anchors.
 6. Install intermittent staple check slots every 30 feet.

7. Construct end lap at end of roll and beginning of new roll. Overlap roll ends with upstream RECP on top.
8. Excavate longitudinal trench along both sides of the channel at the outside edges of installation. Place outer edges of RECP into longitudinal slot. Install anchors, place backfill material, and compact.
9. Terminate installation at downstream end with staple check.
10. Install anchors in a regular pattern over entire area covered according to manufacturer's published recommendations (minimum three anchors per square yard).

3.6 WATTLES

- A. Installation:
 1. Construct a shallow trench, 2 to 4 inches deep, matching the width and contour of the wattle.
 2. Install wattle along contour of slope.
 3. Turn ends of wattle uphill to prevent water from flowing around ends.
 4. Place and compact excavated soil against the wattle, on the uphill side.
 5. Drive stakes through the center of the wattle, into the ground at a maximum spacing of 4 feet along the length of the wattle, and as needed to secure the wattle and prevent movement.
 6. Abut ends of adjacent wattles tightly. Wrap joint with a 36 inch wide section of silt fence and secure with stakes.
- B. Removal: When specified in the contract documents, or as directed by the Engineer, remove the wattle upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.
 1. Completely remove the wattle netting, filler material, and stakes.
 2. Spread the accumulated sediment to match finished grade and to ensure proper drainage.
 3. When allowed by the Engineer, the wattle netting may be sliced open and the filler material spread out over the ground. Removal of netting and stakes and spreading of sediment is still required.
- C. Replacement:
 1. When accumulated sediment reaches a level one-half the height of the wattle, or when the wattle becomes clogged with sediment and no longer allows runoff to flow through, remove the wattle as described above, and replace according to the installation instructions above.
 2. At the Engineer's option, the existing wattle and accumulated sediment may be left in place, and a new wattle installed up-slope from the existing wattle.

3.7 CHECK DAMS

- A. Synthetic Permeable Check Dam (HDPE):
- B. Install according to the manufacturer's recommendations.
- C. Rock Check Dam: Construct according to plan details.
- D. Removal: When specified in the contract documents, or as directed by the Engineer, remove check dams upon completion of the project, and after final stabilization is achieved; or as indicated in the SWPPP, if applicable.
 1. Remove the check dam and dispose of materials, or salvage to the contractor.
 2. Remove the accumulated sediment or spread to match finished grade; ensure proper drainage.
 3. Stabilize the area disturbed by removal operations.

3.8 TEMPORARY EARTH DIVERSION STRUCTURES

- A. Ensure positive drainage along the diversion toward the outlet area.
- B. Adequately compact fill to prevent failures or seepage.
- C. Adequately compact fill to prevent failures or seepage.

- D. Stabilize the surface of the earth diversion with temporary erosion control seeding, as specified in Section 329219.

3.9 LEVEL SPREADERS

- A. Butt multiple timbers together, as necessary to provide the required length.
- B. Ensure the spreader is installed level in all directions. Adjust as necessary during construction to maintain spreader in a level condition.
- C. Excavate a depression behind the spreader to the depth specified in the contract documents. The depression may be over-excavated up to 1 foot to provide an area for sediment accumulation.
- D. Grade as required to prevent flow around the ends of spreader.
- E. Remove the accumulated sediment from the depression when the depth is reduced below that specified in the contract documents.

3.10 RIP RAP

- A. Install the quantity of rip rap (revetment stone or erosion stone) as specified in the contract documents.

3.11 TEMPORARY PIPE SLOPE DRAINS

- A. Place slope drain on undisturbed soil or well compacted fill.
- B. Carefully compact cohesive soils around inlet ends of the drain in 6 inch lifts.
- C. Discharge slope drain to a stable outlet or to a sediment retention device.

3.12 ANTI-SEEP COLLAR

- A. General: Place backfill material and compact over-excavation areas to a minimum of 95% Standard Proctor Density per Section 312000.
- B. Concrete Collar:
 - 1. Place collars a minimum of 2 feet from pipe joints.
 - 2. Provide Class C concrete
- C. CMP Collar:
 - 1. Provide collar of same gauge as the pipe barrel on which it is used.
 - 2. Paint or tag unassembled collars to identify matching pairs.
 - 3. Furnish each collar with two 1/2 inch diameter rods with tank lugs for connecting collars to pipe.
 - 4. Install collar with corrugations vertical.
 - 5. Seal the tap between the two half sections and between the pipe and connecting band with a bituminous jointing compound at the time of installation.

3.13 SEDIMENT TRAPS

- A. Construct the storage area to the size and elevations specified in the contract documents.

3.14 SILT FENCES

- A. Installation:
 - 1. Install material along the contour of the ground, as specified in the contract documents, or as directed by the Engineer.
 - 2. Install silt fence with a mechanical soil slicing machine that creates a slit in the ground while simultaneously installing the fabric. The trenching method may be used when situations will not allow soil slicing, as determined by the Engineer.
 - 3. Construct a "J-hook" at each end of a continuous run of silt fence, by turning the end of the silt fence uphill, as necessary to prevent runoff from flowing around ends when water behind the fence ponds to a level even with the top of the fence.
 - 4. Insert 12 inches of fabric to a minimum depth of 6 inches (fabric may be folded below the ground line).

5. Compact installation by driving along each side of the silt fence, or by other means, as necessary to adequately secure the fabric in the ground, to prevent pullout and water flow under the fence.
 6. Drive steel posts into the ground alongside the silt fence, to a minimum depth of 20 inches, unless otherwise specified by the Engineer. Space posts as shown on plan details or as required to adequately support silt fence.
- B. Maintenance: Repair or replace non-functioning silt fence that allows water to flow under the fence, is torn, or is otherwise damaged, due to inadequate installation, at no additional cost to the Contracting Authority.
- C. Removal:
1. Remove the silt fence upon final stabilization of the project area, or according to the staging indicated in the SWPPP.
 2. Remove and dispose of silt fence and posts.
 3. Remove sediment or spread to match finished grade; ensure proper drainage.
 4. Stabilize the area disturbed by removal operations.
- D. Replacement:
1. When accumulated sediment reaches a level one-half the height of the fence, remove the silt fence as described above, and replace according to the installation instructions above.
 2. At the Engineer's option, the existing silt fence and accumulated sediment may be left in place, and a new silt fence installed up-slope from the existing silt fence.
 3. When allowed by the Engineer, the existing silt fence may be left in place and the accumulated sediment removed to the original ground line and within 6 inches of the silt fence. Carefully inspect the existing silt fence for structural integrity and signs of undermining. Make any necessary repairs.

3.15 STABILIZED CONSTRUCTION ENTRANCE

- A. Install a stabilized construction entrance at all locations where construction traffic leaving the site presents the potential for sediment track-out.
- B. Remove vegetation and excavate soft soils from entrance area. Thoroughly compact subgrade prior to placing stone.
- C. Install culvert under entrance if necessary to maintain drainage.
- D. Grade entrance to prevent runoff from flowing onto street. Direct all runoff from entrance to a sediment retention device.
- E. When specified, install subgrade stabilization fabric prior to placing crushed stone.
- F. Install layer of crushed stone to the thickness (6 inches minimum) and dimensions specified in the contract documents.
- G. Remove the accumulated sediment and install new stone, as required to prevent track-out.

3.16 DUST CONTROL

- A. Water: Apply frequent light watering to ground surface, as required to control dust.
- B. Calcium Chloride: Apply according to local jurisdiction requirements.
- C. Lignosulfonate (Tree Sap):
 1. Loosen the top 1 to 2 inches of the roadway surface.
 2. Apply solution with a 50% residual concentration, at a rate of 0.50 gal/yd², to deliver a 25% residual. For diluted solutions, increase the application rate, as required, to deliver an equivalent 25% residual.
 3. Allow product to penetrate through the loosened material.
 4. Tight-blade road surface.
- D. Soapstock (Soybean Oil):
 1. Loosen the top 1 to 2 inches of the roadway surface.
 2. Apply undiluted soapstock at a rate of 0.70 gal/yd².

3. Allow product to penetrate through the loosened material.
4. Tight-blade road surface.

3.17 EROSION CONTROL MULCHING

- A. Conventional Mulching:
 1. Use conventional mulching when the surface cannot be stabilized by seeding, due to season or ground conditions.
 2. Uniformly distribute mulch over the required areas, at a rate of 2 tons/acre for dry cereal straw, or 2.5 tons/acre for prairie hay.
 3. Work the mulch into the soil with a mulch tucker, designed to anchor the mulch into the soil, by means of dull blades or disks.
- B. Hydromulching:
 1. Place mulch and tackifier (if applicable) in equipment specifically manufactured for hydraulic mulching.
 2. Mix materials with fresh, potable water using a combination of re-circulation through the equipment's pump and mechanical agitation to form a homogeneous slurry.
 3. If necessary, dampen any dry, dusty soil as required to prevent balling of the material during application.
 4. Apply hydromulch in multiple layers from opposing directions, where possible.
 5. Apply the slurry evenly over all specified areas, at the minimum component material rates specified:
 - a. Wood Cellulose Mulch:
 - 1) Mulch: 2,600 lb/acre dry weight.
 - 2) Tackifier: 50 lb/acre.
 - b. Bonded Fiber Matrix: 3,600 lb/acre dry weight.
 - c. Mechanically Bonded Fiber Matrix: 3,600 lb/acre dry weight.
 6. Retain and count empty bags of mulch to ensure final application rate.

3.18 TURF REINFORCEMENT MATS

- A.

Install according to the manufacturer's published installation literature for the product specified and application (slope or channel).

3.19 SURFACE ROUGHENING

- A. Directional Tracking:
 1. Do not use on slopes steeper than 3:1.
 2. Operate tracked equipment up and down exposed slope to create ridges perpendicular to the slope.
 3. Continue operation until the entire surface has been tracked.
- B. Grooving/Furrowing:
 1. May be used on all slopes.
 2. Use rippers, disks, harrows, chisel plows, or other equipment capable of operating on the slope and creating grooves a maximum of 15 inches apart and 3 inches deep.
 3. Operate equipment along the contour of the slope to create grooves that are perpendicular to the slope.
 4. Perform over all exposed slopes as specified.

3.20 INLET PROTECTION

- A. Install inlet protection devices according to the manufacturer's recommendations.
- B. Remove the accumulated sediment, as required to maintain the inlet protection device in working order. Remove any accumulated sediment from streets open to traffic if it encroaches into the traveled roadway.

END OF SECTION

SECTION 015723

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 GENERAL

1.1 INTRODUCTION

- A. This section comprises the Storm Water Pollution Prevention Plan (SWPPP) required for this project. This SWPPP establishes a plan to manage the quality of storm water runoff from construction activities associated with the storm sewer improvements of this project. Contractor shall comply with all aspects of this document.
- B. If there are any discrepancies between these requirements and the land disturbance permit issued for site, the Contractor shall follow the land disturbance permit issued by MDNR.

1.2 RETENTION OF SWPPP DOCUMENTS

- A. The Contractor shall use the construction plan sheets to create an extra set of erosion and sediment control sheets showing erosion and sediment control measures for his use as the SWPPP for showing all BMPs being used on the project.
- B. The Contractor must maintain a copy of the SWPPP and this specification section of the documents on the construction site at all times and at their office from the date of the project initiation to the date of final stabilization.
- C. The SWPPP shall be amended to reflect changes to the original SWPPP. The amended SWPPP shall be retained as described in the subsection above. It is the Contractor's responsibility to update the SWPPP as often as needed to identify what is currently being used on-site. EPA and DNR can fine the Contractor if there is a discrepancy between the SWPPP and actual BMPs installed. See the land disturbance permit in Section 014126 PERMITS for specific requirements for the SWPPP.

1.3 CONSTRUCTION ACTIVITIES

- A. The Drawings show the project area relative to the surrounding area. Contractor shall minimize land disturbance where possible, and install BMPs as soon as possible to minimize erosion.
- B. Typical Sequence of Major Activities
 - 1. This section contains a description of the typical construction sequences for the project.
 - a. Install erosion and sediment control devices as appropriate for each phase of construction.
 - b. Clear and grub each area as the construction progresses.
 - c. Perform excavations for construction
 - d. Backfill
 - e. Grade area
 - f. Apply temporary seeding.
 - g. Reconstruct any pavement, driveways and curb
 - h. Install final stabilization measures and apply permanent seeding
- C. Completion of Project
 - 1. All temporary structural BMPs shall be disposed of within 30 days after final site stabilization is achieved. Trapped sediment and other disturbed soil areas resulting from disposition of temporary measures shall be permanently stabilized to prevent further erosion and sedimentation.

1.4 BEST MANAGEMENT PRACTICES (BMPs)

- A. General
 - 1. The following BMPs are to be implemented on this project, where required to meet the DNR Land Disturbance permit, and marked on the plans and dated for installation and maintenance dates as required by the land disturbance permit and SWPPP:
 - a. Silt Fence
 - b. Check Dams

- c. Storm Drain Inlet Protection
 - d. Rolled Erosion Control Blankets (RECP)
 - e. Mulching
 - f. Temporary Seeding
 - g. Permanent Seeding
 - h. Rock Outlets
2. To ensure that this project does not promote erosion, siltation, or drainage problems, erosion BMPs are to be installed and maintained at each project site.
 3. Perimeter or downstream BMPs shall be installed prior to upstream land disturbance as necessary. Storm water discharging from areas affected by construction shall pass through BMPs.
 4. All applicable soil erosion and sediment control measures shall be implemented in accordance with the SWPPP.
 5. BMPs shall be maintained with sufficient ability to minimize downstream sediment. BMPs shall be replaced when they no longer provide this function, as discussed in detail later in this section.
 6. BMPs shall be maintained during and after construction activities until final stabilization is accomplished. Upon successful revegetation of the disturbed area, all temporary soil erosion and sediment control measures shall be removed. Appropriate impediments for storm water discharge will be implemented, and benchmarks referenced for proper installation, operation and maintenance of drainage courses.
 7. Where soil disturbance activities are halted in an area for more than 14 days, the disturbed area shall be protected from erosion by stabilizing the area with mulch or other effective BMP. If the slope of an area is greater than 3:1, or greater than 3% and greater than 150 feet in length, the disturbed area shall be protected from erosion by use of a RECP or similarly effective BMP.
- B. Temporary Structural BMPs
1. Temporary structural BMPs consist of silt fences, straw bales, coir socks, inlet filters, diversion dikes, and other BMPs. Temporary structural BMPs shall be implemented as necessary.
 2. Silt fence shall be installed in accordance with ASTM D 6462, Standard Practice for Silt Fence Installation.
 3. Coir logs may be used at specific locations in lieu of silt fence, if approved by Engineer.
- C. Permanent Non-Structural BMPs
1. After completion of final grading, the Contractor shall provide permanent seeding as indicated by Section 329219 SEEDING.

1.5 AMENDING/UPDATING THE SWPPP

- A. The SWPPP shall be amended and updated whenever:
1. Design, operation or maintenance of BMPs is changed,
 2. Design of the construction project is changed that could significantly affect the quality of the storm water discharges,
 3. Inspections indicate deficiencies in the SWPPP or any BMP,
 4. Any notifications from MDNR of deficiencies in the SWPPP,
 5. SWPPP is determined to be ineffective in significantly minimizing or controlling erosion and sedimentation (e.g., there is visual evidence, such as excessive site erosion or excessive sediment deposits in streams or lakes),
 6. Total Settleable Solids from a storm water outfall exceeds 2.5 ml/L/hr,
 7. MDNR determines violations or Water Quality Standards may occur or have occurred.

1.6 INSPECTION, REPORTING AND MAINTENANCE

- A. Inspection and Reporting by Contractor
1. Contractor shall properly maintain and regularly inspect all erosion control measures. All erosion and sediment control devices shall be checked at least:

- a. Once per week.
 - b. Within 72 hours of each 0.5-inch rain or greater rainfall event.
 2. Contractor shall record the findings of each inspection on a BMP Inspection Report. The BMP inspection form is attached at the end of this section, and shall be photocopied and used as needed for inspections throughout the project length. Maintenance inspection reports will be completed after each inspection and included in the project file. The inspection reports shall identify any incidents of non-compliance.
 3. All damaged or washed-out facilities shall be repaired and/or replaced immediately upon inspection by the Contractor.
 4. Any deficiencies noted during an inspection shall be corrected within seven calendar days of that inspection. All inspections shall be recorded and signed by the person performing the inspection. Each inspection report shall include, as a minimum;
 - a. Inspector's name
 - b. Date of inspection
 - c. Observations relative to the effectiveness of the BMPs
 - d. Actions taken or necessary to correct deficiencies
 - e. Listing of areas where land disturbance operations have permanently or temporarily stopped
 5. If inspection results indicate a need for revision to the SWPPP, the plan shall be revised, approved by the Engineer, and implemented as appropriate, within seven calendar days following the inspection.
- B. Inspection by Owner
1. During inspection by the construction inspector, temporary erosion control measures found to be ineffective will be reported to the Contractor.
 - a. Sediment will be removed from behind a silt fence when it reaches one-third the height of the barrier.
 - b. Sediment shall be removed from behind curb inlet protection BMPs when it reaches one-half the height of the barrier.
 2. Following the completion of construction and installation of permanent seeding, the construction inspector shall conduct periodic site reviews to ensure that vegetation establishment is satisfactory. If vegetation cover is not adequate, special steps to correct problems shall be implemented, such as re-seeding, mulching, sodding, or the use of RECPs.
 3. All temporary BMPs shall be left in place until the site is permanently stabilized with pavement or in seeded areas having at least 70 percent cover.

1.7 POLLUTION PREVENTION CONTROLS

- A. Waste Disposal
1. The Contractor is responsible for disposing of all solid waste from the site in accordance with state law. Solid waste facilities shall be provided on the job site. An adequate number of trash containers shall be located to provide access to all trades.
 2. Contractor shall keep job site in an orderly condition. All waste material shall be collected daily and stored in a secure container or removed from the project site. The waste container will be inspected regularly with contents disposed properly by the contractor.
 3. No waste oil or other petroleum-based products will be disposed of on-site (e.g. buried, poured, etc.); but shall be taken off-site for proper disposal.
- B. Hazardous Waste
1. Any hazardous waste material shall be disposed of in the manner specified by local and state regulations and by the manufacturer. Site personnel will be instructed to be aware of this requirement.
 2. The Contractor shall notify by telephone and in writing the Owner and DNR of any oil spills or if hazardous substances are found during the prosecution of work.
- C. Sanitary Waste

1. All sanitary waste will be collected from portable units as required and properly disposed of off-site in compliance with local and state regulations.
- D. Vehicle Tracking
1. Public streets and sidewalks will be monitored for sediment tracking by construction equipment and trucking operations. If tracking becomes a nuisance or safety issue, Contractor shall sweep the problem surface.
 2. Contractor may need to install a truck wash-off facility when working "off-site" to avoid excessive tracking.

1.8 SPILL PREVENTION AND CONTROL PLAN

- A. The Spill Prevention and Control Plan (SPCP) describes measures to prevent, control, and minimize impacts from a spill of a hazardous, toxic, or petroleum substance during construction of the proposed project in the State of Missouri. This plan identifies the potentially hazardous materials to be used during this project; describes transport, storage, and disposal procedures for these substances; and outlines procedures to be followed in the event of a spill of a contaminating or toxic substance.
- B. Substances regulated by federal law under the Resource conservation and Recovery Act (RCRA) or the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), which are transported, stored or used for maintenance, cleaning or repairs shall be managed according to the provisions of RCRA and CERCLA.
- C. Due to the chemical makeup of specific products, certain handling and storage procedures are required to promote the safety of handlers and prevent the possibility of pollution. Care shall be taken to follow all directions and warning for products used on the site. All pertinent information can be found on the Material Safety Data Sheets (MSDS) for each product. The MSDS sheets should be located with each product container they represent. Several product-specific practices are listed in the following sections.
- D. All paints, solvents, petroleum products and petroleum waste products (except fuels) and storage containers (such as drums, cans or cartons) shall be stored so that these materials are not exposed to storm water. Sufficient practices of spill prevention, control and/or management shall be provided to prevent any spills of these pollutants from entering a water of the state. Any containment system used to implement this requirement shall be constructed of materials compatible with the substances contained and shall also prevent the contamination of groundwater.
- E. Material Management Practices
1. Properly managing these materials on the construction site will greatly reduce the potential for storm water pollution of these materials. Good housekeeping along with proper use and storage of these construction materials form the basis for proper management of potentially hazardous material.
 2. The proper use of materials and equipment along with the use of general common sense greatly reduces the potential for contaminating storm water runoff. The following is a list of good housekeeping practices to be used during the construction project:
 - a. Chemical fuels, oils and other hazardous materials shall not be stored on-site.
 - b. Fueling of construction equipment shall not be performed within 100 feet of any stream bank, wetlands, water supply well, spring, or other water body.
 - c. Contractor's employees shall be properly trained in handling materials used and/or kept at the job site.
 - d. Contractor's employees shall have proper access to all necessary safety items.
 - e. Trash containers will be provided for waste disposal and regular site clean-up will be conducted.
 - f. Contractor should store only enough product required to do the job, and stored on the site in a neat and orderly manner in their original containers with the original manufacture's label.

- g. When possible, materials should be stored with secondary containment and in a covered structure such as a building or job trailer. Substances will not be mixed with one another unless recommended by manufacturer.
- h. Whenever possible, all of the product will be used before disposing of the container. Manufacturer's recommendations for proper use and disposal of a product will be followed. If surplus product must be disposed of, manufacturer's or local and state recommended methods for proper disposal will be followed.

1.9 Petroleum Products

- A. All fueling facilities present on the job site shall adhere to applicable federal and state regulations concerning underground storage, above ground storage and dispensers, including spill prevention, control and counter measures.
- B. On-site vehicles will be monitored for leaks and receive regular maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed clearly labeled containers. Preferably, the containers will be stored in a covered truck or trailer that provides secondary containment for the products.
- C. Bulk storage tanks having a capacity of greater than 55 gallons will be provided with secondary containment. Containment can be provided by a temporary earthen berm or other means. After each rainfall, the contents of the secondary containment area will be inspected by the contractor. If there is no visible sheen on the collected water, it will be pumped around in a manner that does not cause scouring. If a sheen is present, it must be cleaned up prior to discharging the water.
- D. Bulk fuel or lubricating oil dispensers shall have a valve that must be held open to allow the flow of the fluid. During fueling operations, the contractor shall have personnel present to detect and contain spills.

1.10 Fertilizers

- A. Fertilizers shall be applied to stimulate vegetation growth as recommended by the manufacturer and in accordance with the contract documents. Once applied, the fertilizer shall be worked into the soil to limit the exposure to storm water.

1.11 SPILL CONTROL AND CLEANUP

- A. Spill Control and Cleanup Practices
 - 1. In addition to the best management procedures discussed previously, the following spill control and cleanup practices will be followed to prevent storm water pollution in the event of a spill:
 - a. Spills will be contained and cleaned up immediately after discovery.
 - b. Manufacturers' methods for spill cleanup of a material will be followed as described on the material's MSDS.
 - c. Materials and equipment needed for cleanup procedures will be kept readily available on the site, either at an equipment storage area or on contractor's trucks. Equipment to be kept on the site will include but not be limited to brooms, dust pans, shovels, granular absorbents, sand, saw dust, absorbent pads and booms, plastic and metal trash containers, gloves and goggles.
 - d. Personnel on site will be made aware of cleanup procedures and the location of spill cleanup equipment.
 - e. Toxic, hazardous, or petroleum product spills required to be reported by regulation will be documented to the appropriate federal, state and local agencies.
 - f. Spills will be documented and a record of the spills will be kept with this SWPPP.
 - 2. If a spill occurs that is reportable to the federal, state or local agencies, the contractor is responsible for making the notifications.
 - 3. The federal reportable spill quantity for petroleum products is defined in 40 CFR 11.0 as any oil spill that:
 - a. Violates applicable water quality standards.

- b. Causes a film or sheen upon or discoloration of the water surface or adjoining shoreline.
 - c. Causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.
- 4. A reportable spill for this project shall be defined as the discharge of 50 gallons or more of a petroleum product into the environment. It is the responsibility of the contractor to comply with the most current spill control and cleanup regulations.
- 5. The federal reportable spill quantities for hazardous materials are listed in 40 CFR, Part 302.4 in the table entitled: List of Hazardous Substances and Reportable Quantities." A procedure for determining a reportable spill is outlined below.
 - a. If a reportable spill occurs, a modification to the SWPPP must be made within 14 days. The modification shall include; a description of the release, the date of the release; an explanation of why the spill happened; a description of procedures to prevent future spills from happening; and a description or response procedures should a spill or release occur again and within 14 days of the release. A written description of the release must be submitted to the City by the Contractor that includes; a description of the release, including the type of material and an estimated amount of spill; the date of the spill; an explanation of why the spill occurred; and a description of the steps taken to prevent and control future spills. These modifications to the SWPPP must be made by the Contractor and will be documented appropriately.
- B. Procedures for Determining if a Hazardous Material Spill is a Reportable Quantity
 - 1. First determine the type and quantity of material that has been spilled.
 - 2. Obtain a material safety data sheet (MSDS) for the spilled material and determine whether any of the constituents are listed in Table 302.4 in 40 CFR 302 (Code of Federation Regulations).
 - 3. If none of the constituents in the spilled material are listed in the table (excluding ethylene glycol), the spill is not reportable.
 - 4. If the constituents in the spilled material are listed in the table, use the following equation to determine the pounds of material spilled:
 - a. Pounds Spilled = (V)(Wt%)(Sg)(0.0834)
 - b. Where: V = Volume of the material spilled, in gallons
 - c. Wt% = The weight percent of the constituents in the spilled material (see the MSDS)
 - d. Sg = Specific gravity of spilled material (see MSDS)
 - 5. If based on the calculation, the pounds spilled are Greater than the Final RQ (reportable quantity) value listed in Table 302.4 in 40 CFR 302 or the State's reportable quantity minimum amount, the spill must be reported to the appropriate federal, state, and local agencies.

PART 2 PRODUCTS

PART 3 EXECUTION

END OF SECTION

**SECTION 017400
CLEANING**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions, Bid Form, and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cleaning during the Project.

- B. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
 - 1. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer of fabricator for the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.1 PROGRESS CLEANING

- A. General
 - 1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
 - 2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
 - 3. At least each month, and more often if necessary, completely remove all scrap, debris, and waste material from the jobsite.
 - 4. Provide adequate storage for all items awaiting removal from the jobsite, observing all requirements for fire protection and protection of the ecology.
- B. Site
 - 1. Daily, inspect the site and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
 - 2. Weekly, inspect all arrangements of materials stored onsite. Re-stack, tidy, or otherwise service all material arrangements.
 - 3. Maintain the site in a neat and orderly condition at all times.
- C. Structures
 - 1. Daily, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
 - 2. Weekly, sweep all interior spaces clean. "Clean" for the purposes of this paragraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and handheld broom.
 - 3. In preparation for installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.

4. Following the installation of finish floor materials, clean the finish floor daily while work is being performed in the space in which finish materials have been installed. "Clean" for the purposes of this subparagraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Construction Representative, may be injurious to the finish of the finish floor material.

3.2 FINAL CLEANING

- A. General: Provide final cleaning operations when indicated. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit of Work to the condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
- B. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for the entire Project or a portion of the Project.
 1. Clean the Project Site, yard and grounds, in areas disturbed by construction activities including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 2. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 3. Remove petrochemical spills, stains, and other foreign deposits.
 4. Remove tools, construction equipment, machinery, and surplus material from the site.
 5. Remove snow and ice to provide safe access to the building.
 6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weather of exterior surfaces. Restore reflective surfaces to their original condition.
 7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 8. Broom clean concrete floors in unoccupied spaces.
 9. Vacuum clean carpet and similar soft surfaces removing debris and excess nap. Shampoo, if required.
 10. Clean transparent material, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 11. Remove labels that are not permanent labels.
 12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 13. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 14. Clean plumbing fixtures to a sanitary condition free of stains, including stains resulting from water exposure.
 15. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 16. Clean ducts, blowers, and coils if units were operated without filters during construction.
 17. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 18. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 19. Leave the Project clean and ready for occupancy.

- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid the Project of rodents, insects, and other pests. Comply with regulations of local authorities.
- D. Removal of Protection: Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- E. Compliance: Comply with governing regulations and safety standards for cleaning operations. Remove waste materials from the site and dispose of lawfully.
 - 1. Where extra materials of value remain after Final Acceptance by the Owner, they become the Owner's property.

END OF SECTION

SECTION 017610
PROTECTION OF EXISTING FACILITES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents. All property that is damaged by the Contractor during the construction of the proposed facilities shall be repaired or replaced as directed by the Owner or the Engineer to a like new condition regardless of its physical condition prior to the start of construction.
- B. The Contractor shall verify the exact locations and depths of all utilities shown and the Contractor shall make exploratory excavations of all utilities that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's Work. When such exploratory excavations show the utility location to differ materially from the location shown or specified, the Contractor shall so notify the Engineer.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.2 RIGHTS-OF-WAY

- A. The Contractor shall not do any Work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified by the Engineer that the Owner has secured authority therefor from the proper party. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin Work, and shall give said party convenient access and every facility for removing, shoring, supporting, or otherwise protecting such pipeline, transmission line, ditch, fence, or structure, and for replacing same. When two or more contracts are being executed at one time on the same or adjacent land in such manner that work on one contract may interfere with that on another, the Owner shall determine the sequence and order of the Work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the Owner to the Contractor so desiring, to the extent, amount, in the manner, and at the times permitted. No such decision as to the method or time of conducting the work or the use of territory shall be made the basis of any claim for delay or damage, except as provided for temporary suspension of the work in accordance with Article 15 of the General Conditions of the Contract Documents.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

- A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. It shall be the Contractor's responsibility to notify the proper representatives of the Owner of the time and location that Work will be done. Such notification shall be sufficiently in advance of construction so that there will be no delay due to waiting for survey points to be satisfactorily referenced for restoration. All survey markers or points disturbed by the Contractor without proper authorization by the Engineer, will be accurately restored by the Owner at the Contractor's expense after all street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for

in the Contract Documents or in the requirements of the agency issuing the permit. All temporary and permanent pavement shall conform to the requirements of the affected pavement owner. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.

- B. Within five working days of the pipe installation, temporary restoration shall be completed. All paved areas, including asphaltic concrete berms cut or damaged during construction, shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific restoration requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.
- C. Temporary Restoration: Temporary restoration includes repair to all driveways, sidewalks and roadways. They shall be swept clean and be maintained free of dirt and dust. All areas disturbed by the construction activities shall be restored to proper grade, cleaned up, including the removal of debris, trash, and deleterious materials. All construction materials, supplies, or equipment, including piles of debris shall be removed from the area. All temporarily restored areas shall be maintained by the Contractor. These areas shall be kept clean and neat, free of dust and dirt, until final restoration operations are completed. The Contractor is responsible to utilize dust abatement operations in the temporarily restored areas as required, to the satisfaction of the Engineer.
- D. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- E. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.
- F. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration or, if no such period of time is so fixed, the Contractor shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.
- G. Timely Restoration of Existing Facilities: The Contractor shall test an installed section of pipeline within five calendar days from completion of the pipeline. A section of pipe is defined as a pipe section which can be isolated such as by manholes or valves for testing. Within five calendar days after testing of the pipelines and pipeline appurtenances is satisfactorily completed, the Contractor shall provide the Engineer with a "Schedule of Existing Facilities Restoration" which will be reviewed and be acceptable to the Engineer. The schedule shall show the existing facilities to be restored and schedule of beginning and completion dates for each item of restoration. The work for completing the final restoration of existing facilities for a tested section of work shall be completed within 30 days of acceptance of the pipeline testing.
- H. All temporary restoration/resurfacing work and maintenance is subsidiary to the project.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

- A. General
 - 1. The Contractor shall protect all underground utilities and other improvements which may be impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to

provide for uninterrupted service and to provide such special protection as may be necessary.

B. Utilities to be Moved

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

- C. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Owner and the owner of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal. This includes temporarily supporting and bracing for line and power poles.

D. Owner's Right of Access

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

E. Utilities Shown or Indicated

1. Existing utility lines that are shown or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling. The appropriate utility owner or franchise holder shall be immediately notified of any and all damage to their facilities and they shall have jurisdiction and approval over the means and methods of repair of same.

F. Underground Utilities Not Shown or Indicated

1. In the event that the Contractor damages any existing utility lines that are not shown or the locations of which are not made known to the Contractor prior to excavation, a written report thereof shall be made immediately to the Owner. If directed by the Owner, repairs shall be made by the Contractor under the provisions for changes and extra Work contained in the General Conditions.

- G. All costs of locating, and repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not shown in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessary idled during such Work will be paid for as extra Work in accordance with the provisions of the General Conditions. Compensation shall not include Contractor's costs for the coordination of his activities with the utility company affected. Contractor shall schedule his work in such a manner that he is not delayed by the utilities companies relocating or supporting their facilities. No compensation will be paid the Contractor for any loss of time or delay.

H. Approval of Repairs

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

I. Maintaining in Service

1. All oil and gasoline pipelines, power, and telephone or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall

remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Owner are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The Contractor shall be responsible for and shall repair all damage due to its operations and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

J. Septic Tank Lateral Lines

1. Septic tank lateral lines and drain fields may be encountered during construction operations. The Contractor shall be responsible to locate and take all possible precautions for protecting the lateral lines and drain fields. Any damage shall be repaired and/or replaced by the Contractor, at no additional cost to the Owner, in a manner satisfactory to the Engineer.

1.6 ELECTRICAL POWER POLES

- A. All work on power poles needing to be temporarily supported, braced, or relocated, shall be done by the owner of the utility, (i.e. Ameren), at no charge to the Owner and paid for by the Contractor. The Contractor shall coordinate the work with utility owner.
- B. Underground power lines damaged by the Contractor shall be repaired by utility owner at no cost to the Owner and paid for by the Contractor.

1.7 GAS COMPANY LINES

- A. Gas Company lines damaged by the Contractor shall be repaired by the owner of the utility at no cost to the Owner and paid for by the Contractor.
- B. Gas lines needing to be relocated shall be moved by the utility company and paid for by the Contractor. The Contractor shall coordinate the relocation with the utility owner to eliminate the relocation delays in the interceptor sewer construction.

1.8 LINES FOR STREET LIGHTS

- A. Lines and poles for street lights needing to be temporarily supported/braced, or which are damaged by the Contractor shall be repaired by the owner of the utility, and paid for by the Contractor.

1.9 BURIED TELECOMMUNICATIONS LINES AND/OR CONDUIT

- A. Buried telecommunications lines and/or conduit damaged by the Contractor shall be repaired by the owner of the utility at no additional cost to the Owner and paid for by the Contractor.

1.10 CABLE TELEVISION BURIED CABLE AND/OR CONDUIT.

- A. Cable Television buried lines and/or Conduit damaged by the Contractor shall be repaired by the appropriate Cable Television Company and paid for by the Contractor.

1.11 WATER DIVISION WATER MAINS

- A. Water mains damaged by the Contractor shall be repaired by the owner of the utility or upon written permission by the utility owner, by the Contractor in accordance with the requirements of the utility owner; both to be fully paid for by the Contractor.
- B. The opening and closing of distribution system valves shall be performed only by the utility owner. This includes existing valves and Contractor installed valves that control the flow of potable or non-potable water.

1.12 RECONNECTION OF SERVICE LINES

- A. Reconnection of existing water services to the new water lines will be done by the Water District. The Water District will furnish and install the new main corporation stop, copper piping, water meters, and make the connection to the building water services.
- B. The Contractor shall provide all excavation, backfill, and seeding as required for tapping the new main, trenching across the street where required and shall assist the District in making connection to the existing water services.

- C. The Contractor shall remove and replace the street pavement for service lines. Removal and replacement of pavement will be paid for under the bid item for removal and replacement of the type of pavement removed.

1.13 FIRE LINE CONNECTIONS

- A. The Contractor shall employ the services of a mechanical contractor to purge all air from the reconnected fire lines within the customer building(s) upon completion of the connection to the new water main.
- B. The mechanical contractor shall be a qualified contractor experienced with fire control systems and have the equipment needed to complete the purging of air from the fire protection system and placing the system back on line.
- C. The general contractor shall select one or more proposed mechanical contractors and submit their qualification statements to the Engineer and Owner for approval. The selected mechanical contractor shall be paid by the general contractor. The cost of this work shall be subsidiary to the water line installation.

1.14 TREES WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

- A. General
 - 1. The Contractor shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or Owner. All existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the Contractor to the satisfaction of the Owner. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
- B. Trimming
 - 1. The symmetry of the tree shall be preserved; no stubs or splits or torn branches shall remain. Clean cuts shall be made close to trunk or large branch. Spikes shall not be used for climbing live trees. All cuts over 1½ inches in diameter shall be coated with an asphaltic emulsion material.
- C. Replacement
 - 1. The Contractor shall immediately notify the Owner if any tree is damaged by the Contractor's operation. If, in the opinion of the Owner, the damage is such that replacement is necessary, the Contractor shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged, or, if of a smaller size, the Contractor shall pay to the Owner of said tree compensatory payment acceptable to the tree owner, subject to the approval of the Owner.

1.15 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such Work if they so desire.
- B. The Contractor shall prepare a written notice to property owners adjacent to the project work site notifying them of the schedule of work affecting them and anticipated inconveniences they may expect. The notice shall list the company name and phone numbers of responsible personnel, both local and out of town if non-local contractor, where the property owner, Engineer or Owner, including police, fire and public works can contact him during normal business hours, after hours and on weekends. The notice shall meet the approval of the Engineer and be delivered to property owners at least 72 hours prior to construction adjacent to their property.

PART 2 PRODUCTS (NOT USED)
PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 1. Demonstration of operation of systems, subsystems, and equipment.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site . Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 6. Troubleshooting: Include the following:

- a. Diagnostic instructions.
- b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

**SECTION 024100
DEMOLITION**

PART 1 GENERAL

1.1 SUMMARY

- A. The removal and or reuse, salvage and disposal of materials and equipment necessary for the work to be performed as shown on the Drawings and as specified herein.
- B. Existing buildings, structures, boxes, pipes, pavements, curbs, and other items are to be removed, altered, salvaged, and disposed of as specified herein or indicated in the drawings.
- C. Equipment, material, and piping, except as specified to be salvaged for the Owner, or removed by others, within the limits of the demolition, excavations, and backfills, will become the property of the Contractor and shall be removed from the project site. The salvage value of this equipment, materials, and piping shall be reflected in the contract price.
- D. The existing Effluent Structure shall be abandoned in place in accordance with Part 3.5.H for fill requirements and as indicated in the Drawings.

1.2 PROCEDURES

- A. Procedures to be used for the removal of all types of materials shall provide for careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. Existing property which is damaged by the Contractor's operations shall be repaired or replaced in kind by the Contractor at no additional cost to the Owner.
- B. Existing Utilities: The Contractor shall notify the Owner and other proper authorities concerned not less than seven days before starting work in any area. He shall furnish all necessary information as to the nature and extent of the work and shall obtain their cooperation and instructions in locating and protecting all underground pipes, cables, and other utilities. All utility line locations shown on the Drawings are approximate.
- C. Perform the work in a manner that will not damage parts of the structure not intended to be removed or to be salvaged for the Owner. If, in the opinion of the Owner's Representative, the method of demolition used may endanger or damage parts of the structure or affect the satisfactory operation of the facilities, promptly change the method when so notified by the Owner's Representative.
- D. Explosives: The use of explosives will not be permitted.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items. Include proposed method of demolition and provisions for erosion, dust, and noise control.
- C. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions. Indicate what fill materials were used in backfilling. Information is to be recorded in drawing form.
- D. Salvaged Material Data: Submit description of all savaged materials, inspection data, and parts lists.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials noted to be removed and not relocated, salvaged or reused in the project shall be removed from the construction site and disposed of by the Contractor. Salvaged materials shall be delivered to an area designated by the Engineer or Owner.
- B. Do not reuse material salvaged from demolition work on this project, except as specifically shown or specified.

PART 3 EXECUTION

3.1 GENERAL

- A. During removal operations all persons and property shall be protected from injury or damage. The work shall proceed in a manner that will minimize the generation and spread of dust, flying particles and objectionable odors.

3.2 PROTECTION

- A. Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing structures and examine the Drawings and specifications to determine the extent of the proposed construction activities. The Contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved by the Engineer at no additional cost to the Owner. Repairing shall mean the restoration of a surface or item to a condition as near as practicable to match the existing adjoining surfaces unless otherwise noted, detailed, or specified. When repairing involves painting, special coatings, vinyl fabric, or other applied finish, refinish the entire surface plane (i.e., wall or ceiling), unless complete refinishing of the entire space is scheduled or specified. Repairing includes cleaning of soiled surfaces.
- B. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, Contractor's employees and existing improvements to remain. Method and materials of the partitions including adequate bracing shall be submitted to the Engineer for review.
- C. Provide temporary weather protection, where required.
- D. Mark location of utilities.

3.3 DISPOSITION BY CLASSIFICATION

- A. Disposition of materials and equipment shall be indicated on the plans by the following designations:
 - 1. Reinstall: Material or equipment to be reinstalled into the work shall be carefully removed from the existing location, shall be cleaned and otherwise readied for reuse, and shall be protected from damage. Such items shall be reinstalled in accordance with applicable sections of these specifications covering new items of similar categories.
 - 2. Salvage: Materials and equipment to be salvaged shall be carefully removed, cleaned and delivered to a location on Owner's premises as designated by the Engineer or Owner. Final list of items to be salvaged is subject to the Owner's review.
 - 3. Remove: Materials and equipment to be removed shall be considered scrap and shall be disposed of by the Contractor. Removed concrete shall be disposed of off-site unless otherwise directed by the Owner or his representative. Final list of items to be scrapped is subject to the Owner's review.
 - 4. Abandon: Materials and equipment to be abandoned in place shall be properly taken out of service according to the methods identified in the project specifications.

3.4 CLEAN-UP

- A. Debris and rubbish: Remove debris and rubbish from the site daily.
- B. Debris Control: Remove and transport debris in a manner as to prevent spillage on streets or adjacent areas.
- C. Regulations: Local regulations regarding hauling and disposal apply.

3.5 REMOVALS - GENERAL

- A. All removed items shall be scrapped unless otherwise indicated by the Drawings or specifications herein or as indicated by the Owner.
- B. All mechanical and electrical materials indicated to be salvaged shall be removed prior to initiating the scrapping/removal of the existing structure or facility.

- C. All removed structural steel, supports, grating, etc. shall be scrapped unless otherwise noted on the Drawings.
- D. Structures, Walls and Partitions: Structure and finish shall be removed to the minimum required to remove and install piping. The Contractor shall limit the size of openings for removal. At locations where pipes are removed and not reinstalled, the openings or holes shall be completely filled in to match the surrounding area. At locations where pipes are removed and reinstalled, the openings or holes shall be filled in as shown on the Drawings or specified.
- E. Remove all reinforcement, anchor bolts, and other protruding elements that can cause a safety hazard.
- F. All sanitary sewer lines to be abandoned in place shall be pressure filled with flowable concrete fill as specified in the section entitled "Cast in Place Concrete".
- G. Exposed pipes to be abandoned may be plugged at the ends in lieu of being completely removed.
- H. Underground structures included the Existing Effluent Structure to be abandoned in place shall be filled with concrete or flowable concrete fill to a depth not less than the crown elevation of the uppermost connecting sewer line. The remaining volume of the structures shall be filled with flowable concrete fill or granular fill compacted 90% standard Proctor density.

3.6 REMOVALS - MECHANICAL

- A. Prior to performing any removal work hereunder, the Contractor shall determine the location of all applicable shutoff valves so that the work to be modified can be isolated during construction. In the event that no shutoff valve can be found, the Contractor shall make provision to isolate the work by means of plugs, caps or other effective sealing devices.
- B. During the performance of the removal work, the Contractor shall drain the contents of any affected pipes containing liquid in a manner that will prevent such contents from spilling. Extreme care shall be taken in releasing pressurized gas or liquid lines. Such systems include, but are not limited to, the following:
 - 1. Hoist and bridge crane system including all structural steel and electrical appurtenances.
 - 2. All process pipe fittings 4 inches and larger.
 - 3. All process valves 4 inches and larger.
 - 4. All pumps including drive shafts, bases, motors, bearing support angles, and appurtenances.
 - 5. Exhaust fans.

3.7 REMOVALS - ELECTRICAL

- A. Fixtures not called out or specified to be re-used shall be salvaged. Remove lens, lamps and hangers and separate in boxes. Label as to contents.
- B. Apparatus and equipment not re-used or salvaged shall be scrapped. Such systems include, but are not limited to, the following:
 - 1. Pump electrical and control systems including switchgear and telemetry systems.
 - 2. Electric motors.
 - 3. Fixtures. Remove lens, lamps and hangers and separate in boxes. Label as to contents.
 - 4. Portable emergency generator disconnect.

3.8 REMOVALS - ASBESTOS PIPE

- A. Removal procedures shall be in accordance with current federal and state regulations. Testing of material may be required unless the material has been classified.

END OF SECTION

SECTION 030510

LEAKAGE TESTING OF HYDRAULIC STRUCTURES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall perform all cleaning, flushing, and testing, of all hydraulic structures and appurtenant piping, including conveyance of test water from Owner-designated source to point of use, and including all disposal thereof, complete and acceptable, all in accordance with the requirements of the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS REQUIREMENTS

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

PART 3 EXECUTION

3.1 GENERAL

- A. Water for testing will be furnished by the Owner; however, the Contractor shall make all necessary provisions for conveying the water from the Owner-designated source to the points of use.
- B. All hydraulic structures and appurtenant pressure piping shall be tested. All testing operations shall be done in the presence of the Engineer.
- C. Release and disposal of water from structures, after testing has been completed, shall be in accordance with the contract documents and as acceptable to the Engineer.

3.2 PRELIMINARY CLEANING AND FLUSHING

- A. General
 - 1. Testing shall be performed prior to backfilling, except where otherwise acceptable to the Engineer. Testing shall not be performed sooner than 14 days after all portions of structure walls and associated roof systems have been completed. The test shall consist of filling the structure with water to the maximum operating water surface. All visible leakage shall be repaired in accordance with repair methods specified in applicable sections of Division 3 and 15 of these Specifications.
- B. Leakage Test and Repairs
 - 1. Fill hydraulic structures to be subjected to leakage tests with water to the normal operating liquid level line.
 - 2. Filling shall not exceed 3-feet of water depth per 24-hour period.
 - 3. Filling shall be at a uniform rate over a 24-hour period with continuous monitoring. For structures with adjacent bays, fill all bays simultaneously.
 - 4. Empty adjacent bays alternately.
 - 5. Repair any running leaks which appear during filling before continuing.
 - 6. After the structure has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the structure is complete.
 - 7. Then close all valves and gates to the structure and measure the change in water surface each day for a seven-day period.
 - 8. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots.
 - a. There shall be no visible leaks or damp spots.
 - b. Repair visible leaks or damp spots after dewatering.
 - 9. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the initial and final water level readings, does not exceed 0.2

percent of the total volume of water in the structure, after allowance is made for evaporation loss and rainfall gain.

10. Method for calculating allowances shall be agreed upon by both Engineer and Contractor prior to testing.
 11. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action taken to correct the problem before commencing a new 7-day test period.
 12. Should the structure fail to pass the test, the test may be repeated once.
 13. If, at the end of 14 days, the structure still fails to pass the leakage test, the Contractor shall empty the structure as acceptable to the Engineer and shall examine the interior for evidence of any defects or other conditions that might be responsible for the leakage.
- C. It is intended that all liquid-containing concrete structures, whether tested or not, shall be free from visible leaks. Damp spots on exterior wall surfaces will be considered visible leaks if water can be picked up on a dry hand or facial tissue. Damp spots on wall footings will be permitted. All visible leaks which have not spontaneously plugged or demonstrated a definite decrease in the rate of leakage over a reasonable period of time shall be located and repaired by and at the expense of the Contractor in a manner acceptable to the Engineer.
- D. Each leak which is discovered during the correction period shall be located and repaired to the satisfaction of the Owner by and at the expense of the Contractor. Repairs shall be made regardless of any amount the total measured leakage may have been below the specified maximum allowable leakage during the leakage test.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Building and basin walls.
 - 5. Miscellaneous items (thrust blocks, house keeping pads, etc.)

1.03 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Provisions and Section 013300.10.
- B. Product Data: For each type of product indicated.
- C. Design Mixtures: For each concrete mixture. The proposed mix designs shall be submitted by the contractor for review to the engineer of record. Mix design is the responsibility of the Contractor subject to the limitations of the Specifications. Review processing of this submission will be required only as evidence that the mix has been designed by qualified persons and that the minimum requirements of the Specifications have been met. Such review will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the Specifications relative to all criteria listed in the specification. Concrete mix design quantities and test results shall be submitted for review and shall be accepted before concrete work is started. Reports covering the source, quality, and proportions of the concrete materials used in the design mix should include the following information:
 - D. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
 - G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.

1.05 INFORMATIONAL SUBMITTALS

- A. Submit shop drawings and samples in accordance with the General Provisions and Conditions.
- B. Qualification Data: For manufacturer.

- C. Welding certificates.
- D. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Waterstops.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semirigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity. Provide certificates that aggregate comply with ASTM C 33. State weathering region limits of coarse aggregates: severe, moderate, or negligible. State basis of determining that alkali reactivity potential is negligible. Identify certifications and tests to actual materials to be used in the work. Provide additional tests and certifications for each change in material source. Provide an alternate materials source of aggregate if tests indicate that aggregates are reactive or possess severe weathering potential. Submit gradation analysis for fine and coarse aggregate with concrete mix designs. If deleterious substances are present, state the amount.
- F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 1602 requirements for production facilities and equipment.
 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 318, "Building Code requirements for Structural Concrete"
 - 4. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures"
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Evaluation and Acceptance of Concrete
 - 1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 318, Chapter 5 "Concrete Quality, Mixing, and Placing", and as specified herein.
 - 2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
 - 3. All concrete which fails to meet ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.
- I. In the event tests on control specimens of concrete fall below the specified requirements, the Engineer may permit check tests for strengths to be made by means of typical cores drilled from the related part of the structure in accordance with ASTM C 42 and C 39. All costs associated with the failure to meet the specification requirements, including this type of testing and removal and replacement shall be borne by the Contractor.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
 - 4. Form ties for liquid retaining walls and walls below grade shall be provided with water stop washers located on the permanently embedded portions of the ties at the approximate center of the wall.
 - 5. Bolts and rods that are to be completely withdrawn shall be coated with a nonstaining bond breaker.
 - 6. The Contractor shall be responsible for the water tightness of the form ties and any repairs needed.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 1064, as drawn.
- D. Deformed-Steel Wire: ASTM A 1064.
- E. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064, flat sheet.

2.03 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- C. Bar Couplers: Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc., or approved equal. Use couplers which develop 125% of the specified yield strength of the reinforcing bars. Make field demonstrations and sample splicing prior to splicing bars being included into the work.

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II, gray
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - c. The Portland cement shall contain not more than 0.60% alkalis. The term "alkalies" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114.
 - d. The Portland cement shall contain not more than 8% tricalcium aluminate.

- e. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be acceptable to the Engineer.
 - f. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.
 - g. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.
 - h. Fly ash shall have a carbon content of less than 4% as measured by the loss on ignition. 75% of the fly ash shall have a fineness of 45 microns or less.
2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
- 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - 3. Coarse aggregates shall consist of well-graded, clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. Coarse aggregates shall not contain any materials that are reactive with the alkalis in the cement when exposed to moisture. Where aggregate reactivity has not been established or tested, low-alkali cement shall be used.
 - 4. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that are hard and durable.
 - 5. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - 6. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C 289), the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
 - 7. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
 - 8. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42% after 500 revolutions, or 10.5% after 100 revolutions.
 - 9. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C 88), the loss resulting after five cycles shall not exceed 15% for fine or coarse aggregate when using sodium sulfate.
- D. Water: ASTM C 1602 and potable.

2.05 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Concrete used for liquid containing or retaining structures such as tanks, basins or other liquid retaining or holding structures shall include a crystalline waterproofing admixture such as that manufactured by Xypex Chemical Corp, Tnemec, or Penetron. Such admixture is to be provided for all elements of such liquid containing or retaining structures including top slabs and beams for closed tanks or basins. Equal admixtures from any other manufacturer are acceptable. Follow all manufacturer recommendations including dosage rates.
- C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.

2. Retarding Admixture: Use where the air temperature at the time of placement is expected to be consistently over 80° F. ASTM C 494, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - a. If the high range water reducing agent is added to the concrete at the batch plant, it shall be second generation type. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.
 - b. If the high range water reducer is added to the concrete at the job site, it shall be used in conjunction with a low range water reducer. Concrete shall have a slump of 3 inches \pm 1/2 inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.
 - c. Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.
 5. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
 6. Viscosity Modifying Admixture: ASTM C 494, Type S.
- D. Set-Accelerating Corrosion-Inhibiting Admixture: Use where the air temperature at the time of placement is expected to be consistently under 40° F. Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494, Type C.
- E. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.06 WATERSTOPS

- A. Flexible Rubber Waterstops: CE CRD-C 513 with factory installed metal eyelets for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Greenstreak.
 - b. Williams Products, Inc.
 2. Profile: Ribbed with center bulb.
 3. Dimensions: 6 inches by 3/8 inch thick; non-tapered.
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory installed metal eyelets for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.
1. Products: Subject to compliance with requirements, provide the following:
 - a. JP Specialties, Inc.; Earth Shield TPE-Rubber.
 - b. Vinylex Corp.; PetroStop.
 - c. WESTEC Barrier Technologies, Inc.; 600 Series TPE-R.
 2. Profile: Ribbed with center bulb.
 3. Dimensions: 6 inches by 3/8 inch thick; non-tapered.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
 - b. CETCO; Volclay Waterstop-RX.
 - c. Concrete Sealants Inc.; Con Seal CS-231.
 - d. Greenstreak; Swellstop.
 - e. Henry Company, Sealants Division; Hydro-Flex.
 - f. JP Specialties, Inc.; Earth Shield Type 20.
- D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
 - b. Greenstreak; Hydrotite.
 - c. Vinylex Corp.; Swellseal.

2.07 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. / sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.

- d. Conspec by Dayton Superior; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
- f. Edoco by Dayton Superior; Res X Cure WB.
- g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
- h. Kaufman Products, Inc.; Thinfilm 420.
- i. Lambert Corporation; AQUA KURE - CLEAR.
- j. L&M Construction Chemicals, Inc.; L&M Cure R.
- k. Meadows, W. R., Inc.; 1100-CLEAR.
- l. Nox-Crete Products Group; Resin Cure E.
- m. Right Pointe; Clear Water Resin.
- n. SpecChem, LLC; Spec Rez Clear.
- o. Symons by Dayton Superior; Resi-Chem Clear.
- p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
- q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.08 SEALANT

- A. The joint sealant shall be a two-part, gray, nonstaining, nonsagging, polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber.
- B. Technical Requirements:

1. Consistency	Gun grade
2. Tack free time	72 hours maximum
3. Pot life	1 to 3 hours
4. Hardness	30 Shore A, +/-5
5. Elongation	50%
6. Tensile strength, ASTM D 412	200 psi
7. Peel strength on concrete	No loss of bond with 50% +/- movement
8. Temperature service range	-40 F to +150 F

- C. Backing Rod: Backing rod shall be an extruded closed-cell polyethylene foam road. The rod shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.
- D. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape, which will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.
- E. Expansion Joint Filler: Extruded closed-cell polyethylene foam equal in thickness to joint. Provide foam with tear off strip where joint to receive sealant.
- F. Premolded joint Filler: Joint filler shall be preformed, nonextruded type constructed of closed-cell neoprene conforming to ASTM D 1752. Type 1.

2.09 RELATED MATERIALS

- A. Expansion and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

- E. Nonshrink grout shall conform to ASTM C 1107.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- E. Controlled Low Strength Material (Flowable Fill): Flowable fill shall be manufactured at plants that have qualified as an approved source in accordance with the Standard Operating Procedure for Ready-Mix Concrete
 1. The Contractor shall submit mix design for flowable fill to the Engineer for approval. The following table lists the suggested mix design for flowable fill:

COMPONENT	QUANTITY
CEMENT TYPE 1	75-150 LB/YD3
FLY ASH	150-600 LB/YD3
WATER	MIX DESIGN SHALL PRODUCE A CONSISTENCY THAT WILL RESULT IN A FLOWABLE, SELF-LEVELING PRODUCT AT THE TIME OF PLACEMENT.
AIR	5%-15%
UNIT WEIGHT	100-125 LB/FT3

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Retaining Walls and Mat Foundations: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- C. Exterior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
 5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
- D. Miscellaneous items: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 5000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.40.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 1602. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.03 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.04 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 STEEL REINFORCEMENT

- A. General: Bar bending details and placing drawings shall conform to the "ACI Detailing Manual" ACI SP-66 and with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Concrete surfaces exposed to Ozone shall have 3 inch steel cover.
- G. Steel in walls, unless otherwise shown, shall be continuous through the length of the various members.
- H. Wire mesh reinforcements in slabs shall be continuous, shall have joints lapped at least one full square + 2", and shall be supported as specified.
- I. Welding of reinforcing bars is prohibited unless noted otherwise. When welding is approved, welding shall be in accordance with AWS D1.4 "Welding Reinforcing Steel".
- J. Provide corner bars of the same size and spacing as adjacent reinforcing.

- K. Openings in walls or structural slabs shall be reinforced with minimum 2-#5 bars on all sides or as indicated in details. Extend reinforcing minimum 24" beyond the opening or as indicated.
- L. All reinforcing bars are to be made continuous or lapped minimum 48 bar diameters or as indicated on drawings.
- M. Dowel Bar Substitution: Contractor has the option to replace any or all dowels indicated on the drawings with a dowel bar substitution. Dowel bar substitution shall be of a size to match size of dowels indicated for strength. Inserts shall be secured to the forms in a manner recommended by the manufacturer. Bolts shall be provided with wire fabricated type to provide bolt clearance.
- N. Epoxy Adhesive Set Dowel Bars:
 1. Install in accordance with adhesive manufacture recommendations.
 2. Drill hole 1/8" larger than the bar outer diameter to a depth 1/2" deeper than the minimum design embedment.
 3. Clean the hole completely with brush and air blast removing all debris.
 4. Fill hole half full with properly mixed adhesive.
 5. Insert the bar while rotating it two full revolutions to completely distribute epoxy throughout the annular space.
 6. Agitate the bars to remove all air voids to full depth embedment penetration.

3.06 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1 1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.07 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. To properly secure waterstops in wall joints before concrete is placed, drill holes in waterstops approximately 1 inch from each edge or between the outermost ribs at each edge and center the waterstop in the joint. Tie both edges of the waterstop and fasten to reinforcing steel with black annealed steel tie wire as specified for tying reinforcing steel and secure in place so that the waterstop will be perpendicular to the joint and remain in the required position during concrete placement. The spacing of the waterstop ties shall match the spacing of the adjacent reinforcing, but need not be spaced closer than 12 inches on center.
- C. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
- D. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.

3.08 INSTALLATION OF JOINT SEALANTS

- A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.
- B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer.
- C. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.
- D. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.
- E. After the sealant has been applied, remove the masking tape and any sealant spillage.
- F. Installation of Premolded Joint Filler: Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.09 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless such quantity of water is intentionally withheld for later addition at project site. Such addition, in no case should result in altering of the specified water to cementitious material ratio. Indicate the amount of mixing water that is withheld for later addition at the project site on the batch tickets. Provide such batch tickets to the Resident Project Representative for review and record.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet before the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.
- G. Conveyor Belts and Chutes: All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.
- H. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an upslope direction

- I. Temperature of Concrete: Concrete temperature shall conform to the applicable requirements of ACI 305.1 - Specification for Hot Weather Concreting and ACI 306.1 - Specification for Cold Weather Concreting, unless otherwise modified herein. The temperature of concrete when it is being placed shall be not more than 90° F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90° F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90° F. The Contractor shall be entitled to no additional compensation on the account of the foregoing requirements.
- J. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods, which will prevent segregation or loss of ingredients and in a manner that the required quality of the concrete is maintained. No concrete shall be placed more than 1½ hours after mixing of that particular batch has commenced.
- K. Pumping Equipment: Pumping equipment and procedures, if used, shall conform to the recommendations contained in the report of ACI Committee 304 on Placing Concrete by Pumping Methods, ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1 inch with or without a superplastizer. The slump loss shall be determined by tests made at each end of the pumping system. If tests indicate a loss greater than 1 inch, the contractor shall modify the pumping system as required to reduce the slump loss.
- L. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, placement shall be scheduled so that one end of each unit is free, except at corner closures. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.
- M. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2 of an inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- N. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high-speed power vibrators (8,000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- O. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- P. Concrete in walls shall be internally vibrated and at the same time stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein

specified within 15 minutes after concrete of the prescribed consistence is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Overvibrating and use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at many points, approximately 18 inches apart. At each insertion, the duration shall be sufficient to consolidate the concrete, but not sufficient to cause segregation, generally from 5 to 15 sec. duration.

- Q. Backfill placed against walls and grade beams shall be done evenly on both sides. Do not place backfill against walls until the concrete has attained a compressive strength equal to the specified 28-day compressive strength. Backfill against basement foundation walls shall not be placed until ground level floor and lower level slabs that brace this wall are in place and cured unless the wall is properly braced with temporary bracing. All bracing, if used, shall be responsibility of the contractor. Submit all calculations and details to the structural engineer for record. Backfill placed directly adjacent to basement and retaining walls shall be compacted clean free draining granular material. For a minimum of 2'-6" from face of wall. Provide a 1'-6" deep cap of compacted approved impervious cohesive material at top of granular backfill. All backfill shall be compacted using hand operated equipment; no heavy equipment shall be allowed within 5'-0" of any wall.
- R. No aluminum of any type shall be allowed in concrete work unless coated to prevent aluminum-concrete reaction.
- S. Cross reference structural and architectural drawings for inserts, anchor bolts, notches, ledges, lugs, etc. required on beams. Width and depth of beams given are overall out-to-out dimensions of concrete.
- T. All field bending of reinforcing shall be done cold. Heating of bars will not be permitted.
- U. Maximum O.D. of embedded conduit shall be no larger than 1/3 slab thickness. No conduit shall be placed above the welded wire fabric in slabs- on-grade or concrete fill placed onto composite metal deck. Do not place pipes, ducts, reglets or chases in structural concrete or composite floor systems without approval of the structural engineer through the Engineer.
- V. Provide vertical construction joints in concrete walls that have their outside surface exposed to view at a maximum uniform spacing not to exceed 30'-0". Coordinate joint locations with architectural drawings. Do not cast unexposed walls or grade beams in lengths over 60'-0". Wait 48 hours between adjacent pours. Provide waterstops at all vertical construction joints in walls.
- W. Construction joints in floors shall be located within the middle third of spans of slabs, beams, and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams. Provide waterstops at all construction joints in basin top and bottom concrete slab and beam framing.
- X. No footing shall be placed onto or against sub-grades containing free water, frost, or ice.
- Y. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- Z. Hot-Weather Placement: Comply with ACI 305.1 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 CONCRETE SLAB ON GRADE CONSTRUCTION

- A. All unacceptable fill and top soil shall be removed from below all proposed slabs-on-grade and the exposed natural soil shall be proof rolled and the compaction verified by a qualified independent soils testing firm prior to placing fill. Areas exhibiting weakness shall be removed and replaced by acceptable compacted fill.
- B. A minimum 6" of compacted granular fill shall be placed under all slabs-on-grade. All fill required to attain final sub-grade for slabs and walls shall be an acceptable material placed and compacted as directed by the project soils consultant report recommendations.
- C. Pitch slabs to drains and provide depressions, where shown on the process or structural or architectural drawings, without reducing the thickness of slab indicated. See details for additional reinforcing for slabs on grade depressions greater than 1".
- D. Provide slab-on-grade construction joints around each column, against grade beams, interior walls, and between columns and walls. Provide slab joints to form areas not to exceed 18' in length in each direction. See typical details. Submit detailed drawings showing locations of all construction joints.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view. Example: Exterior walls below grade not exposed to water
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, Example: Interior walls exposed to water. Interior walls of structures or buildings exposed to view. Underside of formed floors or slabs. Exterior walls exposed to view.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete for basin and tank walls that are exposed to view and where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
 - 1. Apply scratch finish to surfaces indicated.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces indicated.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - c. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
 - d. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24.
 - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10 ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.13 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. All concrete in liquid containing structures shall be water cured.
- F. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project. unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, pop outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean,

square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.
- G. Repair of concrete not passing leakage test: After the structure has been tested for leaks, repair leaking concrete cracks by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and apply low viscosity polyurethane joint sealant in accordance with Manufacturer. The Contractor may submit alternate methods of crack repair for review by the Engineer.

3.17 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric methods, for structural lightweight concrete one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 138, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C 31.
 - a. Cast and laboratory cure two sets of two and one set of one standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days. Hold one set of one specimen for future testing if the two tests mentioned above do not meet strength requirements.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 11. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.
- E. Water-Soluble Chloride Ion: Water-soluble chloride ion testing shall be performed in accordance with ASTM C 1218.
- F. Drying Shrinkage Test
1. Concrete shrinkage tests shall be performed once for each 1,000 cubic yards of concrete with controlled shrinkage that is placed and shall be made on concrete from a batch of concrete from which concrete compression test cylinders are made. Shrinkage testing shall be in accordance with ASTM C 157.
 2. A drying shrinkage test shall be conducted on the preliminary trial batch with the maximum water-cementitious materials ratio used to qualify each proposed concrete mix design using the concrete materials, including admixtures, which are proposed for the project. Three test specimens shall be prepared for each test. Specimens shall be fabricated, cured, dried, and measured in accordance with ASTM C 157.
 3. Drying shrinkage for each specimen shall be computed as the difference between the base length at (0) zero days drying age and the length after drying at each test age. Results of

the shrinkage test shall be reported to the nearest 0.001%. If drying shrinkage of any specimen deviates from the average for that test age by more than 0.004%, the results for that specimen shall be disregarded.

4. The average drying shrinkage of each set of test specimens cast in the laboratory from a trial batch as measured at the 21 days drying age shall not exceed 0.035% for concrete to be used in liquid-containing structures and 0.045% for concrete to be used in other structures. Drying shrinkage tests will not be required for isolated footings, pipe blocking, pipe encasement, and duct banks.
5. At the Contractor's option, a shrinkage-reducing admixture may be used to comply with the maximum shrinkage requirements. Shrinkage reducing admixture shall be applied at a rate of 1 gallon per cubic yard. All concrete admixtures shall be from one manufacturer and shall be compatible. Admixture content, batching method, and time of introduction to mix shall comply with these specifications and with manufacturer's recommendations.

END OF SECTION

SECTION 034100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Precast structural concrete.
- B. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
 - 2. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.3 DEFINITION

- A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Engineer.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Precast concrete submittals shall provide a complete structural analysis, placement drawings and individual piece drawings showing reinforcing steel (mild or otherwise). This submittal shall also bear the seal and signature of a professional engineer licensed in the state where the project is located. Lack of seal and signature will be grounds for rejection.
- B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
 - 1. Indicate joints, reveals, and extent and location of each surface finish.
 - 2. Indicate separate face and backup mixture locations and thicknesses.
 - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 6. Include and locate openings larger than by 10 inches.
 - 7. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 8. Indicate relationship of precast structural concrete units to adjacent materials.
 - 9. Indicate estimated camber for precast units.
 - 10. Indicate shim sizes and grouting sequence.
 - 11. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

- D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.
 - 5. Structural-steel shapes and hollow structural sections.
- D. Material Test Reports: For aggregates.
- E. Source quality-control reports.
- F. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Participates in PCI's Plant Certification program and is designated a PCI-certified plant as follows:
 - a. Group C, Category C1 - Precast Concrete Products (no prestressed reinforcement).
 - b. Group CA, Category C1A - Precast Concrete Products (no prestressed reinforcement).
- B. Installer Qualifications: A precast concrete erector qualified as evidenced by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems.
- C. Installer Qualifications: An experienced precast concrete erector who, before erection of precast concrete, has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in Category S1 - Simple Structural Systems and who produces an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."
- D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- F. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- G. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 2. Place adequate dunnage of even thickness between each unit.
 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses that would cause cracking or damage.
- D. Lift and support units only at designated points shown on Shop Drawings.

1.9 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.2 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
1. Mold-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- C. Galvanized Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized, and chromate wash treated after fabrication and bending .
- D. Epoxy-Coated Reinforcing Bars: ASTM A 615, Grade 60, deformed bars, ASTM A 775 epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- E. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- H. Epoxy-Coated-Steel Wire: ASTM A 884, Class A coated, plain, flat sheet, Type 1 bendable coating.
- I. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.4 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A 416, Grade 250 or Grade 270, uncoated, 7-wire, low-relaxation strand.

- B. Unbonded Post-Tensioning Strand: ASTM A 416, Grade 270, uncoated, 7-wire, low-relaxation strand.
 - 1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.6 and sheath with polypropylene tendon sheathing complying with ACI 423.6. Include anchorage devices and coupler assemblies.
- C. Post-Tensioning Bars: ASTM A 722, uncoated high-strength steel bar.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin Admixture: ASTM C 618, Class N.
 - 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
 - 1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: Uniformly graded.
 - 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate unless otherwise approved by Engineer.
- D. Lightweight Aggregates: Except as modified by PCI MNL 116, ASTM C 330, with absorption less than 11 percent.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
 - 5. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 7. Plasticizing and Retarding Admixture: ASTM C 1017.
- H. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A 36.
- B. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A 283.
- D. Malleable-Iron Castings: ASTM A 47.
- E. Carbon-Steel Castings: ASTM A 27, Grade 60-30.

- F. High-Strength, Low-Alloy Structural Steel: ASTM A 572.
- G. Carbon-Steel Structural Tubing: ASTM A 500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A 675, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.
- J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
 - 1. Do not zinc coat ASTM A 490 bolts.
- L. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123 or ASTM A 153.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- M. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.
- N. Welding Electrodes: Comply with AWS standards.
- O. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.7 STAINLESS-STEEL CONNECTION MATERIALS

- A. Stainless-Steel Plate: ASTM A 666, Type 304, of grade suitable for application.
- B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.
- C. Stainless-Steel-Headed Studs: ASTM A 276, with minimum mechanical properties of PCI MNL 116.

2.8 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.
 - 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test 1 specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO Load and Resistance Factor Design (LRFD) Bridge Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 - 4. Frictionless Pads: Tetrafluoroethylene, glass-fiber reinforced, bonded to stainless- or mild-steel plate, of type required for in-service stress.
 - 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.9 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881, of type, grade, and class to suit requirements.

2.10 ANCHORS AND INSERTS

- A. Anchors and Inserts shall be ASTM A 36 steel with unprimed finish. Accurately position built-in anchorage and insert devices and secure to formwork. Locate anchorages and inserts where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.

2.11 OPENINGS

- A. Cast-in openings larger than 6 inches in diameter or 6 inches in either length or width according to Shop Drawings. Smaller holes may be field cut by trades requiring them. Contractor to coordinate such field cut opening sizes and locations with engineer and precast manufacturer. Such work should only be conducted after approval is received from precast manufacturer and engineer.

2.12 DRY PACK AND MORTAR

- A. Dry Pack and Mortar for bedding under pre cast concrete shall be non-shrink, non-ferrous and shall have a minimum compressive strength of 3,000 psi in seven days.

2.13 SEALANTS

- A. Exterior and interior caulking at joints: Two part urethane sealant meeting ASTM C 920 equivalent to Sonneborn Sonolastic NP-2, Tremco Dymeric, or equal.
- B. Back-up: Non-staining closed cell polyethylene foam.
- C. Color: Concrete gray to match concrete panels.

2.14 FORM COATINGS

- A. Form Coatings shall be non-staining and not impact the finish.

2.15 FINISH

- A. Exterior finish shall be as specified in the drawings
- B. Interior finish shall be smooth form face, typical.

2.16 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
 - 2. Limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.

- D. Normal-Weight Concrete Mixtures: Proportion face mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu.ft., plus or minus 3 lb/cu. ft., according to ASTM C 567.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- I. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.17 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly chamfered.

2.18 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcement to maintain at least 3/4-inch minimum coverage. Increase cover requirements according to ACI 318 when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 5. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 5. Protect strand ends and anchorages with a minimum of 1 inch thick, non-metallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- L. Comply with ACI 306R procedures for cold-weather concrete placement.
- M. Comply with PCI MNL 116 procedures for hot-weather concrete placement.
- N. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or

permanently mark casting date on each precast structural concrete unit on a surface that will not show in finished structure.

- O. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- P. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.19 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

2.20 COMMERCIAL FINISHES

- A. Commercial Grade: Remove fins and large protrusions and fill large holes. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch.
- B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur more than once per 2 sq. in. Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.
- D. Grade A Finish: Fill surface blemishes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
- E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- G. Apply roughened surface finish according to ACI 318 to precast concrete units that will receive concrete topping after installation.

2.21 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements.
 - 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.
 - 1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer.
 - 2. Cores will be tested in an air-dry condition or, if units will be wet under service conditions, test cores after immersion in water in a wet condition.
 - 3. Strength of concrete for each series of 3 cores will be considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - 4. Test results will be made in writing on same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports will include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

3.2 FORMS

- A. Cast concrete units in leak-proof rigid forms of plywood or concrete of sufficient strength to withstand deformation of the units. Use forms with surfaces free from irregularities and dents and produce concrete surfaces of smooth appearance free from fins. Construct forms so that they can be removed without hammering or prying against the concrete.

3.3 CASTING BEDS

- A. Maintain casting platforms or slabs in a clean condition prior to depositing concrete. Clean dirt, oil, footprints, and foreign materials from wall panels. In hot or dry weather, cool the casting platform or slabs by water spray prior to concreting. Cover control joints in castings surfaces with tape or fill with putty to minimize transfer of crack patterns to the wall.

3.4 CAMBER

- A. The camber, at the time of casting precast prestressed concrete units, if required, shall be designed by the precast manufacturer and shown on the shop drawings. The camber, at the

time of casting, shall be designed and provided so that it will remain in the units at midspan after the units have been placed. Such camber shall be substantiated by calculations that include the anticipated upward deflection caused by prestressing forces and the plastic deflection that will occur during the time interval between stressing and placement of units as applicable. Camber calculations shall be based on the precast manufacturer's estimate of the modulus of elasticity at the applicable concrete age.

- B. If unanticipated deflections occur prior to the time the topping concrete is placed, adjust the slope of the deck to maintain a minimum of 1 inch of topping concrete between the top of the precast units and the topping reinforcement. Such adjustments will not be considered a change in dimensions. Additional costs resulting from such adjustments due to unanticipated deflections shall be borne by the Contractor at no expense to the Owner.

3.5 HANDLING

- A. Do not remove castings until the concrete has attained adequate compressive strength to avoid cracking.
- B. Use handling steel, eyebolts, or other lifting inserts located to minimize stresses in handling.
- C. Store and handle units so that the edges are protected from damage. Replace damaged units at Contractor's expense. Clean surfaces and remove surface residue of the curing compound or bond breaker.
- D. Do not erect pre cast units until the concrete reaches the compressive strength required by the design calculations as confirmed by concrete cylinder tests.

3.6 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Do not erect precast wall panels on wall footings until footing concrete has attained a minimum of 2000 psi compressive strength confirmed by concrete cylinder tests.
- C. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
- D. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- E. Field cutting of precast units is not permitted without approval of the Engineer.
- F. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless shown on drawings and approved by precast manufacturer's Engineer. Coordinate all field drilling or fastening with Engineer and precast manufacturer before conducting such work.
- G. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.

2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780.
 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 4. Remove, reweld, or repair incomplete and defective welds.
- H. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot. For friction connections, apply specified bolt torque and check 25 percent of bolts at random by calibrated torque wrench.
- I. Grouting: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled.
1. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.7 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.
- C. Remove fins and large protrusions and fill large holes. Rub or grind ragged edges.
- D. Units not conforming to specified tolerances rejected and replaced at Engineer's discretion.

3.8 CURING

- A. Cure in accordance with the requirements of PCI MNL 116 and so strength and finish of unit is not impaired. Protect the pre cast wall units from damage of any nature.
- B. Maintain concrete in a moist condition until the expiration of the minimum curing period specified.

3.9 JOINTS

- A. Seal both interior and exterior longitudinal joints. Use type of sealant and back up material specified.

3.10 TOUCH UP

- A. Touch up exposed hardware with two coats of red primer.

3.11 FIELD QUALITY CONTROL

- A. Field welds will be visually inspected and nondestructive tested according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- B. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

3.12 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units has not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.13 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. After erection, clean units of dirt and debris in an approved manner.
- C. Take precautions not to stain, mark, dirty or damage other work during cleaning operations
- D. Upon completion of work of this Section, remove plant equipment, surplus materials and debris resulting from work of this trade.
- E. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Metal bollards.
 - 3. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 055100 "Metal Stairs, Handrails and Railings."
 - 3. Section 055300 "Metal Gratings, Cover Plates and Access Hatches."

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design steel members including comprehensive engineering analysis by a qualified professional engineer licensed in the state where the project is located, using performance requirements and design criteria indicated on the drawings and in accordance with the building code.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Samples for Verification: For each type and finish of extruded nosing.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.
- C. Welding certificates.

- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53, standard weight (Schedule 40) unless otherwise indicated.

2.3 NONFERROUS METALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Eyebolts: ASTM A 489.
- G. Machine Screws: ASME B18.6.3.
- H. Lag Screws: ASME B18.2.1.
- I. Wood Screws: Flat head, ASME B18.6.1.
- J. Plain Washers: Round, ASME B18.22.1.
- K. Lock Washers: Helical, spring type, ASME B18.21.1.
- L. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- M. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- N. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- O. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6 inch embedment and 2 inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

2.8 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Cap bollards with 1/4 inch thick steel plate.
 - 2. Where bollards are indicated to receive controls for door operators, provide necessary cutouts for controls and holes for wire.
 - 3. Where bollards are indicated to receive light fixtures, provide necessary cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 3/8 inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4 inch anchor bolts.
 - 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4 inch thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.
- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4 inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4 inch steel machine bolt.

2.9 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.
- C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.13 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).
- C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 1. Cast Aluminum: Heavy coat of bituminous paint.
 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING METAL BOLLARDS

- A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 055100
METAL STAIRS, HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aluminum Pipe railing.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design metal stairs, handrails and railings including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Handrails and Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7
 - 1. Component Importance Factor is 1.5.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Railing brackets.
 - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel railing products certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for railings.
 - 1. Test railings according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.2, "Structural Welding Code - Aluminum."

1.7 COORDINATION

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication of railings.
- B. Coordinate installation of anchorages for metal stairs and railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
- D. Schedule installation of railings so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Brackets, Flanges, and Anchors for railings: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 NONFERROUS METALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
- B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.
- C. Aluminum Reinforcing: ASTM B221 extruded tubes, Alloy 6063-T52.
- D. Aluminum Bars: Shapes and Moldings: ASTM B221 extruded shapes, Alloy 6063-T52.

2.3 ALUMINUM RAILINGS

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars: ASTM B 221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe: ASTM B 429, Alloy 6063-T6.
 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26, Alloy A356.0-T6.
- H. Perforated Metal: Aluminum sheet, ASTM B 209, Alloy 6061-T6, 0.063 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows
- I. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2 inch woven-wire mesh, made from 0.162 inch nominal diameter wire complying with ASTM B 211, Alloy 6061-T94.

2.4 RAILING MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Aluminum Pipe and Tube Railings:
 - a. ATR Technologies, Inc.
 - b. Blum, Julius & Co., Inc.
 - c. Braun, J. G., Company; a division of the Wagner Companies.
 - d. CraneVeyor Corp.
 - e. Hollaender Manufacturing Company.
 - f. Kee Industrial Products, Inc.
 - g. Moultrie Manufacturing Company.
 - h. Pisor Industries, Inc.
 - i. Sterling Dula Engineerural Products, Inc.; Div. of Kane Manufacturing.
 - j. Superior Aluminum Products, Inc.
 - k. Thompson Fabricating, LLC.
 - l. Tri Tech, Inc.
 - m. Tubular Specialties Manufacturing, Inc.
 - n. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
 - o. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.5 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.
- D. Machine Screws: ASME B18.6.3.
- E. Lag Screws: ASME B18.2.1.
- F. Plain Washers: Round, ASME B18.22.1.
- G. Lock Washers: Helical, spring type, ASME B18.21.1.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 FASTENERS FOR RAILINGS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- E. Anchoring Cement for Railings: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION, GENERAL

- A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- C. Form exposed work with accurate angles and surfaces and straight edges.
- D. Weld connections to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Weld exposed corners and seams continuously unless otherwise indicated.
 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.
- F. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.9 FABRICATION RAILINGS

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads..
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By bending.
 - 3. By flush bends.
 - 4. By radius bends of radius indicated.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- R. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
 - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
 - 2. Orient expanded metal with long dimension of diamonds parallel to top rail.
- T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from steel.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
 - 2. Orient perforated metal with pattern parallel to top rail.
- U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1 by 1/2 by 1/8 inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
 - 1. Orient wire mesh with diamonds vertical.
- V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.10 RAILINGS

- A. Aluminum Handrails: Construct aluminum handrails of clear anodized aluminum pipe conforming to ASTM B429, Alloy 6063-T6. Handrail shall be CV Pipe Rail by Craneveyor, Wesrail as manufactured by Moultrie Manufacturing Co., or equal.
- B. Stainless Steel Handrail Safety Chains: Handrail safety chains shall be Type 316 stainless steel. Chains shall be proof coil style, 3/16 inch in diameter, with at least 12 links per foot and with snaphooks at each end. Snaphooks shall be Type 316 stainless steel.
- C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- D. Form changes in direction of railings as follows:
 - 1. As detailed.
 - 2. By bending or by inserting prefabricated elbow fittings.
 - 3. By flush bends or by inserting prefabricated flush-elbow fittings..
 - 4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
 - 5. By inserting prefabricated elbow fittings.
- E. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

- F. Close exposed ends of railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 1. Connect posts to stair framing by direct welding unless otherwise indicated.
 - 2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 - 3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- I. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.11 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Engineerural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 ALUMINUM RAILING FINISHES

- A. Mechanical Finish: AA-M12 (Mechanical Finish: nonspecular as fabricated).
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, or thicker.

PART 3 EXECUTION

3.1 RAILING EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do

not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- E. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
 - 1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- G. Installing Safety Chains: Provide two chains 4 inches longer than the access opening for each opening. Mount the top chain 3 feet 6 inches above the floor, and mount the lower chain 2 feet above the floor.

3.3 RAILING AND HANDRAIL INSTALLATION

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding directly to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Fit exposed connections together to form tight, hairline joints.
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- D. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- E. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- G. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt. Provide bracket with 1 1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.
- H. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 099000, System No. 51 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.

- I. Where aluminum surfaces come in contact with dissimilar metals or concrete, keep the dissimilar surfaces from direct contact by use of neoprene gaskets or washers.

3.4 HANDRAIL AND RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.5 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Leave anchorage joint exposed with 1/8 inch buildup, sloped away from post.
- E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.6 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1 1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 2. For hollow masonry anchorage, use toggle bolts.
 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.7 ADJUSTING AND CLEANING

- A. Clean aluminum railings by washing thoroughly with clean water and soap and rinsing with clean water.

3.8 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION

SECTION 055300

METAL GRATINGS, COVER PLATES AND ACCESS HATCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal bar gratings.
 - 2. Glass-fiber-reinforced plastic gratings.
 - 3. Cover and Floor Plates.
 - 4. Access Hatches.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance for Gratings, cover plates and floor plates: These shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf., whichever produces the greater stress.
 - 2. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
 - 3. Limit deflection under live load to L/360 or 1/4 inch, whichever is less.
- C. Floor access hatches shall meet non- structural Performance Characteristics as specified in drawings and in specifications.
- D. Structural Performance for Access Hatches shall be as listed below unless noted otherwise on drawings:
 - 1. Load Capacity: Typical 3 ft square hatch: Adequate strength and rigidity to support a minimum live load of 300 psf with a maximum deflection limit of 1/150th of the span.
 - 2. Operation: Smooth, easy, and controlled cover operation throughout the entire arc of motion.
 - 3. Temperature Tolerance: Operation not be affected by difference in temperature.
 - 4. Corrosion Resistance: Entire door and all hardware components shall be highly corrosion resistant.
- E. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to ASCE 7.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Glass-fiber-reinforced plastic gratings.
 - 2. Clips and anchorage devices for gratings.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer.
- B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 4. AWS D1.6, "Structural Welding Code - Stainless Steel."
- D. Grating provided by manufacturer with minimum 20 years' experience unless approved by Project Engineer.
- E. Verify that field measurements are as indicated on shop drawings.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).
- D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205).
- E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.
- F. Expanded-Metal Carbon Steel: ASTM F 1267, Class 1.
- G. Expanded-Metal Galvanized Steel: ASTM F 1267, Class 2, Grade A.
- H. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- I. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- J. Expanded-Metal Stainless Steel: ASTM F 1267, Class 3, made from stainless-steel sheet, ASTM A 666, Type 304.

2.2 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer for type of use indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

- B. Extruded Bars and Shapes: ASTM B 221 (ASTM B 221M), alloys as follows:
 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 2. 6061-T1, for grating crossbars.
- C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 5052-H32.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 1. Provide stainless-steel fasteners for fastening aluminum.
 2. Provide stainless steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).
- F. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Perimeter Closure: Band all edges with same material as grating. For pipe and conduits (including electrical conduit) larger than 1 inch in diameter penetrating grating, cut and band grating before galvanizing.

2.5 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
 - 2. Fabricate toeplates for attaching in the field.
 - 3. Toeplate Height: 4 inches unless otherwise indicated.

2.6 METAL BAR GRATINGS

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following. Equal products from other manufacturers are also acceptable:
 - 1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
 - 2. All American Grating.
 - 3. BarnettBates Corporation.
 - 4. Borden Metal Products (Canada) Limited.
 - 5. Fisher & Ludlow; Division of Harris Steel Limited.
 - 6. Grating Pacific, Inc.
 - 7. Grupo Metelmex, S.A. de C.V.
 - 8. IKG Industries; a division of Harsco Corporation.
 - 9. Marwas Steel Co.; Laurel Steel Products Division.
 - 10. Ohio Gratings, Inc.
 - 11. Seidelhuber Metal Products; Division of Brodhead Steel Products.
 - 12. McNichols.
- B. Welded Steel Grating 19-W-4:
 - 1. Bearing Bar Spacing: 1-3/16 inch o.c.
 - 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 - 3. Bearing Bar Thickness: As required to comply with structural performance requirements.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Plain.
 - 6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.
- C. Pressure-Locked, Rectangular Bar Aluminum Grating 19-P-4: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars.
 - 1. Bearing Bar Spacing: 1 3/16 inch o.c.
 - 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 - 3. Bearing Bar Thickness: As required to comply with structural performance requirements.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Plain.
 - 6. Aluminum Finish: Mill finish.
- D. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 - 1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.
3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced less than 15/16 inch o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
5. Furnish threaded bolts with nuts and washers for securing grating to supports.
6. Furnish self-drilling fasteners with washers for securing grating to supports.
7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following. Equal products from other manufacturers are also acceptable:
 - 1) Kee Industrial Products, Inc.; Grating Clip.
 - 2) Lindapter North America, Inc.; Grate-Fast.
 - 3) McNichols.
- E. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 1. Edge-band openings in grating with bars of same size and material as bearing bars.
- F. Do not notch bearing bars at supports to maintain elevation.

2.7 GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following. Equal products from other manufacturers are also acceptable:
 1. American Grating, LLC.
 2. Creative Pultrusions, Inc.
 3. Enduro Systems Inc.; Composite Products Division.
 4. Fibergrate Composite Structures Inc.
 5. Fisher & Ludlow; Division of Harris Steel Limited.
 6. Grating Pacific, Inc.
 7. Seasafe, Inc.; a Gibraltar Industries company.
 8. Strongwell Corporation.
 9. McNichols.
- B. Molded Glass-Fiber-Reinforced Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.
 1. Configuration:
 - a. 1 1/2 inch square mesh, thickness as required to comply with structural performance requirements.
 2. Weight: 2.5 lb/sq. ft.
 3. Resin: Polyester
 - a. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
 - b. U.S.D.A. Acceptance: Accepted for food-processing applications.
 4. Color: Beige.
 5. Traffic Surface: Plain, meniscus.
- C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.8 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1 1/4 inches wide by 1/4 inch thick by 8 inches long.
- B. Galvanize steel frames and supports in the following locations:
 - 1. Exterior.
 - 2. Interior, where indicated.

2.9 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

2.10 STEEL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish gratings, frames, and supports after assembly.
- C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.11 ACCESS HATCHES

- A. Aluminum Sheet: Unless otherwise shown, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, wood, porous materials, or dissimilar metals shall have contact surfaces coated with a heavy coat of Tnemec 46-465 Heavy Duty Black. Aluminum design shall be in accordance with the Aluminum Association standards. Aluminum shall be fastened with 316 stainless steel bolts. Unless otherwise specified, aluminum items shall be in standard mill finish.
- B. Frame: Extruded aluminum channel frame with bend down anchor tabs around the perimeter and 1-1/2" drain coupling welded under the frame for connection to pipe drain.
- C. Gasket: EPDM gasket mechanically attached to frame.
- D. Hinges: Heavy forged aluminum hinges; 1/4" 316 stainless steel hinge pins.
- E. Latch: 316 stainless steel slam lock; fixed interior handle; removable exterior turn/lift handle. Latch release is protected by a flush, gasketed, removable screw plug.
- F. Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with grip handle release.
- G. Hardware: Engineered composite compression spring tubes. Steel compression springs with electrocoated acrylic finish. All other components of door are aluminum or Type 316 stainless steel.
- H. Protective Grate for Access Hatches and Existing Access Hatch Openings: Provide hinged grating panel to cover each access hatch opening, existing access hatch opening, and where indicated in the drawings. The grating panel shall fit beneath the access hatch cover. Provide Type 316 stainless steel hold-open arm with aluminum latch, Type 316 stainless steel hardware including mounting hardware and supports and aluminum grating with OSHA Safety Orange

fusion-bonded coating. Provide spring-loaded lifting handle. Products: Halliday Products "Retro-Grate" or equal

PART 3 EXECUTION

3.1 STORAGE OF MATERIAL

- A. Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.2 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- F. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- H. Verify that framing opening sizes and dimensional tolerances are acceptable.
- I. Verify that supports are correctly positioned.
- J. Galvanizing: Zinc coating for plates, bolts, anchor bolts, and threaded parts shall be in accordance with ASTM A153 and F2329.
- K. Repair of Galvanized Surfaces: Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000, System No. 55.

3.3 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.
- D. Mechanically cut galvanized finish surfaces. Do not flame cut. Repair galvanized surfaces in accordance with ASTM A780

3.4 INSTALLING GLASS-FIBER-REINFORCED PLASTIC GRATINGS

- A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

3.5 INSTALLING ACCESS HATCHES

- A. Install manufactured hatches per hatch manufacturer's instructions.

3.6 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 CORROSION PROTECTION OF ALUMINUM SURFACES

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 099000, System No. 51 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

END OF SECTION

SECTION 099000
PAINTING AND COATING

PART 1 - GENERAL

1.1 Description

- A. This section includes materials and application of painting and coating systems for the following surfaces:
- B. Exposed, submerged and buried metal.
- C. PVC
- D. Masonry
- E. Concrete
- F. Wood
- G. Drywall

1.2 REFERENCES

- A. ASTM D 16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D 4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.
- C. ASTM F 1869 - Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- D. AWWA D 102 - Painting Steel Water Storage Tanks
- E. International Concrete Repair Institute (ICRI) Guideline No. 310.2-1997 (formerly 03732) - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- F. NACE SP0188 - Standard Recommended Practice, Discontinuity (Holiday) Testing of Protective Coatings.
- G. NAPF 500-03-04 Abrasive Blast Cleaning.
- H. SSPC-SP 1 - Solvent Cleaning.
- I. SSPC-SP 3 - Powertool Cleaning
- J. SSPC-SP 5/NACE 1 - White Metal Blast Cleaning.
- K. SSPC-SP 6/NACE 3 - Commercial Blast Cleaning.
- L. SSPC-SP 10/NACE 2 - Near-White Metal Blast Cleaning.
- M. SSPC-SP 13/NACE 6 - Surface Preparation of Concrete.
- N. SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
- O. SSPC-TU 11 - Inspection of Fluorescent Coating Systems

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's data sheets showing the following information, including surface preparation products such as block fillers and galvanized metal primers:
 - 1. Percent solids by volume.
 - 2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - 3. Recommended surface preparation.
 - 4. Recommended thinners.
 - 5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - 6. Application instructions including recommended equipment and temperature limitations.
 - 7. Curing requirements and instructions.

- C. Submit color swatches or charts.
- D. Submit certifications from the manufacturer of field coatings that shop prime coat materials to be applied by others is compatible with field coats.
- E. Submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- F. Submit material safety data sheets for each coating.
- G. Submit certificate identifying the type and gradation of abrasives used for surface preparation.
- H. Warranty: Submit manufacturer's standard warranty, or special warranty if set forth in the contract documents.

1.4 Quality Assurance

- A. Manufacturer's Qualifications:
 - 1. Specialize in manufacture of coatings with a proven successful experience.
 - 2. Able to demonstrate successful performance on comparable projects.
 - 3. Single Source Responsibility: Coatings and coating application reducers and additives shall be products of a single manufacturer.
- B. Applicator's Qualifications:
 - 1. Experienced in application of specified coatings on projects of similar size and complexity to this Work.
 - 2. Applicator's Personnel: Employ persons trained for application of specified coatings.
 - 3. Applicator's Quality Assurance: Upon request, submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
 - a. Project name and location.
 - b. Name of owner.
 - c. Name of contractor.
 - d. Name of engineer.
 - e. Name of coating manufacturer.
 - f. Approximate area of coatings applied.
 - g. Date of completion.
- C. Provide field primers and undercoat paint produced by the same manufacturer as the intermediate and finish coats. All field coatings shall be by the same manufacturer.

1.5 Delivery, Storage, and HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
 - 1. Coating or material name.
 - 2. Manufacturer.
 - 3. Color name and number.
 - 4. Batch or lot number.
 - 5. Date of manufacture.
 - 6. Mixing and thinning instructions.
- B. Storage:
 - 1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions in the area designated by owners representative.
 - 2. Keep containers sealed until ready for use.
 - 3. Do not use materials beyond manufacturer's shelf life limits.
- C. Handling: Protect materials during handling and application to prevent damage or contamination
 - 1. Avoid danger of fire: Deposit cleaning rags and waste materials in metal containers having tight covers or remove from building each night. Provide fire extinguishers of type recommended by coating manufacturer in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvents. Store solvents in safety cans.

2. Upon project completion, remaining material will become property of Owner. Seal material as required for storage, marked as to contents and shelf life, and store where required by Owner.
3. Protect floor and walls of storage area from splatter and disfiguration.
4. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

1.6 Work Schedule

Two weeks prior to the beginning of any coating work, establish with the Owner and Engineer a mutually agreeable schedule for the work. The schedule shall allow for all inspections required.

1.7 Regulatory Requirements

Conform to applicable code for flame and smoke rating requirements for products and finishes.

PART 2 - MATERIALS

2.1 Manufacturers

- A. Tnemec Company Inc.
- B. The Sherwin Williams Company
- C. Indurion
- D. Diamond Vogel
- E. ENGINEER Approved Equal

2.2 PAINT SYSTEMS SCHEDULE

Paint Systems Schedule is located at the end of this section. Painting products are listed on the System Schedule.

2.3 PAINT FINISH SCHEDULE

The Paint Finish Schedule at the end of this section or located on the drawings indicates which surfaces are to be painted. If there is a doubt as to whether a surface is to be painted, assume it is until instructed otherwise by the Engineer.

2.4 Colors

Paint colors will be selected from the manufacturer's standard color charts by the Owner and Engineer.

2.5 Touch-up Paint

Furnish a minimum of one gallon of each coating, in each color used, for the Owners use in future touch-up and minor repair work. Furnish the coatings in unbroken containers clearly labeled with the manufacturer's name, product number, product number, color, date of manufacture and coating system identification.

2.6 Galvanized Metal Touch-up

Touch-up galvanized metals with Sherwin Williams Zinc Clad "Cold Galvanizing Compound", or equal, 3 mils DFT minimum, unless shown otherwise in another specification section. Provide SSPC-SP1 surface preparation.

2.7 Abrasives and surface profile

Abrasives and surface profile shall be as recommended by the paint manufacturer for the paint material being coated and the application. Provide information for Engineer review.

PART 3 - EXECUTION

3.1 Environmental REQUIREMENTS

- A. Weather:
 - 1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.
 - 2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
 - 3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
 - 4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
 - 5. Wind: Do not spray coatings if wind velocity is above manufacturer's limit.
- B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.
- C. Dust and Contaminants:
 - 1. Schedule coating work to avoid excessive dust and airborne contaminants.
 - 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing
 - 3. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.
- D. Maintain interior temperature and relative humidity of space, as recommended by coating manufacturer, 24 hours before applying and until coating is cured.
- E. Do not paint when temperature of metal to be painted is above 120°F.
- F. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.

3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated

3.3 SURFACE PREPARATION OF STEEL

- A. Prepare steel surfaces in accordance with paint manufacturer's instructions.
- B. Fabrication Defects:
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Immersion or Below Grade Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2. Create a surface profile as required by the coating manufacturer.
- E. Exterior Exposed or Interior Exposed Surfaces: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. Create a surface profile mils as required by the coating manufacturer.
- F. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours. Do not touch blasted surface with bare hands. Do not abrasive blast or prepare more

surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day.

- G. For carbon steel surfaces, after abrasive blast cleaning, verify the surface profile by measuring with an impresser tape acceptable to the Owner's Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner's Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner's Representative.
- H. Shop Primer: Shop primed steel shall receive a field sweep blast prior to the application of subsequent coats. Prepare shop primer to receive field coat in accordance with manufacturer's instructions. Removal all unknown shop primers and re-prime in accordance with this specification.

3.4 SURFACE PREPARATION OF GALVANIZED STEEL AND NONFERROUS METAL

- A. Prepare galvanized steel and nonferrous metal surfaces in accordance with SSPC-SP 16 and the coating manufacturer's instructions.
- B. Test galvanized surfaces for chromate treatments and remove as required by SSPC-SP 16, or other Engineer approved method.
- C. Ensure surfaces are dry.

3.5 SURFACE PREPARATION OF DUCTILE OR CAST IRON

- A. Prepare ductile or cast iron surfaces in accordance with NAPF 500-03-04 Abrasive Blast Cleaning with the exception that ALL rust and mold coating be removed. Only tightly adhered annealing oxide may remain.
- B. Bituminous coated pipe shall NOT be allowed if field painting is required.
- C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- D. Painting contractor shall install a 360 degree bead of caulk. Prior to painting, in the void between mating flange faces and in the void between any pipe and the thread-on flange. The bead caulk shall prevent exterior water from penetrating into the described void and leaving rust streaks.
- E. Caulk shall be a paintable, high grade flexible polysulfide joint sealant as manufactured by Polyspec or equal

3.6 SURFACE PREPARATION OF CONCRETE

- A. Interior, Wet Substrate:
 - 1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 - 2. Allow concrete to cure for a minimum of 28 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.
 - 4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
 - 5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
 - 6. Fill holes, pits, voids, and cracks with manufacturer approved surfacer.
 - 7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.
- B. Exterior and Interior Dry:
 - 1. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
 - 2. Allow concrete to cure for a minimum of 28 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.
 - 4. Level concrete protrusions and mortar spatter.

5. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.
6. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with manufacturer's instructions.
7. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with manufacturer's instructions.
8. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

3.7 SURFACE PREPARATION OF CONCRETE FLOORS

- A. Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 310.2.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow concrete to cure for a minimum of 28 days before coating.
- D. Test concrete for moisture in accordance with ASTM D 4263 and, if necessary, F 1869.
- E. Verify that the pH of the cleaned concrete surfaces to be coated is within the range of to 8 to 11. Application of coating materials outside this range will not be permitted without written approval from the Engineer.

3.8 SURFACE PREPARATION OF WOOD

- A. Prepare wood surfaces in accordance with manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.
- C. Seal knots and pitch pockets.
- D. Sand rough spots with the grain.
- E. Fill cracks and holes with approved materials after primer is dry. Sand flush with surface when filler is hard.
- F. Lightly sand between coats.

3.9 Procedures for Items Having Shop-Applied Prime Coats

- A. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
- B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.10 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Rinse scrubbed surfaces with clean water.

- C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
- E. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- F. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- G. Surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.
- H. Review other Specification Sections in which primers are shop applied to assure compatibility of the total coating system. On request, furnish information on characteristics of intermediate and finish coating materials to assure compatibility with primers. Notify the Owners Representative of anticipated problems using the materials specified over substrates primed by others.

3.11 Procedures for the Application of Coatings

- A. Apply coatings in accordance with manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions. Only full kits shall be mixed, unless properly measured using graduated measuring devices. Only mix coatings in areas designated for that purpose by the Owner's Representative.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer. Apply an additional stripe coat of the intermediate coating material in immersion areas.
- I. Roll or backroll the first coat of epoxy or block filler applied to concrete or interior block substrates to work the material into the substrate

3.12 Surfaces Not To Be Coated

- A. Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:
- B. Prefinished items not to be painted include, but are not limited to, the following factory-finished components, unless noted otherwise:
 1. Architectural woodwork and casework
 2. Shop finished water treatment process, mechanical, and electrical equipment
 3. Light fixtures
 4. Switchgear
 5. Distribution cabinets
 6. Metal Building Wall and Roof Panels
 7. FRP Pipe Supports, Hangers, and grating

- C. Finished metal surfaces not to be painted include, but are not limited to, the following, unless noted otherwise:
 - 1. Aluminum
 - 2. Stainless steel and stainless steel piping, except for color coding
 - 3. Chromium plated
 - 4. Copper pipe, except for color coding
 - 5. Submerged brass and copper.
- D. Interior and exterior galvanized metal surfaces shall not be painted, unless noted otherwise in the paint schedule or on the plans.
- E. Operating parts not to be painted include moving parts of operating equipment, such as the following:
 - 1. Valve and damper operators
 - 2. Linkage
 - 3. Sensing devices
 - 4. Motor and fan shafts
- F. Labels
 - 1. Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- G. Concrete and masonry surfaces unless noted to be painted on Paint Finish Schedule.
- H. Shop primed steel joists if not exposed to view upon completion of construction.
- I. Miscellaneous Items
 - 1. Fencing
 - 2. Concrete reinforcement steel
 - 3. Buried piping unless specifically noted otherwise
 - 4. Exposed electrical conduit.
 - 5. Glass
 - 6. Roofing
 - 7. Metal letters
 - 8. Grease fittings
- J. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.13 Surfaces To Be Coated

- A. Coat surfaces with the specific coating systems as described below:
 - 1. Coat mechanical equipment, such as pumps, as described in the various mechanical equipment specifications. Color of finish coat shall match the color of the connecting piping.
 - 2. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications.
 - 3. Coat valves as described in the various valve specifications. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
 - 4. Coat aluminum surfaces in contact with concrete per System No. 11.
 - 5. Field applied epoxy coatings for patching and touch-up of fusion-bonded epoxy lining and coatings shall meet the requirements of Specification Section 09961.

3.14 FIELD QUALITY CONTROL

- A. Required Inspections and Documentation:
 - 1. Verify coatings and other materials are as specified.
 - 2. Verify environmental conditions are as specified.

3. Verify surface preparation and application are as specified.
4. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA2.
5. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - a. Check for holidays on interior steel immersion surfaces using holiday detector in accordance with NACE SP0188 or SSPC TU-11 using a safe blue light inspection lamps if OAP technology is used.
6. Report:
 - a. Prepare inspection reports daily.
 - b. Submit written reports describing inspections made and actions taken to correct nonconforming work.
 - c. Report nonconforming work not corrected.
 - d. Submit copies of report to Engineer and Contractor.
7. Perform tests in the presence of the Owner's Representative when available. The Owner's Representative may perform independent testing of coating systems, including wet film, dry film, holiday, surface profile, or testing of paint products as deemed necessary.
8. Manufacturer's Field Services: Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems

3.15 Repair of Improperly Coated Surfaces

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or mechanically abrade visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.16 Cleaning

- A. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
- B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
- C. Upon completion of painting work, remove masking tape, tarps, and other protective materials. Clean glass and paint spattered surfaces. Remove spattered paint by washing and scaping. Use care not to scratch or damage finished surfaces.
- D. All glass that is scratched or damaged by the painter's work or while cleaning off the paint from the glass shall be replaced.
- E. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.

END OF SECTION

**PAINT SYSTEMS SCHEDULE
(Utilizing Themec Paints)**

System No.	Description	Surface Preparation	Prime Coat		Intermediate Coat		Final Coat	
			Series	Min. DFT	Series	Min. DFT	Series	Min. DFT
1	Exterior Metal - Architectural	SSPC SP3	10	2.0 to 4.0	1029	2.0 to 3.0	1029	2.0 to 3.0
2	Exterior Metal - Corrosive	SSPC SP6; See Note 3	90-97	2.0 to 4.0	N69	3.5 to 4.5	73	2.0 to 3.0
3	Exterior Galv. Metal	SSPC SP1 & brush blast	N69	3.5 to 4.5	---	---	73	2.0 to 3.0
4	Exterior Concrete	14 day cure & clean and dry	156	4.0 to 8.0	---	---	156	4.0 to 8.0
5	Exterior Burried Concrete	14 day cure & clean and dry	46-413	8.0 to 12.0	---	---	46-413	8.0 to 12.0
6	Exterior Masonry	14 day cure & clean and dry	156	60 to 80 ft2/gal	---	---	156	80 to 100 ft2/gal
7	Exterior Wood	sand & no residues	10	2.5 to 3.5	1029	2.0 to 3.0	1029	2.0 to 3.0
8	Exterior Pipe and Equipment	SSPC SP6; See Note 2 for DIP	N69	3.0 to 5.0	N69	4.0 to 6.0	73	4.0 to 6.0
9	Exterior PVC and FRP	Lightly Abrade	27	2.0 to 3.0	---	---	73	2.0 to 3.0
10	Buried Metal	SSPC SP6; See Note 3	46H-413	16.0 to 20.0	---	---	---	---
11	Aluminum in Contact with Concrete	SSPC SP6	46H-413	16.0 to 20.0	---	---	---	---
12	Submerged Metal - Potable	SSPC SP10	N140	3.0 to 5.0	N140	4.0 to 6.0	N140	4.0 to 6.0
13	Submerged Metal - Nonpotable	SSPC SP10	N69	3.0 to 5.0	N69	4.0 to 6.0	N69	4.0 to 6.0
14	Submerged Concrete - Potable	28 day cure & brush blast	N140	4.0 to 6.0	N140	4.0 to 6.0	N140	4.0 to 6.0
15	Submerged Concrete - Nonpotable	28 day cure & brush blast	N69	4.0 to 6.0	N69	4.0 to 6.0	N69	4.0 to 6.0
16	Metal High Temp	SSPC SP10	1501	2.0 to 3.0	---	---	1552	2.0 to 3.0
17	Interior Metal - Architectural	SSPC SP3	10	2.0 to 4.0	1029	2.0 to 3.0	1029	2.0 to 3.0
18	Interior Metal - Corrosive	SSPC SP6	N69	2.0 to 3.0	N69	3.0 to 5.0	N69	3.0 to 5.0
19	Interior Galv. Metal	SSPC SP6	27	4.0 to 6.0	---	---	73	2.0 to 3.0
20	Interior Concrete - Architectural	28 day cure & brush blast	104	60 to 80 ft2/gal	---	---	104	80 to 100 ft2/gal
21	Interior Concrete - Corrosive	28 day cure & brush blast	104	60 to 80 ft2/gal	---	---	104	80 to 100 ft2/gal
22	Concrete Floor Painted	28 day cure & brush blast	201	6.0 to 8.0	280	8.0 to 10.0	248	2.0 to 3.0
23	Concrete Floor Clear Sealer	28 day cure & brush blast	201	10.0 to 12.0	---	---	---	---
24	Interior Masonry - Architectural	28 day cure	130	60 to 80 ft2/gal	1029	2.0 to 3.0	1029	2.0 to 3.0
25	Interior Masonry - Corrosive	28 day cure	104	60 to 80 ft2/gal	---	---	104	80 to 100 ft2/gal
26	Interior Wood	sand & no residues	10	2.0 to 3.0	1029	2.0 to 3.0	1029	2.0 to 3.0
27	Interior Gypsum Drywall	See Spec. 09260	151	1.0 to 2.0	113	2.0 to 3.0	113	2.0 to 3.0
28	Sound Absorption Panels	No residues	2H	1.5 to 3.0	---	---	2H	1.5 to 3.0
29	Interior Pipe and Equipment, See Note 1	SSPC SP6; See Note 2 for DIP	27	3.0 to 5.0	N69	4.0 to 6.0	N69	4.0 to 6.0
30	Interior PVC and FRP	Lightly Abrade	27	2.0 to 3.0	---	---	N69	2.0 to 3.0
31	Electrical Conduit Runs, Metallic Tubing	SSPC SP6	37H	2.0 to 3.5	Match	Wall	Match	Wall
32	Cotton/Canvas on Pipe Insulation	---	1029	1.5 to 2.0	---	---	1029	1.5 to 2.0
33	Submerged Metal - Zinc Primer	SSPC SP10	91-H2O	2.5 to 3.5	N140	4.0 to 6.0	N140	4.0 to 6.0
34	Metal Corrosive - Zinc Primer	SSPC SP6	91-H2O	2.5 to 3.5	N69	3.0 to 5.0	N69	3.0 to 5.0
35	Interior Gypsum Drywall - Epoxy	See Spec. 09255	151-1051	0.7 to 1.5	113	4.0 to 5.0	113	4.0 to 5.0
36	Exterior Metal - Architectural, Epoxy	SSPC SP6	27	4.0 to 6.0	---	---	73	2.0 to 3.0
37	Interior Metal - Architectural, Epoxy	SSPC SP6	27	4.0 to 6.0	---	---	73	2.0 to 3.0

Notes:

All paint systems may not be used on this project.

1 Unless otherwise specified.

2 Surface prep. shall be in compliance with Themec Technical Bulletin No. 07-52. If surface profile is less than 1.5 mils then brush-off blast clean, if surface profile is more than 1.5 mils then hand or power tool clean.

3 SSPC SP10 for immersion service.

SECTION 099761
FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100 percent solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves and flexible pipe couplings.

1.2 SUMMARY

- A. Related Sections
 1. Section 099000 "Painting and Coating".
 2. Section 400722 "Flexible Pipe Couplings and Expansion Joints."
 3. Section 400762 "Wall Pipe, Seep Rings, and Penetrations"
 4. Section 402040 "Ductile Iron Process Pipe."
- B. Section 400561 "Gate Valves."
- C. Flexible Pipe Couplings and Expansion Joints: 400722.
- D. Wall Flanges, Seep Rings, and Penetrations: 400762.
- E. Pipe Hangers and Supports: 400764.
- F. Ductile Iron Process Pipe: 402040.

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.
- C. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 PRODUCTS

2.1 Piping and Equipment Surfaces

- A. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.
- B. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

2.2 Shop-Applied Epoxy Lining and Coating

- A. Lining and coating shall be a 100 percent solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red," H. B. Fuller 1F-3003, or equal. Epoxy lining and coating shall meet or exceed the following requirements:
 1. Hardness (minimum): Barcol 17 (ASTM D2583); Rockwell 50 ("M" scale).
 2. Abrasion resistance (maximum value): 1,000 cycles-0.05 gram removed; 5,000 cycles-0.115 gram removed; ASTM D1044, Tabor CS 17 wheel, 1,000 gram weight.
 3. Adhesion (minimum): 3,000 psi (Elcometer).
 4. Tensile strength: 7,300 psi (ASTM D2370).
 5. Penetration: 0 mil (ASTM G17).
 6. Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line: 4,300 psi (ASTM D1002).
 7. Impact (minimum value): 100 inch-pounds (Gardner 5/8-inch diameter tup).

2.3 Field-Applied Epoxy Coating for Patching

- A. Use a two-component, 80 percent solids liquid resin, such as Scotchkote 306.

2.4 Painting and Coating of Grooved-End and Flexible Pipe Couplings

- A. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 EXECUTION

3.1 Shop Application of Fusion-Bonded Epoxy Lining and Coating--General

- A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.
- B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
- C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5 degrees F above the dew point temperature during blast cleaning and inspection.
- D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.
- E. After cleaning and surface preparation, test the surface for residual chloride concentration. If the residual chloride concentration exceeds 5 micro grams per square centimeter, then apply a phosphoric acid wash to the surface after sandblasting. Apply a phosphoric acid wash to the pipe, item, or piece of equipment after sandblasting. The average temperature, measured in three different locations, shall be 80 degrees F to 130 degrees F during the acid wash procedure. The acid wash shall be a 5 percent by weight phosphoric acid solution. After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos per centimeter at a minimum nozzle pressure of 2,500 psi. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:
 - 1. Surface temperature 80 degrees F: 52 second contact time.
 - 2. Surface temperature 85 degrees F: 45 second contact time.
 - 3. Surface temperature 90 degrees F: 36 second contact time.
 - 4. Surface temperature 95 degrees F: 33 second contact time.
 - 5. Surface temperature 100 degrees F: 28 second contact time.
 - 6. Surface temperature 105 degrees F: 24 second contact time.
 - 7. Surface temperature 110 degrees F: 21 second contact time.
 - 8. Surface temperature 130 degrees F: 10 second contact time.
- F. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.2 Shop Application of Fusion-Bonded Epoxy Lining and Coating to Pipe--Additional Requirements

- A. Apply lining and coating per AWWA C213 except as modified herein.
- B. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.3 Shop Application of Fusion-Bonded Epoxy Lining and Coating to Joint Areas of Ductile-Iron and Cast-Iron Fittings--Additional Requirements

- A. Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

3.4 Quality of Lining and Coating Applications

- A. The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.5 Factory Testing of Coating--General

- A. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.
- B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

3.6 Factory Testing of Lining and Coating of Pipe--Additional Requirements

- A. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

3.7 Field Repairs

- A. Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80 percent solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply a two-part epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

SECTION 260010
SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
1. A: Ampere, unit of electrical current.
 2. AC or ac: Alternating current.
 3. AIC: Ampere interrupting capacity.
 4. ATS: Automatic transfer switch.
 5. AWG: American wire gauge; see ASTM B258.
 6. BAS: Building automation system.
 7. BIL: Basic impulse insulation level.
 8. BIM: Building information modeling.
 9. CB: Circuit breaker.
 10. CO/ALR: Copper-aluminum, revised.
 11. COPS: Critical operations power system.
 12. CU or Cu: Copper.
 13. CU-AL or AL-CU: Copper-aluminum.
 14. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
 15. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
 16. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
 17. dBm: Decibel absolute power with respect to 1 mW.
 18. DC or dc: Direct current.
 19. EGC: Equipment grounding conductor.
 20. EMF: Electromotive force.
 21. EMI: Electromagnetic interference.
 22. EPM: Electrical preventive maintenance.
 23. EPS: Emergency power supply.
 24. EPSS: Emergency power supply system.
 25. fc: Footcandle, a unit of illuminance equal to one lumen per square foot.
 26. FLC: Full-load current.
 27. ft.: Foot.
 28. GEC: Grounding electrode conductor.
 29. GFCI: Ground-fault circuit interrupter.
 30. GFPE: Ground-fault protection of equipment.
 31. GND: Ground.
 32. HACR: Heating, air conditioning, and refrigeration.
 33. HDPE: High-density polyethylene.
 34. HID: High-intensity discharge.
 35. HP or hp: Horsepower.
 36. HVAC: Heating, ventilating, and air conditioning.
 37. Hz: Hertz.
 38. IBT: Intersystem bonding termination.
 39. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
 40. IS: Intrinsically safe.
 41. ITE: Information technology equipment.
 42. kAIC: Kiloampere interrupting capacity.
 43. kcmil or MCM: One thousand circular mils.
 44. kV: Kilovolt.

45. kVA: Kilovolt-ampere.
46. kVA_r or kVAR: Kilovolt-ampere reactive.
47. kW: Kilowatt.
48. kWh: Kilowatt-hour.
49. lb: Pound (weight).
50. LCD: Liquid-crystal display.
51. LED: Light-emitting diode.
52. LRC: Locked-rotor current.
53. MCC: Motor-control center.
54. MG set: Motor-generator set.
55. MLO: Main lugs only.
56. mW: Milliwatt.
57. NC: Normally closed.
58. NiCd: Nickel cadmium.
59. NO: Normally open.
60. OCPD: Overcurrent protective device.
61. PF or pf: Power factor.
62. PoE: Power over Ethernet.
63. PVC: Polyvinyl chloride.
64. RFI: Radio-frequency interference (electrical); Request for interpretation (contract).
65. RMS or rms: Root-mean-square.
66. RPM or rpm: Revolutions per minute.
67. SCADA: Supervisory control and data acquisition.
68. SCR: Silicon-controlled rectifier.
69. SPD: Surge protective device.
70. sq.: Square.
71. SWD: Switching duty.
72. TEFC: Totally enclosed fan-cooled.
73. TR: Tamper resistant.
74. TVSS: Transient voltage surge suppressor.
75. UL: Underwriters Laboratories, Inc. (standards) or UL LLC (services).
76. UL CCN: UL Category Control Number.
77. UPS: Uninterruptible power supply.
78. UV: Ultraviolet.
79. V: Volt, unit of electromotive force.
80. V(ac): Volt, alternating current.
81. V(dc): Volt, direct current.
82. VA: Volt-ampere, unit of complex electrical power.
83. VA_r: Volt-ampere reactive, unit of reactive electrical power.
84. VFC: Variable-frequency controller.
85. VOM: Volt-ohm-multimeter.
86. W: Watt, unit of real electrical power.
87. Wh: Watt-hour, unit of electrical energy usage.
88. WPT: Wireless power transfer.
89. WPTe: Wireless power transfer equipment.
90. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.

6. EPEC: Electrical HDPE underground conduit.
 7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
 8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
 9. EPEC-A: Type A electrical HDPE underground conduit.
 10. EPEC-B: Type B electrical HDPE underground conduit.
 11. ERMC: Electrical rigid metal conduit.
 12. ERMC-A: Aluminum electrical rigid metal conduit.
 13. ERMC-S: Steel electrical rigid metal conduit.
 14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
 15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
 16. ERMC-SS: Stainless steel electrical rigid metal conduit.
 17. FMC: Flexible metal conduit.
 18. FMC-A: Aluminum flexible metal conduit.
 19. FMC-S: Steel flexible metal conduit.
 20. FMT: Steel flexible metallic tubing.
 21. FNMC: Flexible nonmetallic conduit. See LFNC.
 22. HDPE: See EPEC.
 23. IMC: Steel electrical intermediate metal conduit.
 24. LFMC: Liquidtight flexible metal conduit.
 25. LFMC-A: Aluminum liquidtight flexible metal conduit.
 26. LFMC-S: Steel liquidtight flexible metal conduit.
 27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
 28. LFNC: Liquidtight flexible nonmetallic conduit.
 29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
 30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
 31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
 32. PVC: Rigid PVC conduit.
 33. PVC-40: Schedule 40 rigid PVC conduit.
 34. PVC-80: Schedule 80 rigid PVC Conduit.
 35. PVC-A: Type A rigid PVC concrete-encased conduit.
 36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
 37. RGS: See ERMC-S-G.
 38. RMC: See ERMC.
 39. RTRC: Reinforced thermosetting resin conduit.
 40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
 41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.
- C. Definitions:
1. Basic Impulse Insulation Level: Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
 2. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
 3. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
 4. Direct Buried: Installed underground without encasement in concrete or other protective material.

5. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - i. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - j. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - k. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - l. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - m. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
6. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
7. Essential Electrical Systems: Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system. (healthcare facilities)
8. Jacket: A continuous nonmetallic outer covering for conductors or cables.
9. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
10. Miniature 8-Position Series Jack (8PSJ): Also called an 8-position 8-contact (8P8C) modular jack. An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Shape and dimensions are specified by TIA-1096.
 - a. Caution: An 8PSJ is not the same thing as an FCC "registered jack" RJ45S, now called a miniature 8-position keyed jack (8PKJ). Ethernet cable plugs do not have rejection keys. Many manufacturers and suppliers incorrectly use "RJ45" as a generic

term to describe any 8-position series plug or jack whether it has a rejection key or not.

11. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
12. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
13. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
14. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
15. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
16. Sheath: A continuous metallic covering for conductors or cables.
17. UL Category Control Number: An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
18. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by Class 2 or Class 3 power supplies having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation, in contrast to control-voltage devices that require or contain transformer power supplies. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Low Voltage: Listed and labeled for use in circuits supplied by Class 1 or other power supplies having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.
 - d. Medium Voltage: Listed and labeled for use in circuits supplied by a power supply having rated output greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Parts I and II.

1.2 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
- B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.3 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
 1. Electrical installation schedule.
 2. Value analysis proposals and requests for substitution of electrical equipment.
 3. Utility work coordination and class of service requests.
 4. Commissioning activities.

1.4 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.5 ACTION SUBMITTALS

- A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- B. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- C. Coordination Drawings for Large Equipment Outdoor Installations:
 - 1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
 - b. Indicate clear dimensions for fence gates and wall openings.
 - c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
 - d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
 - e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways.
 - f. Dimensioned working clearances and dedicated areas around electrical equipment.

1.6 CLOSEOUT SUBMITTALS

- A. Facility EPM Program Binders:
 - 1. Complete Set: On approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
 - 2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb, acid-free, bond paper.
- B. Operation and Maintenance Data:
 - 1. Provide emergency, operation, and maintenance manuals for each system, equipment, and device listed below:
 - a. Generator and Transfer Switch.
 - 2. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
 - f. List of load-current and overload-relay heaters with related motor nameplate data.
 - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.
 - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
 - 1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
 - 2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
 - 3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

- A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.
- B. Applicable Standards:
 - 1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
 - 2. General Characteristics:
 - a. Volume 1 - Introduction:
 - 1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
 - 2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
 - 3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
 - b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
 - 1) Include training requirements for employees and contractors.
 - 2) Include list of known facility hazards impacting IT&R activities.
 - 3) Include approval and permitting procedures for IT&R activities.
 - 4) Include incident emergency response procedures.
 - 5) Include emergency shutdown procedures.
 - 6) Include electrical disaster recovery procedures.
 - c. Volume 3 - Operating Procedures for Electrical Equipment and Controls:
 - 1) [Generator, ATS.
 - d. Volume 4 - Facility Diagrams and Schedules:
 - 1) Include single-line diagrams.
 - 2) Include grounding and bonding diagrams.
 - 3) Include essential wiring diagrams.
 - 4) Include system automation diagrams (SCADA, BMS, lighting, HVAC, etc.).
 - 5) Include records of switchgear, switchboard, and panelboard schedules.
 - 6) Include time-current curves for overcurrent protective devices.
 - 7) Include list of load-current and overload-relay heaters with related motor nameplate data.
 - e. Volume 5 - Inventory of Facility Equipment Using Electrical Power:
 - 1) Include simplified floor plans showing equipment locations.
 - 2) Identify critical equipment (electrical or otherwise).
 - 3) Include identifying designations and nameplate data.
 - 4) Include warranty and maintenance contract information.

- f. Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
 - 1) Include schedules of maintenance material items recommended to be stored at facility.
 - 2) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
 - 3) Include calibration and servicing data for each item.
- g. Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
 - 1) Include tables showing frequency of activities for each item.
 - 2) Include annual schedule with activities mapped to specific days of the year.
 - 3) Include exterior pole inspection and repair procedures.
- h. Volume 10 - Spare Parts List:
 - 1) Include list of all parts required to perform IT&R procedures.
 - 2) Identify quantities of which parts are recommended to be stored on-site.
 - 3) Include source contact information and budget cost for each item.
- i. Volume 11 - Construction Project Closeout Record Documentation:
 - 1) Include records of power system studies and photometric studies.
 - 2) Include records of risk assessment studies.
 - 3) Include records of electrical system startup and commissioning activities.
 - 4) Include records of baseline inspections and tests.
 - 5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
 - 6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

- A. Facility EPM Program must be developed by qualified EPM specialist.
- B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - 1. Renovation Projects:
 - a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
- C. Compile operation and maintenance data from Facility EPM Program analysis and submit Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.3 SYSTEM STARTUP

- A. Commissioning Activities:
 - 1. Generator and ATS startup.

3.4 FIELD QUALITY CONTROL

- A. Administrator for Low-Voltage Electrical Tests and Inspections:

1. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
3. Administer and perform tests and inspections.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration:

1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel how to operate the following systems and equipment:
 - a. Generator and Transfer Switch.

END OF SECTION

SECTION 260510
COMMON MOTOR REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

1.3 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 2. Motor winding failure.
 3. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Manufacturers:
 1. US Motor
 2. General Electric Company
 3. Westinghouse
 4. Approved Equal.
- C. Efficiency: Premium efficient, as defined in NEMA MG 1.
- D. Service Factor: 1.15.
- E. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
- F. Multispeed Motors: Separate winding for each speed.
- G. Rotor: Random-wound, squirrel cage.
- H. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

- I. Temperature Rise: Class B.
- J. Insulation: Class F.
- K. Peak Voltage Rating of stator wiring to be a minimum of 2,200 volts.
- L. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- M. Enclosure Material: Cast iron frame and end bells.
- N. Thermal Protection: Comply with NEMA MG 1.
- O. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
- P. Provide shaft grounding (diverter) ring on drive end of all vertical motors.
- Q. Provide shaft grounding (diverter) ring on drive end and insulated bearing on the non-drive end of all motors 25 hp and larger controlled by variable-frequency motor controllers.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.2 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire Company
 - 2. American Bare Conductor
 - 3. Belden Inc
 - 4. Cerro Wire LLC
 - 5. Encore Wire Corporation
 - 6. General Cable; Prysmian Group North America
 - 7. Okonite Company (The)
 - 8. Service Wire Co.
 - 9. Southwire Company
 - 10. WESCO
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with for stranded conductors.
- E. Conductor Insulation:
 - 1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Electrical Products
 - 2. ABB, Electrification Products Division
 - 3. AFC Cable Systems; Atkore International
 - 4. Gardner Bender
 - 5. Hubbell Incorporated, Power Systems
 - 6. Ideal Industries, Inc.
 - 7. ILSCO
 - 8. NSi Industries LLC
 - 9. O-Z/Gedney; Emerson Elect Co., Automation Solutions, Appleton Group

10. Service Wire Co.
 11. Shawcor
 12. TE Connectivity Ltd.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
 2. Type: One hole with standard barrels.
 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

- A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260523

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M
 - 2. AMP NETCONNECT; a TE Connectivity Ltd. Company
 - 3. Belden Inc
 - 4. Berk-Tek Leviton; a Nexans/Leviton Alliance
 - 5. CommScope, Inc.
 - 6. General Cable; Prysmian Group North America
 - 7. Hitachi Cable America Inc.
 - 8. Mohawk; a division of Belden Networking, Inc.
 - 9. Superior Essex Inc.
 - 10. SYSTIMAX Solutions; a CommScope Inc. Brand
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Conductors: 100 ohm, No. 23 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Riser.
- G. Jacket: White thermoplastic.

2.2 CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1685.

2.3 CONTROL-CIRCUIT CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Encore Wire Corporation
 - 2. General Cable; Prysmian Group North America
 - 3. Service Wire Co.
 - 4. Southwire Company
- B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
- C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

2.4 SOURCE QUALITY CONTROL

- A. Factory test twisted pair cables according to TIA-568-C.2.

- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes must be no smaller than 2 inch wide, 3 inch high, and 2-1/2 inch deep.
 - 2. Outlet boxes for cables must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit must not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 - 11. Support: Do not allow cables to lie on removable ceiling tiles.
 - 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 - 13. Provide strain relief.
 - 14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 - 15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

- C. Installation of Control-Circuit Conductors:
 1. Install wiring in raceways.
 2. Use insulated spade lugs for wire and cable connection to screw terminals.
 3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Separation from EMI Sources:
 1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch.

3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 1. Class 1 remote-control and signal circuits; No 14 AWG.
 2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.

3.5 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.2 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Ground rods.
 - 2) Grounding arrangements and connections for separately derived systems.
 - b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
 - 1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB Electrification Products Division
 - 2. Advanced Lightning Technology, Ltd.
 - 3. Burndy; Hubbell Incorporated, Construction and Energy
 - 4. Dossert; AFL Telecommunications LLC
 - 5. ERICO; nVent
 - 6. Fushi Copperweld Inc.
 - 7. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 8. Hargar Lightning & Grounding
 - 9. ILSCO
 - 10. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - 11. Robbins Lightning, Inc.
 - 12. Siemens Industry, Inc., Energy Management Division

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Mechanical-Type Bus-Bar Connectors: Cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Conduit Hubs: Mechanical type, terminal with threaded hub.
- G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with socket set screw.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- J. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.
- K. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- L. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 ft..
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inch below grade.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inch from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.

3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Grounding for Steel Structure: Install a driven ground rod at base of each corner.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and

key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

- B. Grounding system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Substations and Pad-Mounted Equipment: 5 ohms.
- E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
 - 1. Hangers. Include product data for components.
 - 2. Slotted support systems.
 - 3. Equipment supports.
 - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit; Atkore International
 - c. B-line; Eaton, Electrical Sector
 - d. CADDY; nVent
 - e. Flex-Strut Inc.
 - f. Gripple Inc.
 - g. G-Strut
 - h. Haydon Corporation
 - i. Metal Ties Innovation
 - j. MIRO Industries
 - k. Unistrut; Atkore International
 - l. Wesanco, Inc.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316
 4. Channel Width: 1-5/8 inch.
 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) B-line; Eaton, Electrical Sector
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 6. Toggle Bolts: Stainless steel springhead type.
 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA NEIS 101
 2. NECA NEIS 102.

3. NECA NEIS 105.
 4. NECA NEIS 111.
- B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
 - C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.
 - D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, ERMC may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions:
 - 1. For Type ERMC-S-PVC.

PART 2 - PRODUCTS

2.1 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Bluesteel Services LLC
 - c. Calbond; Atkore International
 - d. KorKap; Robroy Industries
 - e. Perma-Cote; Robroy Industries
 - f. Plasti-Bond; Robroy Industries
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 6 and UL Category Control Number DYIX.
 - 2) Exterior Coating: PVC complying with NEMA RN 1.
 - 3) Interior Coating: Zinc.
 - 4) Fittings for PVC-Coated Conduit:
 - (a) Minimum coating thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
 - (b) Conduit bodies must be Form 8 with an effective seal and a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.
 - (c) Form 2 inch long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
 - (d) PVC coating on the outside of conduit couplings must be protected from tool damage during installation.
 - (e) Female threads on fittings and couplings must be protected by urethane coating.
 - (f) Fittings must be from same manufacturer as conduit.
 - (g) Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover the exposed portions of threads.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - 3) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.2 TYPE LFMC RACEWAYS

- A. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB Electrification Products Division
 - b. Anaconda Sealtite; Anamet Electrical, Inc
 - c. Electri-Flex Company
 - d. International Metal Hose Co
2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standard: UL 360 and UL Category Control Number DXHR.
 - 2) Material: Steel.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

2.3 TYPE PVC RACEWAYS AND FITTINGS

- A. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Calconduit; Atkore International
 - c. JM Eagle; J-M Manufacturing Co., Inc.
 - d. NAPCO; Westlake Chemical Corp
 - e. Opti-Com Manufacturing Network, Inc (OMNI)
 - f. Topaz Lighting & Electric
 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 651 and UL Category Control Number DZYR.
 - 2) Dimensional Specifications: Schedule 40.
 - c. Options:
 - 1) Minimum Trade Size: 3/4 inch.
 - 2) Markings: For use with maximum 90 deg C wire.

2.4 FITTINGS FOR CONDUIT, TUBING, AND CABLE

- A. Fittings for Type ERM, Type PVC, and Type EPEC, Raceways:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Crouse-Hinds; Eaton, Electrical Sector
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - d. Konkore Fittings; Atkore International
 - e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial
 - g. Southwire Company
 - h. Topaz Lighting & Electric
 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DWTT.
 - 2) Material: Steel.
 - 3) Coupling Method: Compression coupling.

- c. Options:
 - 1) Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
 - 2) Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.
- B. Fittings for Type LFMC Raceways:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Liquid Tight Connector Co
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514B and UL Category Control Number DXAS.

2.5 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division
- B. Applicable Standards:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and approved by authorities having jurisdiction for application to threaded conduit assemblies.
 - 2. General Characteristics:
 - a. Reference Standards: UL 2419 and UL Category Control Number FOIZ.

2.6 SOLVENT CEMENTS

- A. Solvent Cements for Type PVC Raceways and Fittings:
 - 1. Applicable Standards:
 - a. General Characteristics:
 - 1) Reference Standards: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.

2.7 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Metallic Outlet Boxes:
 - 1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; Eaton, Electrical Sector
 - d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - e. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial
 - f. Killark; Hubbell Incorporated, Construction and Energy
 - g. MonoSystems, Inc.
 - h. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - i. Pass & Seymour; Legrand North America LLC
 - j. Plasti-Bond; Robroy Industries
 - k. Raco Taymac Bell
 - l. Spring City Electrical Manufacturing Company
 - m. Topaz Lighting & Electric
 - n. Wiremold; Legrand North America LLC
 - o. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial

3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Cast metal.
 - 2) Cast-Metal Depth: Minimum 1.8 inch.
- B. Metallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Crouse-Hinds; Eaton, Electrical Sector
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - d. Killark; Hubbell Incorporated, Construction and Energy
 - e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Pass & Seymour; Legrand North America LLC
 - g. Plasti-Bond; Robroy Industries
 - h. Raco Taymac Bell
 - i. Topaz Lighting & Electric
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
- C. Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Arlington Industries, Inc.
 - c. Crouse-Hinds; Eaton, Electrical Sector
 - d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - e. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial
 - f. Killark; Hubbell Incorporated, Construction and Energy
 - g. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - h. Plasti-Bond; Robroy Industries
 - i. Raco Taymac Bell
 - j. Topaz Lighting & Electric
 - k. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.
 - c. Options:
 - 1) Material: Cast metal.
 - 2) Cast-Metal Depth: minimum 2.4 inch.
- D. Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. B-line; Eaton, Electrical Sector
 - c. Crouse-Hinds; Eaton, Electrical Sector
 - d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - e. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Pass & Seymour; Legrand North America LLC
 - g. Raco Taymac Bell
 - h. Topaz Lighting & Electric
 - i. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514A and UL Category Control Number QCIT.

2.8 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Nonmetallic Outlet Boxes:
 1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit; Atkore International
 - c. Arlington Industries, Inc.
 - d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector
 - e. Cantex Inc.
 - f. Crouse-Hinds; Eaton, Electrical Sector
 - g. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - h. Ericson Manufacturing Company
 - i. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial
 - j. Intermatic, Inc.
 - k. JM Eagle; J-M Manufacturing Co., Inc
 - l. Leviton Manufacturing Co, Inc
 - m. Panduit Corp
 - n. Pass & Seymour; Legrand North America LLC
 - o. Raco Taymac Bell
 - p. Topaz Lighting & Electric
 - q. Wiremold; Legrand North America LLC
 - r. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514C and UL Category Control Number QCMZ.
- B. Nonmetallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit; Atkore International
 - c. Arlington Industries, Inc.
 - d. Cantex Inc.
 - e. JM Eagle; J-M Manufacturing Co., Inc
 - f. Raco Taymac Bell
 - g. Topaz Lighting & Electric
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514C and UL Category Control Number QCMZ.
- C. Nonmetallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit; Atkore International
 - c. Arlington Industries, Inc.
 - d. Cantex Inc.
 - e. Crouse-Hinds; Eaton, Electrical Sector
 - f. Pass & Seymour, Legrand North America LLC
 - g. Raco Taymac Bell
 - h. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514C and UL Category Control Number QCMZ.
- D. Nonmetallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit; Atkore International
 - c. Arlington Industries, Inc.
 - d. Arrow Hart, Wiring Devices, Eaton, Electrical Sector
 - e. Cantex Inc.
 - f. Raco Taymac Bell
 - g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514C and UL Category Control Number QCMZ.

2.9 TERMINATION BOXES

- A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.
- B. Termination Boxes and Termination Bases for Installation on Line Side of Service Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. B-line; Eaton, Electrical Sector
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - d. Erickson Electrical Equipment Company
 - e. Hoffman; nVent
 - f. Metron; Hubbell Incorporated, Commercial and Industrial
 - g. Milbank Manufacturing Co.
 - h. N J Sullivan Company
 - i. Square D; Schneider Electric USA
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 1773 and UL Category Control Number XCKT.
 - 2) Listed and labeled for installation on line side of service equipment.
- C. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. B-line; Eaton, Electrical Sector
 - c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - d. Erickson Electrical Equipment Company
 - e. Hoffman; nVent
 - f. Metron; Hubbell Incorporated, Commercial and Industrial
 - g. Milbank Manufacturing Co.
 - h. N J Sullivan Company
 - i. Square D; Schneider Electric USA
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 1773 and UL Category Control Number XCKT.
 - 2) Listed and labeled for installation on load side of service equipment.

2.10 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

- A. Outdoor Cast-Metal Junction and Pull Boxes:
 - 1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adalet
 - b. Crouse-Hinds; Eaton, Electrical Sector
 - c. EGS, Emerson Electric Co., Automation Solutions, Appleton Group
 - d. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group

3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - (a) Non-Environmental Characteristics: UL 50.
 - (b) Environmental Characteristics: UL 50E.
 - c. Options:
 - 1) Degree of Protection: Type 4X.
- B. Outdoor Polymeric Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit Atkore International
 - c. Cantex Inc.
 - d. JM Eagle; J-M Manufacturing Co., Inc.
 - e. Robroy Enclosures; Robroy Industries
 - f. Topaz Lighting & Electric
 - g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 3. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL Category Control Number BGUZ.
 - (a) Non-Environmental Characteristics: UL 50.
 - (b) Environmental Characteristics: UL 50E.
 - c. Options:
 - 1) Degree of Protection: Type 4X.

2.11 COVER PLATES FOR DEVICES BOXES

- A. Nonmetallic Cover Plates for Device Boxes:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Arlington Industries, Inc.
 - c. Arrow Hart, Wiring Devices; Eaton Electrical Sector
 - d. Crouse-Hinds; Eaton, Electrical Sector
 - e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial
 - g. Intermatic, Inc.
 - h. Leviton Manufacturing Co., Inc.
 - i. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group
 - j. Panduit Corp.
 - k. Pass & Seymour, Legrand North America LLC
 - l. Raco Taymac Bell
 - m. Topaz Lighting & Electric
 - n. Wiremold; Legrand North America LLC
 - o. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial
 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

- b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Wallplate-Securing Screws: Metal with head color to match wallplate finish.
- c. Options:
 - 1) Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - 2) Wallplate Material: 0.060 inch thick high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
 - 3) Color: Gray.

2.12 EXPLOSION PROOF/WATERTIGHT FLEXIBLE CONNECTIONS

- A. Description: Class 1, Division 1, braided stainless steel.
- B. Connections shall be Appleton EXGJH-SS, or equal.

2.13 HOODS FOR OUTLET BOXES

- A. Extra-Duty, While-in-Use Hoods for Outlet Boxes:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABB, Electrification Products Division
 - b. Allied Tube & Conduit: Atkore International
 - c. Arlington Industries, Inc.
 - d. Arrow Hart, Wiring Devices; Eaton Electrical Sector
 - e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group
 - f. Intermatic, Inc.
 - g. Leviton Manufacturing Co., Inc.
 - h. Raco Taymac Bell
 - 2. Applicable Standards:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
 - b. General Characteristics:
 - 1) Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
 - 2) Marked "Extra-Duty" in accordance with UL 514D.
 - 3) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
 - 4) Mounts to box using fasteners different from wiring device.
 - c. Options:
 - 1) Provides clear, weatherproof, "while-in-use" cover.
 - 2) Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

- A. Refer to Conduit & Boxes Schedule on plans.
- B. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.
- C. Outdoors:
 - 1. Exposed Conduit: PVC coated rigid steel conduit with matching gittings and boxes.
 - 2. Direct-Buried Conduit: PVC-40.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

3.2 SELECTION OF BOXES AND ENCLOSURES

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 1. Outdoors:
 - a. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

3.3 INSTALLATION OF RACEWAYS

- A. Installation Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
 2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
 4. Comply with NECA NEIS 101 for installation of steel raceways.
 5. Comply with NECA NEIS 102 for installation of aluminum raceways.
 6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
 7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch trade size and insulated throat metal bushings on 1-1/2 inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits
 9. Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits
- B. General Requirements for Installation of Raceways:
 1. Complete raceway installation before starting conductor installation.
 2. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
 3. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 4. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 5. Support conduit within 12 inch of enclosures to which attached.
 6. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
 7. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - b. Where an underground service raceway enters a building or structure.

- c. Conduit extending from interior to exterior of building.
 - d. Conduit extending into pressurized duct and equipment.
 - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - f. Where otherwise required by NFPA 70.
8. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
 9. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
 10. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
 11. Cut conduit perpendicular to the length. For conduits 2 inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 12. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- C. Requirements for Installation of Specific Raceway Types:
1. Type ERMC-S-PVC:
 - a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC raceway.
 - c. Coat field-cut threads on PVC-coated raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
 2. Types LFMC:
 - a. Comply with NEMA RV 3. Provide a maximum of 36 inch of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 3. Types PVC:
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's written instructions for solvent welding and fittings.
- D. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 2. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
- E. Expansion-Joint Fittings:
1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft.. Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft..
 2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF BOXES AND ENCLOSURES

- A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- C. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
- D. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

- A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend:
 - a. Indicate voltage and system or service type.
 - b. Panel of origin.
 - c. Equipment served.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.

- c. Phase C: Yellow.
- 5. Color for Neutral: White or gray.
- 6. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES ."
- E. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- thick, polyester flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels:
 - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. 4 by 6 inches for arc flash labels.
 - d. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
 - 1. Tape:

- a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
3. Tape :
- a. Pigmented polyolefin, bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Thickness: 4 mils.
 - d. Weight: 18.5 lb/1000 sq. ft.
 - e. Tensile according to ASTM D882: 30 lbf and 2500 psi.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 SIGNS

- A. Baked-Enamel Signs:
- 1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches.
- B. Metal-Backed Butyrate Signs:
- 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4-inch grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inches.
- C. Laminated Acrylic or Melamine Plastic Signs:
- 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in. , minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- L. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
- O. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- R. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- T. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
 2. Limit use of underground-line warning tape to direct-buried cables.
 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- V. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.
- W. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- G. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- J. Arc Flash Warning Labeling: Self-adhesive labels.
- K. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- L. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels:
 - 1. Outdoor Equipment: Laminated acrylic or melamine sign.
 - 2. Equipment to Be Labeled:
 - a. Panelboards:
 - 1) Cover Label:
 - (a) Equipment ID as scheduled.
 - 2) Interior Label Legend:
 - (a) Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - 1) Cover Label:
 - (a) Equipment ID.
 - c. Transformers: Equipment ID as scheduled.
 - d. Emergency system boxes and enclosures.
 - 1) Cover Label:
 - (a) Equipment ID.
 - e. Enclosed switches.
 - 1) Cover Label
 - (a) Equipment ID as scheduled.
 - (b) Equipment served.
 - 2) Interior Label Legend:
 - (a) Nameplate horsepower, if applicable.
 - (b) Full Load Amps, if applicable.
 - (c) Code Letter, if applicable.
 - (d) Service Factor, if applicable.
 - (e) Voltage Phase Rating.
 - f. Push-button stations.
 - 1) Cover Label:
 - (a) Equipment served.
 - g. Power transfer equipment.
 - 1) Cover Label:
 - (a) Equipment ID as scheduled.
 - h. Monitoring and control equipment.

END OF SECTION

SECTION 262200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers".

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme Electric Corporation.
 - 2. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Products.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Sola/Hevi-Duty.
 - 5. Square D Co./Groupe Schneider NA; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

- B. Cores: Grain-oriented, non-aging silicon steel.
- C. Coils: Continuous windings without splices except for taps.
 - 1. Internal Coil Connections: Brazed or pressure type.
 - 2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NEMA ST 20, and list and label as complying with UL 1561.
- B. Cores: One leg per phase.
- C. Enclosure: Ventilated, NEMA 250, Type 3R.
 - 1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
- D. Transformer Enclosure Finish: Comply with NEMA 250.
 - 1. Finish Color: Gray.
- E. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- F. Insulation Class: 428 deg F, UL-component-recognized insulation system with a maximum of 302 deg F rise above 104 deg F ambient temperature.
- G. Energy Efficiency for Transformers Rated 15 kVA and Larger:
 - 1. Complying with NEMA TP 1, Class 1 efficiency levels.
 - 2. Tested according to NEMA TP 2.
- H. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
- I. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.
 - 3. Shield Effectiveness:
 - a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
 - b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
 - c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.
- J. Fungus Proofing: Permanent fungicidal treatment for coil and core.
- K. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

- A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems".

2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.
- B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install rack-mounting transformers level and plumb with brackets fabricated by transformer manufacturer.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Remove and replace units that do not pass tests or inspections and retest as specified above.
- E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
 - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
 - 4. Detail bus configuration, current, and voltage ratings.
 - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 6. Include evidence of NRTL listing for SPD as installed in panelboard.
 - 7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 8. Include wiring diagrams for power, signal, and control wiring.
 - 9. Key interlock scheme drawing and sequence of operations.
 - 10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.8 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 - 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.
- D. Enclosures: Surface-mounted, dead-front cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 4X.
 - 2. Height: 84 inches maximum.
 - 3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
 - 4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
 - 5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 7. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Same finish as panels and trim.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- E. Incoming Mains:
1. Location: Convertible between top and bottom.
 2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- F. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- G. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
- H. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- I. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 10 percent.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc., Energy Management Division
 - 3. Square D; Schneider Electric USA
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: As Indicated.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc., Energy Management Division
 - 3. Square D; Schneider Electric USA
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: As Indicated.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc., Energy Management Division
 - 3. Square D; Schneider Electric USA
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

- g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:
 - 1. Attach panelboard to the uni-strut rack surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 72 inches above finished grade unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- I. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

- K. Install filler plates in unused spaces.
- L. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 262713
ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of meter.
 - 2. For metering infrastructure components.
 - 3. For metering software.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Include elevation views of front panels of control and indicating devices and control stations.
 - 2. Include diagrams for power, signal, and control wiring.
 - 3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Include series-combination rating data for modular meter centers with main disconnect device.
 - 5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.3 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Owner shall be notified and issued written permission no fewer than seven days in advance of proposed interruption of electrical service.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metering equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
 - 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.5 COORDINATION

- A. Electrical Service Connections:
 - 1. Coordinate with utility companies and utility-furnished components.
 - a. Comply with requirements of utility providing electrical power services.
 - b. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 916.

2.2 UTILITY METERING INFRASTRUCTURE

- A. Install metering accessories furnished by the utility company, complying with its requirements.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets:
 - 1. Comply with requirements of electrical-power utility company.
 - 2. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc., Energy Management Division
 - 3. Square D; Schneider Electric USA
 - 4. Comply with requirements of utility company for meter center.
 - a. Comply with UL 67.
 - 5. Housing: NEMA 250, Type 4X enclosure.
 - 6. Meter Socket Rating: Coordinated with connected feeder circuit rating.
 - 7. Minimum Short-Circuit Rating: As indicated, symmetrical at rated voltage.
 - 8. Steady-state and short-circuit current ratings shall have ratings that match connected circuit ratings.
 - 9. Main Disconnect Device: Fusible switch, UL 98 Type GD, series-combination rated by fuse manufacturer to protect downstream feeder and branch circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers." Switch shall be operable from outside the enclosure to disconnect the unit. Configure cover so that it can be opened only when the disconnect switch is open.
 - 10. Surge Protection at Main Disconnect: Field-mounted external to the device, UL 1449 Type 2, with integral disconnect and overcurrent protective device. Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
 - 11. Surge Protection at Main Terminal Box: Field-mounted external to the device, UL 1449 Type 2, with integral disconnect and overcurrent protective device. Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
- E. Arc-Flash Warning Labels;
 - 1. Labels: Comply with requirements for "Arc-Flash Warning Labels" in Section 260573.19 "Arc-Flash Studies." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
 - 2. Labels: Comply with requirements for "Self-Adhesive Equipment Labels" and "Signs" in Section 260553 "Identification for Electrical Systems." Apply a 3-1/2-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.

- 5) Incident energy.
- 6) Working distance.
- 7) Engineering report number, revision number, and issue date.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written instructions. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Electrical Contractor is responsible for getting new electrical service connected to the new site. Provide CT cabinet as required by utility.
- D. Electrical Contractor is responsible for contacting the Electrical Utility and getting all requirements for new electrical service to site including providing CT cabinet as required. Electrical contractor shall pay all fees associated with utility connection of new electrical service.
- E. Electrical Contractor is to comply with all electrical utility regulations and provide all conduit, trenching/backfill and connections as required by electrical utility.
- F. Electrical Contractor is to pay all fees associated with getting, installing and using temporary electrical service for construction.
- G. Install arc-flash labels as required by NFPA 70.
- H. Wiring Method:
 1. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 2. Minimum conduit size shall be 1/2 inch .

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
 2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide an additional card holder suitable for typewritten card with occupant's name.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
 5. Generate test report and billing for each tenant or activity from the meter reading tests.
- D. Electricity metering will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Electric Utility Contact Information

1. Contact Name: Brian Blackburn
2. Utility Company Name: Ameren Missouri
3. Phone Number: 573-473-2763
4. Email Address: BBlackburn@ameren.com

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's clerical and maintenance personnel to use, adjust, operate, and maintain the electronic metering and billing software.

END OF SECTION

SECTION 262726
WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
- C. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- D. Comply with NFPA 70.
- E. Comply with NEMA WD 1.
- F. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
 - 1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 - 2. Devices shall comply with requirements in this Section.
- G. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
- H. Wall Plate Color: For plastic covers, match device color.
- I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; VGF20.
 - b. Pass & Seymour; 2095.
- 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
- 3. Configuration: NEMA WD 6, Configuration 5-20R.
- 4. Type: Feed through.
- 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
- B. Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A :
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; WRSGF20
 - b. Hubbell; GFTWRST83
 - c. Legrand; 2097TRWR
 - d. Leviton; G5362-WT
 - 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 3. Configuration: NEMA WD 6, Configuration 5-15R.
 - 4. Type: Feed through.
 - 5. Standards: Comply with UL 498 and UL 943 Class A.
 - 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A :
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH1221.
 - b. Hubbell; HBL1221.
 - c. Leviton; 1221-2.
 - d. Pass & Seymour; CSB20AC1.
 - 2. Standards: Comply with UL 20 and FS W-S-896.

2.4 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.3 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 1. Test Instruments: Use instruments that comply with UL 1436.
 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 1. Line Voltage: Acceptable range is 105 to 132 V.
 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 5. Using the test plug, verify that the device and its outlet box are securely mounted.

- 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 262813

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
 5. Coordination charts and tables and related data.
 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in include the following:
 1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
 4. Coordination charts and tables and related data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Bussmann; Eaton, Electrical Sector.
 2. Littelfuse, Inc.
 3. Mersen USA

- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class RK1, time delay.
 - 2. Feeders: Class RK1, time delay.
 - 3. Motor Branch Circuits: Class RK1, time delay.
 - 4. Large Motor Branch (601-4000 A): Class L, time delay.
 - 5. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 6. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. Include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Fuse Pullers: Two for each size and type.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F .
 - 2. Altitude: Not exceeding 6600 feet .

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. Siemens Industry, Inc. Energy Management Division.
 - 3. Square D; Schneider Electric USA.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 7. Service-Rated Switches: Labeled for use as service equipment.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

- B. Enclosure Finish: The enclosure shall be a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Outdoor Locations: NEMA 250, Type 4X.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
- C. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - (a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - (a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
- D. Enclosed switches will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 262913
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. N.C.: Normally closed.
- E. N.O.: Normally open.
- F. OCPD: Overcurrent protective device.
- G. SCR: Silicon-controlled rectifier.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.
- B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
 - 1. Show tabulations of the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Nameplate legends.
 - d. Short-circuit current rating of integrated unit.
 - e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
 - f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
 - 2. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data", include the following:
 - 1. Routine maintenance requirements for enclosed controllers and installed components.
 - 2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - 3. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.6 MATERIALS MAINTENANCE SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Engineer no fewer than two days in advance of proposed interruption of electrical systems.
 2. Indicate method of providing temporary utilities.
 3. Do not proceed with interruption of electrical systems without Owner's written permission.
 4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

- A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. Rockwell Automation, Inc.; Allen-Bradley brand.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Configuration: As indicated.
 - 3. Surface mounting.
 - 4. Red pilot light.
- C. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - b. Rockwell Automation, Inc.; Allen-Bradley brand.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D; a brand of Schneider Electric.
 - 2. Fusible Disconnecting Means:
 - a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 - b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
 - 3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

- A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.
 - 1. Outdoor Locations: Type 4X.

2.3 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.
 - a. Push Buttons: Shielded types; momentary as indicated.
 - b. Pilot Lights: LED types; colors as indicated.
 - c. Selector Switches: Rotary type.
 - 2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
 - 3. Meters: Panel type, 2 1/2 inch minimum size with 90 or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Reversible N.C./N.O. auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

- F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Spare control wiring terminal blocks, quantity as indicated; wired.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive enclosed controllers, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Rack-Mounted Controllers: Install enclosed controllers on racks with tops at uniform height unless otherwise indicated. Provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems".
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in each fusible-switch enclosed controller.
- D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses".
- E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- G. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems".
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers, remote devices and facility's central control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables".
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control selection devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
 - 2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- D. Tests and Inspections:
1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
 3. Test continuity of each circuit.
 4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
 5. Test each motor for proper phase rotation.
 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed controllers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.
- B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION

SECTION 263213
ENGINE GENERATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. LP: Liquid petroleum.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 - 1. Thermal damage curve for generator.
 - 2. Time-current characteristic curves for generator protective device.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data", include the following:
 - 1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.
- C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASME B15.1.
- F. Comply with NFPA 37.
- G. Comply with NFPA 70.
- H. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- I. Comply with UL 2200.
- J. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- K. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Engineer no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: 5 deg to 104 deg F.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases for package engine generators . Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Kohler Co.
 - 2. Onan/Cummins Power Generation; Industrial Business Group.
 - 3. MTU Onsite Energy Corporation.
 - 4. Or Approved Equal.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.
- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
 - 8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: The following items are mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gauge glass and petcock.
 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging, ultraviolet, and abrasion-resistant fabric.
 - a. Rating: 50 psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
 2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
- J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- K. Starting System: 12-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
 5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Equalizing-charging rate of 10 A 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.
 - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F to plus 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
 1. Tank level indicator.
 2. Capacity: 24 hours at full load.
 3. Vandal-resistant fill cap.
 4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 1. AC voltmeter.
 2. AC ammeter.
 3. AC frequency meter.
 4. DC voltmeter (alternator battery charging).
 5. Engine-coolant temperature gauge.

6. Engine lubricating-oil pressure gauge.
 7. Running-time meter.
 8. Ammeter-voltmeter, phase-selector switch(es).
 9. Generator-voltage adjusting rheostat.
 10. Fuel tank derangement alarm.
 11. Fuel tank high-level shutdown of fuel supply alarm.
 12. Generator overload.
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
 2. Trip Rating: Matched to generator rating.
 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

- K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
 - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

2.9 MOTORS

- A. General requirements for motors are specified in Division 26 Section "Common Motor Requirements".
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.10 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. Isolation Technology, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.
 - f. Vibration Isolation.
 - g. Vibration Mountings & Controls, Inc.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Smooth pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.
 - 8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.
- B. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ace Mountings Co., Inc.
 - b. Isolation Technology, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Eliminator Co., Inc.

- f. Vibration Isolation.
- g. Vibration Mountings & Controls, Inc.
- 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
- 3. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
- 4. Minimum Additional Travel: 50 percent of required deflection at rated load.
- 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.
 - 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 - 9. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Project Type: Wastewater Treatment Plant Site
 - 1. Voltage: 277/480 volt 3 phase, 60 hz.
 - 2. Rating: 600 KW.

3.3 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems".
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables".

3.5 IDENTIFICATION

- A. Identify system components according to Section 260553 "Identification for Electrical Systems".

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
 - 5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
 - 7. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
 - 8. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

9. On-site "cold Start" test.
 10. Two hour (minimum) full load test with load bank.
 11. One step rated load pickup test.
 12. Contractor to provide resistive load bank and make all temporary connections for all testing.
- D. Coordinate tests with tests for transfer switches and run them concurrently.
 - E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
 - F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - I. Remove and replace malfunctioning units and retest as specified above.
 - J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
 - K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training".
- B. Contractor to provide all fuel for testing and start up. Provide full tank of fuel for generator at job close (after all testing and acceptance testing).

END OF SECTION

SECTION 263600
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
 - 2. Include material lists for each switch specified.
 - 3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
 - 4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 - 1. Include the following:
 - a. Features and operating sequences, both automatic and manual.
 - b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA ICS 1.
- C. Comply with NFPA 110.
- D. Comply with UL 1008 unless requirements of these Specifications are stricter.

- E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
 - 1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
 - 2. Short-time withstand capability for three cycles.
- G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.
- J. Service-Rated Transfer Switch:
 - 1. Comply with UL 869A and UL 489.
 - 2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
 - 3. In systems with a neutral, the bonding connection shall be on the neutral bus.
 - 4. Provide removable link for temporary separation of the service and load grounded conductors.
 - 5. Surge Protective Device: Service rated.
 - 6. Ground-Fault Protection: Comply with UL 1008 for normal bus.
 - 7. Service Disconnecting Means: Externally operated, manual electrically actuated.
- K. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.
- L. Neutral Terminal: Solid and fully rated unless otherwise indicated.
- M. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.
- N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
 - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
 - 4. Accessible via front access.
- O. Enclosures: General-purpose NEMA 250, Type 4X, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cummins Power Generation
 - 2. Eaton
 - 3. Emerson Electric Co,

4. Kohler Power Systems.
- B. Comply with Level 1 equipment according to NFPA 110.
- C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 1. Limitation: Switches using contactor-based components are unacceptable.
 2. Switch Action: Double throw; mechanically held in both directions.
 3. Contacts: Silver composition or silver alloy for load-current switching.
 4. Conductor Connectors: Suitable for use with conductor material and sizes.
 5. Material: Hard-drawn copper, 98 percent conductivity.
 6. Main and Neutral Lugs: Mechanical type.
 7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 8. Connectors shall be marked for conductor size and type according to UL 1008.
- D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
 1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
- E. Manual Switch Operation, Load-Breaking: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- F. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.
- G. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.
- H. Automatic Transfer-Switch Controller Features:
 1. Controller operates through a period of loss of control power.
 2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
 4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
 5. Test Switch: Simulate normal-source failure.
 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
 - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
 - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
 - a. Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
 - b. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
 - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - b. Push-button programming control with digital display of settings.
 - c. Integral battery operation of time switch when normal control power is unavailable.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.
- B. Prepare test and inspection reports.
 1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:
 - a. Overvoltage.
 - b. Undervoltage.
 - c. Loss of supply voltage.
 - d. Reduction of supply voltage.
 - e. Alternative supply voltage or frequency is at minimum acceptable values.
 - f. Temperature rise.
 - g. Dielectric voltage-withstand; before and after short-circuit test.
 - h. Overload.
 - i. Contact opening.
 - j. Endurance.
 - k. Short circuit.
 - l. Short-time current capability.
 - m. Receptacle withstand capability.
 - n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pad-Mounting Switch: Anchor to pad by bolting.
 1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
 3. Provide workspace and clearances required by NFPA 70.
- B. Identify components according to Section 260553 "Identification for Electrical Systems."
- C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

- D. Comply with NECA 1.

3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
 - 1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."
- G. Route and brace conductors according to manufacturer's written instructions. and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.
- H. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

- A. Administrant for Tests and Inspections:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
 - 1. After installing equipment, test for compliance with requirements according to NETA ATS.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that the unit is clean.
 - e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of all control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.
 - k. Perform visual and mechanical inspection of surge arresters.
 - l. Inspect control power transformers.
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

- 2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.
3. Electrical Tests:
- a. Perform insulation-resistance tests on all control wiring with respect to ground.
 - b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set all relays and timers.
 - e. Verify phase rotation, phasing, and synchronized operation.
 - f. Perform automatic transfer tests.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay on transfer.
 - 4) Alternative source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer on normal power restoration.
 - 8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
- a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
- a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
 - f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
 - g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
- a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

- E. Transfer switches will be considered defective if they do not pass tests and inspections.
- F. Remove and replace malfunctioning units and retest as specified above.
- G. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.
- B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.
- C. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 264313

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 DEFINITIONS

- A. In: Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- G. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include electrical characteristics, specialties, and accessories for SPDs.
 - b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:
 - 1) Tested values for VPRs.
 - 2) In ratings.
 - 3) MCOV, type designations.
 - 4) OCPD requirements.
 - 5) Manufacturer's model number.
 - 6) System voltage.
 - 7) Modes of protection.
- B. Field quality-control reports.

1.3 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.
 - 1. Initial Extended Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.
 - 2. Follow-On Extended Warranty Period: 10 year(s) from date of Substantial Completion, for materials only, f.o.b. the nearest shipping point to Project site.

PART 2 PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies Inc. (APT)
 - 2. Eaton
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Liebert; a brand of Vertiv
 - 5. Mersen USA

6. Schneider Electric USA, Inc.
 7. Siemens Industry, Inc. Energy Management Division
 8. SSI, an ILSCO Company
- B. Source Limitations: Obtain devices from single source from single manufacturer.
- C. General Characteristics:
1. Reference Standards: UL 1449, Type 2; UL 1283.
 2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
 3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 150 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
 4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:
 - a. Line to Neutral: 1200 V for 480Y/277 V.
 - b. Line to Ground: 1200 V for 480Y/277 V.
 - c. Neutral to Ground: 1200 V for 480Y/277 V.
 - d. Line to Line: 2000 V for 480Y/277 V.
 5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
 - a. Line to Neutral: 700 V.
 - b. Line to Ground: 700 V.
 - c. Neutral to Ground: 700 V.
 - d. Line to Line: 1200 V.
 6. SCCR: Equal or exceed 200 kA.
 7. In Rating: 20 kA.
- D. Options:
1. Include LED indicator lights for power and protection status.
 2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
 3. Include NEMA ICS 5, dry Form C contacts rated at for remote monitoring of protection status.
 4. Include surge counter.

2.2 ENCLOSURES

- A. Outdoor Enclosures: Type 4X.

2.3 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.
- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
 2. Do not exceed manufacturer's recommended lead length.
 3. Do not bond neutral and ground.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's installation requirements.
- B. Nonconforming Work:
 - 1. SPDs that do not pass tests and inspections will be considered defective.
 - 2. Remove and replace defective units and retest.
- C. Prepare test and inspection reports.
- D. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION

SECTION 265619
LED EXTERIOR LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaire.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79 and IES LM-80.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - 6. Wiring diagrams for power, control, and signal wiring.
 - 7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Structural members to which equipment and luminaires will be attached.
 - 3. Building features.
 - 4. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of the following:
 - 1. Luminaire.
- D. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.
- E. Source quality-control reports.
- F. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.

2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.7 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Refer to Lighting Fixture Schedule on drawings.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- E. UL Compliance: Comply with UL 1598 and listed for wet location.
- F. Internal driver.
- G. Nominal Operating Voltage: 120 V ac.
- H. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- I. Source Limitations:
 1. Obtain luminaires from single source from a single manufacturer.

2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 LUMINAIRE TYPES

- A. Canopy:
 1. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.
 2. Shape: Rectangular..
 3. Dimensions: Refer to plans.
 4. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Refer to plans.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: . Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 1. White Surfaces: 85 percent.
 2. Specular Surfaces: 83 percent.
 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: .

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 1. Sized and rated for luminaire weight.
 2. Able to maintain luminaire position after cleaning and relamping.
 3. Support luminaires without causing deflection of finished surface.
 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION

SECTION 310000
EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes the site preparation activities and defines certain items and aspects of earthwork relative to other work.
- B. Provide all operations necessary to complete site clearing, stockpiling, dewatering, excavations, embankments and backfilling, subgrade preparation, placement of topsoil, and finish grading.
- C. Construct and maintain all temporary drainage swales, berms and diversions; furnish, operate, and maintain all necessary pumping and other equipment for dewatering. After above items serve their purpose, remove them and restore site.

1.2 GENERAL

- A. Definition: Earthwork is defined as all excavation, trenching, fill, backfill, site preparation, subgrade preparation and other appurtenant work.
- B. Classification: Excavation shall be unclassified, and the term "excavation" shall include all material encountered without regard to its physical properties, characteristics or composition.
- C. Limits of the Work:
 - 1. Earthwork shall not extend beyond the areas of excavation, embankment or other construction shown on the drawings.
 - 2. Excavations for new construction shall not undercut existing footings and foundations.
 - 3. Contractor shall install construction fencing or other visible barrier around trees and other areas that need to be protected from the earthwork prior moving equipment into that area.
- D. Safety and Protection:
 - 1. Shoring, sheeting and bracing shall be provided as required to protect the work and workmen from damage or injury by caving or sloughing.
 - 2. Laws and ordinances regulating health and safety measures shall be strictly observed.
- E. Blasting: Blasting will not be permitted on this project.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. D 698 Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and a 12 inch (304.8 mm) Drop.
 - 2. D 2922 Test Methods for Density of Soil and Soil Aggregate In Place by Nuclear Methods (Shallow Depth).
 - 3. D4318 Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
 - 4. D4546 Test Method for One-Dimensional Swell/Settlement Potential of Cohesive Soils.
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. M6 Fine Aggregate for Portland Cement Concrete.
 - 2. T99 Moisture Density Relations of Soils, Using a 5.5 lb. (2.5 kg) Rammer and a 12 inch (305 mm) Drop.
- C. Military Standard (MIL-STD-619):
 - 1. MIL-STD-619B Unified Soil Classification System for Roads, Airfields, Embankments and Foundations.
- D. Missouri Department of Transportation (MODOT):
 - 1. 2020 Edition Standard Specifications for State Road and Bridge Construction.
- E. Federal Register - Occupational Safety and Health Administration (OSHA)
 - 1. 29CFR Part 1926 Occupation Safety and Health Standards - Excavations.
- F. Department of the Army, Kansas City District, Corps of Engineers:

1. Guidebook General information for sponsors of flood protection projects constructed by the Corps of Engineers.

1.4 SUBMITTALS

- A. Submit shop drawings and submittals in accordance with the General Conditions and Section 013300.10
- B. Bedding and Backfill Materials: The Contractor shall notify the Engineer of the off-site sources of bedding and backfill materials, and submit to the Engineer detailed information of the materials to be used including but not limited to a sieve analysis and Standard Proctor Curve.
- C. Density test results as required by this specification.

1.5 QUALITY CONTROL

- A. The Contractor shall engage a Geotechnical Engineer to complete all soils testing. Owner will not furnish any required soils and compaction testing of any kind.
- B. Prior to the placement of any excavated or borrowed soils, each type of soil approved for fill or backfill shall have a Standard Proctor Curve developed to indicate the moisture-density relationship required to obtain maximum density.
- C. Compaction Testing:
 1. Sample backfill materials for the density testing shall be taken according to ASTM D75.
 2. Compaction is the calculated ratio of the in-place (dry) density to the laboratory maximum (dry) density expressed as a percentage.
 3. Determine laboratory moisture-density relations of soils according to the ASTM test method identified in the specific subsection.
 4. If the Contractor is responsible for compaction testing, the Contractor shall also pay the costs of any retesting of work not conforming to specifications.
 5. The following table identifies the compaction required based on the location of the soil.

LOCATION	COMPACTION DENSITY
Under paved areas, sidewalks and piping	90% of ASTM D 1557 or 95% of ASTM D698
Unpaved areas	85% of ASTM D698
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under fill material	90% of ASTM D1557 or 95% of ASTM D698
Outside structures next to walls, piers, columns and any other structure exterior members	90% of ASTM D1557 or 85% of ASTM D698
Outside structures under equipment support foundations *	95% of ASTM D1557 or 100% of ASTM D698
Granular fill under base slabs and building floor slbs on grade	75% relative density per ASTM D4253 and ASTM D4254
Structural fill for over excavations	90% of ASTM D1557 or 95% of ASTM D698
*Granular fill or flowable fill may be substituted	

- D. Density tests shall be taken at the frequency indicated in the table below and at all road and street crossings. The Engineer has the authority to require the Contractor to perform additional test locations based upon field conditions. All density testing for all backfill shall be performed using Standard Soil Proctor Curves provided by the Contractor. The Engineer has the authority and right to not accept backfill based on the results of these tests, but the results of the tests do not waive the responsibilities of the Contractor to ultimately guarantee the density and stability of the fill material. When test results indicate that compaction is not as specified, the material shall be removed, replaced, and recompacted to meet specification requirements at no expense to

the Owner. Subsequent tests on recompacted areas shall be performed to determine conformance with specification requirements at the Contractor's expense.

Materials	Minimum Test Frequency
Fill and Backfill	1 per lift per 500 square feet
Subgrade	1 per lift per 2,500 square feet
Embankment	1 per lift per 500 cubic yards

- E. Periodically, the Resident Project Representative may test backfill for density using Standard Soil Proctor Curves provided by the Contractor. The results of these compaction tests will only be provided to the Contractor at his request. However, the Contractor shall be provided these results for informational purposes only and they, in no way, alter the Contractor's ultimate responsibility for compaction requirements. The Engineer has the right not to accept backfill based on the results of these tests, but the results of the tests in no way waives the responsibilities of the Contractor to guarantee the density and stability of the material.
- F. Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM Method D 698 or AASHTO-T99 (Standard Proctor) as a percent of laboratory maximum density.
- G. Compaction Methods
 - 1. Obtain compaction of backfill and embankment by mechanical means. Jetting or flooding is not permitted. Compact each layer with mechanical tampers. Do not place backfill at hydraulic structures until hydraulic testing has been completed. Do not place backfill against cantilevered walls until design strength of concrete has been reached. Do not place backfill against walls supported at the top by floor slabs until design strength has been reached.
 - 2. Use light vibratory or hand tamping equipment adjacent to the wall. Take particular care compacting around pipe spools. Do not use heavy compaction equipment within a horizontal distance from the wall equal to the height of the wall.

1.6 SUBSURFACE INFORMATION

- A. Geotech investigations were completed at the Triplepoint and UV site and are attached to this specification.
- B. The Contractor shall satisfy himself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. Information and data, when furnished, are for the Contractor's general information. However, it is expressly understood that any interpretation or conclusion drawn there from is totally the responsibility of the Contractor. Engineer and Owner assume no liability for the accurateness of the data reported or the materials used.

1.7 PROTECTION AND REMOVAL OF UTILITY LINES

- A. The presence of utilities is not guaranteed to be shown accurately or completely. On-site verification of utilities is required by the Contractor prior to excavations. Existing pipelines and electric cables that are shown on the Drawings or the locations of which are made known to the Contractor during on-site investigations prior to excavation operations, shall be protected from damage during excavation and backfilling, and if damaged shall be repaired by the Utility company at Contractor's expense.

PART 2 PRODUCTS

2.1 EARTH FILL MATERIALS

- A. Fill material used for compacted impervious material shall consist of excess suitable impervious material obtained from on-site suitable excavations or suitable imported clay or silt material. Excess suitable material obtained from structure and trench excavation shall be used for the construction of fills and embankments. Additional material shall be provided as required under sub-section 2.3 - Borrow Material.
- B. All material placed in fills and embankments shall be free from rocks, stones, or shale particles larger than 2 inches, frozen matter, brush, stumps, vegetation, logs, roots, debris, and organic or other deleterious materials. The material for fill shall have a liquid limit less than 45 percent

and a plasticity index less than 25 as determined by ASTM D4318. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the allowable size limit, incorporated in the remainder of fills and embankments, shall be distributed so that they do not congregate or interfere with proper compaction.

- C. Fill material shall be limited to materials classified as SC, ML, and CL by the Unified Soils Classification.
- D. Moisture content is to be maintained at a level sufficient to obtain the specified compaction.

2.2 EXCAVATED MATERIALS

- A. Topsoil obtained by stripping and suitable for finish grading where arable soil is required shall be stockpiled in a location approved by the Owner or Engineer.
- B. Excavated material approved for embankment, fill or backfill shall be placed in areas receiving embankment or stored for future use in a location approved by the Owner or Engineer.

2.3 BORROW MATERIAL

- A. Where suitable materials, including topsoil, are not available in sufficient quantity from all required excavations under this contract, approved materials shall be obtained from approved sources on and off site at the Contractor's responsibility and expense. The necessary clearing and grubbing of borrow areas, disposal and removing of debris therefrom, the developing of sources including any access roads for hauling, the necessary right-of-way, and the satisfactory drainage of the borrow areas shall be considered as incidental items to borrow excavation.
- B. Material obtained for fill shall be approved by the Engineer. Fill material shall be limited to materials specified in Section 2.1 - Earth Fill Materials.

2.4 TOPSOIL

- A. Topsoil shall be the top few inches of field or pasture loam having a good supply of humus along with a high degree of fertility. Acceptable topsoil shall be a fertile, friable, and loamy soil of uniform quality with a loose crumbly structure, free from materials such as roots, hard clods, stiff clay, fill material, stone with any dimension greater than 1 inch, and similar impurities, relatively free from grass, roots, weeds, and other objectionable plant material.
- B. Soils from ditch bottoms, drained ponds or eroded areas are not acceptable. Soils supporting growth of noxious weeds or undesirable weeds are not acceptable. Topsoil handled too wet or soggy are unacceptable.

2.5 DISPOSAL OF UNSUITABLE OR EXCESS MATERIAL

- A. Excess excavated suitable material in excess of the backfill or grading requirements not used for any purpose associated with the completion of the work shall remain the property of the Owner and shall be moved by the Contractor to a site designated by the Owner or Engineer on or near the project site. The available area for placement of excess material is adjacent to and southwest of lagoon cell 2.

2.6 WATER FOR COMPACTION

- A. Water shall be clean and free of acid, alkali, or organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l. Provide temporary tanker trucks, equipment and materials to convey water from the source to the point of use.

2.7 CAPILLARY WATER BARRIER

- A. Aggregate shall be clean, crushed, nonporous rock as graded below or as shown in plan details:
 - 1. Crushed, nonporous rock maximum particle size shall be $\frac{3}{4}$ inch and no particles shall be small enough to pass a No. 4 sieve.

PART 3 EXECUTION

3.1 SITE PREPARATION

- A. Clearing and Grubbing:
 - 1. The site of the work shall be cleared of all trash and debris which may be found on the site.

2. Grass and weeds shall be mowed to a height of not more than three inches and raked into windrows or piles.
 3. Trees noted to be removed shall be removed to a minimum depth of 2 feet 0 inches below the surface of the finished grade.
 4. All materials accumulated by clearing and grubbing operations shall be disposed of at an offsite location to be provided by the Contractor.
- B. Stripping:
1. Strip topsoil to a depth of not less than four inches from all areas to be covered by buildings, pavement, curb and gutter or other construction.
 2. Material obtained by stripping shall be stockpiled for use in finish grading or areas not covered by construction.

3.2 ROCK EXCAVATION

- A. The use of explosives is not permissible on this project.

3.3 EMBANKMENTS

- A. Place all embankments to lines and grades shown. Areas to be covered with topsoil shall be underfilled so the finished lines conform after topsoil placement. Protect and maintain embankments during the course of construction. Replace all materials lost due to storm damage until permanent stabilization. Use materials obtained during excavation or imported materials. Do not use brush, sod, or other unsuitable materials in embankments.
- B. No embankment shall be constructed on frozen material, nor shall organic material be used for embankment.
- C. When an embankment is to be placed against a hillside or existing embankment whose slopes are steeper than 4:1; the existing slope shall be continuously benched in approximately 24 inches rises as the new fill is brought up on lifts as specified below. The material bladed out, the bottom of the area cut into, and the embankment material being placed shall be compacted to the required density.
- D. In fill sections, place material in loose lifts not exceeding 6 inches, brought to within 2% to +4% of optimum moisture content. Bring up each lift uniformly over the entire area being filled and compact each lift to its required density.
- E. Maintain the proper moisture content in the uppermost layer. If placing of materials is interrupted and the material dries, bring to proper moisture content before resuming by sprinkling, cultivating, and rolling to the required compaction. Do not place or roll material during rainfall of sufficient intensity to materially increase the moisture content. If any material placed in embankment acquires a greater moisture content than is suitable for compaction, allow to dry or remove. If removed, recondition the new surface before placing new material. Repair any irregularities caused by erosion by excavating, cultivating, filling, and compacting.

3.4 EXCAVATION FOR STRUCTURES

- A. Structural excavation is the removal of all materials of whatever nature to approved structural subgrade and as necessary for construction of structures and foundations. Approved structural subgrade is that material which has been observed by the Engineer and upon which structural foundations or other materials may be placed. Locate limits of excavation for structures with formed vertical surfaces at least 5 feet from the extreme outside of the structure to the toe of the cut slope or at a 1:1 slope as detailed on the drawings, whichever is greater.
- B. Design excavations in the proximity of adjacent structures so as to protect the structures from damage or undermining. Design and install shoring if necessary. Side slopes of excavation shall be only as steep as is safe for material to stand. Avoid unnecessary disturbance of adjacent ground.
- C. Subgrade Preparation
1. Remove all existing "fill", loose natural clays, sand, and compressible materials under proposed structures. Provide a relatively smooth subgrade.
 2. The exposed bottoms of excavations shall consist of undisturbed native material.

3. Where excavation is inadvertently carried beyond the design elevation or approved structural subgrade, adjust the construction as directed to meet the structural requirements. Over excavations shall be backfilled with graded structural fill compacted to the required density, or adjust the construction as required to meet the structural requirements as approved by the Owner's Representative.

3.5 FILL WITHIN STRUCTURES

- A. Approved fill shall be placed at optimum moisture content in lifts of not more than 6 inches loose lift and compacted to at least 95 percent of Laboratory Maximum Density. Fill shall be placed up to the bottom of the structural floor slabs, with allowance for capillary water barrier (gravel sub-base) and/or concrete mud mat as specified or shown on the drawings, to the elevations shown.

3.6 CAPILLARY WATER BARRIER

- A. Subgrade under floor slab shall be finished off smooth after the required density as specified above is achieved to the proper elevation.
- B. Capillary water barrier shall be placed directly on the subgrade and compacted with a minimum of two passes of a plate-type vibratory compactor.
- C. The minimum compacted thickness of the capillary water barrier shall be 4-inches unless noted otherwise in the Drawings.

3.7 BACKFILL FOR STRUCTURE FOUNDATION WALLS, GRADE BEAMS AND FOOTINGS

- A. Backfill shall be brought up on each side of the foundation wall concurrently. After foundation walls, grade beams and footings have cured, forms have been removed, and all trash has been removed, backfill shall be placed at optimum moisture content in lifts of not more than 6 inches loose lifts and compacted to at least 95 percent of Laboratory Maximum Density.
- B. Backfill for areas not to be paved shall be placed to within 6 inches of the finished grade. The top 6 inches shall be topsoil.

3.8 AREA GRADING

- A. Under pavement, pads and sidewalks, excavate and fill to grades and contours shown on the Drawings, making allowance for thickness of pavement, pads and sidewalks.
- B. General Fill:
 1. Excavate and fill to grades and contours shown on the Drawings making allowance for the placing of a minimum of 6 inches of topsoil.
 2. Areas receiving embankment or topsoil shall be scarified to a depth of 6 inches and/ recompact at optimum moisture content to at least 90 percent of Laboratory Maximum Density.
 3. Fill material shall be approved earth free of stones larger than 6 inches diameter and suitable for compaction. Fill material shall be placed at optimum moisture content in lifts not to exceed 6 inches loose lift and compacted to at least 90 percent of Laboratory Maximum Density.
 4. Topsoil shall be placed in a 6 inch lift and not compacted.

3.9 SUBGRADE PREPARATION FOR PAVEMENT, PADS, SIDEWALKS AND CURBS

- A. Subgrade preparation shall extend one (1) foot beyond the back of curb line or edge of pavement, whichever is appropriate. Sidewalk replacement subgrade preparation shall be limited to width of sidewalk and form limits.
- B. The subgrade shall be free of organic material, trash and debris, and rocks larger than 3 inches in diameter. Subgrade shall not be frozen while construction is in progress.
- C. Scarify the upper six (6) inches of the subgrade and compact to 95% of the maximum density at optimum moisture, plus or minus 3%, in accordance with AASHTO T99 (Standard Proctor). The subgrade material shall be properly "worked" and installed to provide a stable road base, absent of shrinkage or swell potential. The subgrade shall be maintained within the proper moisture content limits until the curb & gutter and pavement is placed. Mechanical tamping may

be utilized or required for certain areas. If the subgrade contains excess moisture the subgrade shall be aerated or removed and replaced with new material so that moisture limits fall within limits of the standard proctor. The prepared subgrade shall support the weight of vehicles and equipment without producing ruts in the surface, and shall be maintained until pavement has been placed thereon. The Engineer may require proof rolling of the subgrade surface. Proof rolling shall be provided at no additional cost to the Owner.

- D. The elevations and cross sections of the subgrade surface shall be thoroughly checked immediately prior to the pavement placement. All high and low places shall be removed and filled with suitable material and mechanically tamped. All subgrades shall be checked not less than 100 feet in advance of paving operation. Any damage or irregularities to the subgrade during paving operations shall be repaired prior to placing of additional pavement.

3.10 CONTROL OF WATER

- A. Surface Water:
 - 1. Surface water shall be diverted to prevent entry to trenches and excavations for structures.
 - 2. In the event surface water does accumulate in trenches and other excavations, the excavations shall be dewatered as necessary to permit the proper execution of the work. Dewatering shall be provided at no additional cost to the Owner.
- B. Ground Water: Where ground water is encountered, trenches and other excavations shall be dewatered as necessary to permit the proper execution of the work.
 - 1. The Contractor shall provide pumps, well points, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition as specified except where authorized tremie concrete construction Work is shown or permitted. The groundwater level shall be controlled so as to permit the placing of sewer lines and structure foundations, curing of concrete, and the maintenance of supporting foundations and adjacent Work and structures. The dewatering system and points of discharge shall be subject to permitting, reviews, and acceptance by the Engineer before installation. Disposal of water to any surface water body will require silt screens.
 - 2. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps. He shall be totally responsible for protecting structures from flotation until final acceptance of the Work. The Contractor shall also modify the dewatering system during the course of construction to satisfy faults, legitimate complaints, or legal requirements.

3.11 FINISH GRADING

- A. After construction is completed, areas requiring finish grading shall be cleared of all building materials, equipment and debris and a minimum depth of 6 inches of topsoil placed. The 6 inches of topsoil is included in and not added to the final grade indicated on the plans. Surfaces shall be smooth and suitable for planting or sodding.

3.12 PROTECTION

- A. Subgrade shall be repaired from action of the elements or others. Any settlement or erosion that occurs prior to the placing of the pavement thereon, shall be repaired and the specific lines, grades and cross section re-established. Any subgrade that has become unacceptable shall be reworked as necessary to restore the subgrade to shape, tolerance, density, and moisture content range for such density, immediately prior to the placing of the pavement. The Contractor shall protect all existing improvements from damage resulting from his subgrade operation. Any improvements damaged shall be repaired or replaced at no additional expense to the Owner.

END OF SECTION

SECTION 311000
SITE CLEARING

PART 1 GENERAL

1.1 Summary

- A. This section describes the work included in site clearing to prepared the project site for construction operations.

1.2 Clearing

- A. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, sticks, branches, and other vegetative growth. Remove rocks, tiles, and lumps of concrete. Remove all evidence of their presence from the surface. Remove and dispose of rubbish and fencing which is called out in drawings. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth and fencing which are not designated for removal.
- B. Fencing not called out on Plans but that is required for construction shall be removed and replaced with fencing that is the same type and meets conditions that are better than or equal to existing conditions.

1.3 Stripping

- A. Remove and dispose of topsoil to a depth of 3 inches (unless mentioned otherwise on the plans) grass and grass roots, and other objectionable material remaining after clearing from the areas designated to be stripped.
- B. Retain topsoil material onsite for dressing backfill areas before planting.

1.4 Grubbing

- A. After clearing and stripping, remove and dispose of wood or root matter, including stumps, logs, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

PART 2 PRODUCTS

2.1 Trees and Shrubbery

- A. Existing trees, shrubbery, and other vegetative material may not be shown in the drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein.

2.2 Preservation of Trees, Shrubs, and Other Plant Material

- A. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.
- B. Cut and remove tree branches where necessary for construction. Remove branches other than those required for a balanced appearance of any tree. Treat cuts with a tree sealant.

PART 3 EXECUTION

3.1 SITE Clearing Limits

- A. Clear, strip, and grub excavation and embankment areas associated with new structures, slabs, walks, and roadways, and as shown on the Plans.
- B. Limits of clearing, stripping, and grubbing:
 - 1. Excavation, Excluding Trenches: 5 feet beyond tops of cut slopes.
 - 2. Trench excavation for piping and electrical conduits: 3 feet from edge of trench.
 - 3. Earth Fill: 5 feet beyond toe of permanent fill as indicated in the drawings.
 - 4. Structures: 15 feet beyond footings.
 - 5. Streets, Roadways, and Parking Areas: 10 feet from toe of fill or top of cut.

3.2 Disposal of Clearing and Grubbing Debris

- A. Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose.

3.3 Disposal of Strippings

- A. Remove stripped material and dispose offsite, except topsoil.

END OF SECTION

**SECTION 312320
SLUDGE REMOVAL**

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

- A. Earthwork
- B. Trenching, Backfilling and Compaction
- C. Seeding and Fertilizing

1.2 REFERENCES

- A. State of Missouri :
 - 1. Missouri Department of Natural Resources- Wastewater Guidelines and Standards Document
 - 2. Missouri Department of Natural Resources - 10 Code of State Regulations, Division 20
 - 3. University of Missouri Extension Water Quality Guide Sheets for Biosolids - WQ 423 through 434 and WQ 449.
 - 4. Missouri Clean Water Law
 - 5. Missouri Clean Water Commission Rules
- B. United States Environmental Protection Agency(EPA):
 - 1. 40 CFR Part 503

1.3 GENERAL

- A. The Contractor shall be completely responsible for the sludge removal in Cell 3 lagoon at Moberly Correctional Center located in Moberly, MO, including the DNR Form S submittal for sludge disposal.
- B. Definition: Sludge removal is defined as all work necessary to properly remove wastewater sludge from the existing lagoon cells by either the "wet" or "dry" method.
- C. Definition: Wet sludge removal method is defined as removing the wastewater sludge by dredging or other similar method while the lagoon cell(s) remain in service. Equipment to be used for this purpose shall be desinged and operated in a manner that protects the lagoon bottom seal.
- D. Definition: Dry sludge removal method is defined as removing the wastewater sludge by first taking the lagoon cell out of service. Excess liquid is removed typically by pumping and discharged into another part of the treatment plant for proper treatment. The sludge is then removed from the cell with a front end loader, backhoe or similar piece of equipment.
- E. Safety and Protection: Laws and ordinances regulating health and safety measures shall be strictly observed.

1.4 PERMITTING AND SEQUENCE OF WORK

- A. The following procedure shall be performed for Cell #3. Note that it shall be the Contractor's full responsibility to comply with all state and federal regulations, which includes paperwork and documentation. This section shall not be considered all-inclusive, but rather a guidance that shall be addressed at a minimum. The general permitting and work sequence follows:
 - 1. Contractor shall obtain sites for land application of sludge or disposal of sludge at a WWTP which meet Federal and State requirements. Property owner agreements shall be obtained and approved by the State prior to land application of sludge. This agreement will certify the following: total tons of applied sludge per acre on a wet and dry weight basis, pounds of nitrogen, phosphorous and potassium per acre, condition of field, field entrances and fences before and after application in language that absolves the State of responsibility for damages caused by the Contractor's operations.
 - 2. Engineer will apply for and obtain Land Disturbance Permit for the lagoon site, if applicable, on behalf of Owner. Owner shall pay DNR land disturbance permit fee.

3. Completion, preparation, soil testing, data gathering, measurement, and anything else required for the Form S submittals to Missouri DNR is the sole responsibility of the Contractor. **Contractor shall fill out and submit the Form S to DNR for this project.**

1.5 PROTECTION OF UTILITY LINES

- A. Existing pipelines and/or electric cables that are shown on the Drawings or the locations of which are made known to the Contractor prior to removal operations, shall be protected from damage during the work, and if damaged shall be repaired by the Contractor or Utility company at Contractor's expense.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

- A. Only one lagoon cell shall be taken out of service at a time. The Contractor shall schedule and coordinate the work with the Moberly Correctional Center and State of Missouri.
- B. All sludge shall be removed and shall be disposed of in accordance with the requirements of the Missouri Department of Natural Resources and the United States Environmental Protection Agency 40 CFR Part 503 Regulations.
- C. The sludge shall be contained within the disposal sites. If the sludge is not contained within the boundaries of the approved site(s), the Contractor shall be responsible for all costs of clean up and remediation.
- D. Sludge depths were measured in 2021 by Bartlett & West staff. The sludge measurements indicated an average sludge depth of 2.4 feet in Cell No. 3. This equates to approximately a total of 530,000 gallons. THIS IS PROVIDED FOR INFORMATIONAL PURPOSES ONLY. The Contractor is responsible for removing the sludge from the cell, regardless of the actual volume.

3.2 SLUDGE REMOVAL

- A. The lagoon may be cleaned by either the Wet or Dry Sludge Removal method. The Contractor shall carefully remove all sludge from the lagoon cell.
- B. Equipment utilized for removing, transferring and loading sludge shall be attended at all times while in use. Spillage shall be avoided and if it occurs the Contractor shall be responsible for clean up. Any cleanup activities required shall be completed immediately. In the case of a spill of sludge that reaches the waters of the state, notification of the Missouri Department of Natural Resources is required immediately, in no case more than 24 hours.

3.3 SLUDGE HANDLING, TRANSPORT AND DISPOSAL

- A. The sludge shall be properly transported to the disposal site in accordance with federal, state, county and local requirements. It may be transported in a watertight container or tanker or pumped to the site. Care shall be taken to avoid spillage during transportation from the lagoon to the disposal site. All spillage shall be immediately cleaned from the roadways to the satisfaction of the Owner, Engineer and any other authority having jurisdiction.
- B. No land owned by the Owner is available for land application of sludge.
- C. The sludge material shall be hauled to a WWTP in accordance with EPA Part 503 regulations, the sludge material then becomes the responsibility of the receiving WWTP authority.

3.4 FINISH GRADING.

- A. After the sludge removal and disposal process is completed, all disturbed areas shall be finish graded. The disturbed areas shall be graded to generally conform to slope and contours prior to the sludge disposal operation. All areas shall be graded with no depressions, high points or ridges to impede proper drainage. Surfaces shall be smooth and suitable for planting or sodding after the finish grading operation.

END OF SECTION

SECTION 312333
TRENCHING AND BACKFILLING

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes materials and installation for trench excavation, backfilling, and compacting.
- B. Sheet piling, shoring, bracing, and protection of adjacent property, trees, and structures.
- C. Preparation of subgrades, bedding for pipe, backfilling, and disposal of excess excavation.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. All specified bedding and backfill material, except earth excavated material.
- C. Moisture-Density test for each backfill material.

1.3 DEFINITIONS

- A. Pipe Embedment Zone - The full width of trench from both below and above the bottom of the pipe or conduit to a horizontal level above the top of the pipe as defined by the embedment class or as shown on the details.
- B. Trench Zone - The portion of the trench from the pipe embedment zone to finished grade in unpaved areas, and to the bottom of the drive zone in drive areas.
- C. Pipe Cover - The distance from the top of the finished grade of the trench to the top of the pipe.
- D. Unclassified Excavated Material - All earth or other materials including soil and solid rock.

1.4 COMPACTION TESTING

- A. An independent geotechnical firm material testing and field compaction testing and any necessary retesting.
- B. Minimum testing frequency for in-place field shall be:
 - 1. One in-place field density test whenever there is a suspicion of a change in backfill material, quality of moisture or effectiveness of compaction.
 - 2. Compaction shall meet requirements of this specification and plan details for various trench conditions, especially at full depth aggregate backfill in roadways, adjacent pump houses, and within storage basin berms.
- C. Sample backfill materials for the density testing shall be taken according to ASTM D75.
- D. Compaction is the calculated ratio of the in-place (dry) density to the laboratory maximum (dry) density expressed as a percentage.
- E. Determine laboratory moisture-density relations of soils according to the ASTM test method identified in the specific subsection.
- F. The following table identifies the compaction required based on the location of the trench.
 - 1. LOCATION/COMPACTION DENSITY
 - a. Under paved areas, sidewalks, and pipe crossings: 95% of ASTM D698
 - b. Under foundations and equipment support pads : 95% of ASTM D698
 - c. Unpaved areas: 85% of ASTM D698

PART 2 PRODUCTS

2.1 Pipe Embedment Material

- A. Refer to plan details for embedment material per specific conditions.

2.2 Granular Backfill Material

- A. Granular backfill material shall match plan details per specific condition.

- B. The granular material shall not contain clay lumps or organic matter. The fraction passing the No. 4 sieve shall have liquid limits no greater than 25 and a plasticity index no greater than 5. The material shall meet the quality requirements of ASTM C33.

PART 3 EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify by visible markings all plant life, trees, lawns, fences and other features that are to be protected.
- C. Existing underground installations such as water mains, gas mains, sewers, telephone lines, power lines, and buried structures in the vicinity of the work to be done hereunder are indicated on the drawings only to the extent such information has been made available to or discovered by the Engineer in preparing the drawings. There is no guarantee as to the accuracy or completeness of such information, and all responsibility for the accuracy and completeness thereof is expressly disclaimed. Generally, service connections are not indicated on the drawings.
- D. The Contractor shall be solely responsible for locating all existing underground installations, including service connections in advance of excavating or trenching by contacting the owners thereof and prospecting. The Contractor shall use his own information and shall not rely upon any information shown on the drawings concerning existing underground installations.
- E. Where utilities are parallel to or cross the construction but do not conflict with the permanent work to be constructed, follow the procedures given below or as indicated in the drawings. If not specifically stated on plans, notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements.
- F. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in the construction of the utility crossing.

3.2 SHEETING, SHORING, AND BRACING OF TRENCHES

- A. Sheeting and bracing, or trench boxes shall be provided where necessary to conform to 29CFR1926 Subpart P-Excavations, OSHA requirements.
- B. Where it is necessary to drive sheeting below the centerline of the pipe, it shall be driven to a depth of at least 2 feet below the flow line of the pipe, or as directed by the geotechnical engineer.

3.3 TRENCH WIDTHS

- A. Trench widths shall be as shown in the drawings.
- B. Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of 6 inches below and on each side of the pipe.

3.4 TRENCH EXCAVATION

- A. Perform all excavation regardless of type, nature or condition of the material encountered to accomplish the construction. Excavate the trench to the lines and grades shown on the drawings with allowance for pipe thickness and for pipe base or special bedding.
- B. Care shall be taken not to over-excavate. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade with native material and compact to a density equal to the rest of the trench bottom.
- C. Length of open trench to be no more than 40 feet in advance of pipe laying . Backfilling of the open trench to grade to be no more than 40 feet behind the installed pipe.
- D. Blasting will not be permitted .

- E. After the required excavation has been completed, the Owner's Representative will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist in the exposed subgrade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24-inches greater than the pipe outside diameter and to the depth required. Refill the trench to subgrade of pipe base with native material. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6 inches deep compacted to 95 percent relative compaction and carried to the required grade.

3.5 LOCATION OF EXCAVATED MATERIAL

- A. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

3.6 DEWATERING

- A. Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill has been completed.
- B. Water entering the excavation or other parts of the work shall be removed until all the work has been completed. No sanitary sewer shall be used for the disposal of trench water, unless specifically approved by the engineer, and then only if the trench water does not ultimately arrive at existing pumping or wastewater treatment facilities
- C. Dispose of the water in a manner to prevent damage to adjacent property. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise around the pipe until jointing compound has set hard.

3.7 Installing Buried Piping

- A. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe laying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified herein. Before laying each section of the pipe, check the grade and correct any irregularities.
- B. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified or indicated in the drawings for use in the pipe zone.
- C. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
- D. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.
- E. Lay the pipe at the proper elevation and grade and properly attach to the adjacent pipe according to the type of joint.
- F. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.
- G. Keep the trench dry until the pipe has been installed and jointed to the other pipe.

3.8 TRENCH BACKFILLING

- A. Backfill according to the details for the particular type of pipe, and per the following:
 - 1. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe laying to provide firm, uniform support along the full

length of pipe. Organic matter or clay material which may fall in an open trench during construction shall be removed. The Contractor shall limit the amount of native material which may fall on top of the completed pipe base until the pipe is installed.

2. Backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for final backfill within 2 feet (0.6 m) of the top of the pipe. Do not bury waste material.
3. After pipe has been bedded, backfill simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
4. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.
5. Continue to place the backfill material in the trench until it reaches the finished grad according to the following criteria:
 - a. Backfilling under Paved Areas: Plus or minus 1/2 inch from required elevations.
 - b. General Backfilling: Plus 3 inches from required elevations.

3.9 BACKFILL COMPACTION METHODS

- A. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe. Jetting will not be allowed.
- B. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of walls and structures.
- C. When existing pipe is encountered during excavation, care shall be taken to support pipe sufficiently so pipe remains in service and to ensure safety of workers. During backfilling place bedding material in and around the existing pipe and compact to specifications above.

3.10 Installing Impervious Barriers

- A. Construct impervious barriers in the pipe and trench zones at 300-foot intervals on slopes exceeding 30% (16.7 degrees) and within 50 feet of vertical points of inflection on slopes exceeding 30%. Construct concrete barriers such that the bottom of the collar extends at least 3 inches into the pipe base, at least 3 inches into each side of the walls of the trench, and at least 3 inches above the top of the pipe zone.
- B. Construct additional impervious barriers at storage basin berms as shown on the plans.

3.11 PROTECTING UNDERGROUND UTILITIES

- A. Underground utilities are to be protected in place and remain in service, unless otherwise specified on the Plans or in the specifications. Compact bedding material under and around the utility so that no voids are left. Flowable fill may be an acceptable method of bedding and backfill if agreed to by all the Owner's representative and the Utility's representative.
- B. Unless otherwise stating in the plans, abandoned utility lines may be cut to facilitate installation of the new Works. All open ends are to be plugged. The cut utility line shall be removed from the site.
 1. Waterlines are to be capped with a cast-iron cap or a 3-foot-long concrete plug.
- C. Sewer services, water services, and other utility service lines are not shown on the Drawings. Interference with these services may occur. If such situations arise, the Contractor shall move the conflicting utilities (such as water service leads, sewer service lines, gas lines, etc.) or adjust the pipeline vertical and/or horizontal alignment to maintain required vertical and/or horizontal separations. All proposed modifications to the pipeline alignment shall be presented to the Owner's Representative for review and all changes made shall conform to the recommendations of the Owner's Representative.

- D. If the utility must be removed to facilitate construction of the new Works, the utility will be reconstructed with new materials and placed back into service. During this period, Contractor shall provide temporary service for the disconnected utility.
- E. Disruption of water service to residential and/or places of business as a result of the Contractor's operations shall be limited to a maximum of 8 (eight) hours. In the event that disruption of a particular service will be longer than 8 hours, the Contractor shall provide temporary potable water service which meets the Department of Health requirements for potable water to the affected residence or place of business for drinking purposes. In the event that disruption of a particular service will be longer than 24 hours, the Contractor shall provide temporary potable water service which meets the entire domestic water demands of the affected residence or place of business. The Contractor shall at all times maintain on site, the materials required for providing temporary water services.
- F. Waterlines whose thrust is in the direction of the new excavation, may be affected by the construction. Protect thrust blocks in place or shore to resist the thrust by a means approved by the Owner's Representative. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Owner's Representative, reconstruct them to bear against firm unexcavated.

END OF SECTION

SECTION 313219
FILTER FABRIC

PART 1 - GENERAL

1.1 Description

- A. This section includes materials and installation of filter fabric and its maintenance until either riprap, gravel base, or special rock cover is completed.

1.2 Related Work Specified Elsewhere

- A. Section 313700 "Riprap".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog data.
- C. Submit manufacturer's installation instructions and details.
- D. Submit mill certificate or affidavit signed by a legally authorized official from the company manufacturing the fabric. The mill certificate or affidavit shall attest that the fabric meets the chemical, physical, and manufacturing requirements stated in this section.

PART 2 - MATERIALS

2.1 Filter Fabric

- A. Filter fabric shall be a pervious sheet of non-woven extruded monofilament. The filter fabric shall provide an equivalent Opening Size (EOS) no finer than the U.S. Standard Sieve No. 100 and no coarser than the U.S. Standard Sieve No. 30. non-woven filter fabric shall be North American Green GGS 8.0 or equal.
- B. The extruded monofilaments shall consist of 100% polypropylene staple fibers and shall resist ultraviolet deterioration, rotting, biological degradation, and naturally encountered basics and acids. The fabric shall conform to the physical strength requirements as follows.
 - 1. Tensile Strength: 205 pounds, minimum in any principal direction, measured in accordance with ASTM D4632.
 - 2. Puncture Strength: 525 pounds, minimum, measured in accordance with ASTM D6241.
 - 3. Weight: 8.0 ounces per square yard, minimum, measured in accordance with ASTM D5261.
- C. Manufacture the fabric so that the yarns will retain their relative position with respect to each other. Finish the edges of the fabric to prevent the outer yarn from pulling away from the fabric.

2.2 Securing Pins

- A. Securing pins shall meet the requirements of the manufacturer.

PART 3 - EXECUTION

3.1 Shipment and Storage

- A. Protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140° F., mud, dirt, dust, and debris at all times during shipment and storage. To the extent possible, wrap the fabric in a heavy-duty protective covering.

3.2 Subgrade Preparation

- A. Prepare the surface to receive fabric to a smooth condition free of sharp objects, obstructions, depressions, debris, and soft or low density pockets of material.

3.3 Placement

- A. Place filter fabric in the manner and at the locations shown on the Drawings. Do not use fabric with defects, rips, holes, flaws, deterioration, or damage of any nature.
- B. Handle and place filter fabric in accordance with the manufacturer's recommendations. Stretch, align, and place the fabric in a wrinkle-free manner.

- C. Place fabric with the long dimension parallel to the centerline of the channel for placement beneath riprap and transversely across the trench for use as buoyancy restraint. Lay smooth and free of tension, stress, folds, wrinkles, or creases. Place the strips to provide a minimum width of 12-inches of overlap for each joint or per manufacturer's recommendations, whichever is greater.
- D. Insert securing pins with washers through both strips of overlapping fabric at not greater than 3 foot intervals along a line through the midpoint of the overlap or as indicated by manufacturer's recommendations, whichever is greater.
- E. Install additional pins regardless of location to prevent any slippage of the filter fabric. Place the fabric so that the upstream strip of fabric will overlap the downstream strip. Each securing pin shall be pushed through the fabric until the washer bears against the fabric and secures it firmly to the foundation.

3.4 Covering with Riprap

- A. Schedule the work so that the covering of the fabric with the planned thickness of riprap is accomplished within 30 days after placement of the fabric. Failure to comply shall require replacement of the fabric.
- B. Protect the filter fabric from damage due to the placement of riprap by limiting the height of drop of the material or by placing a cushioning layer of sand on top of the fabric before dumping the material. Before placement of riprap, the Contractor shall demonstrate that the placement technique will prevent damage to the fabric.

3.5 Repairing Damage

- A. Protect the fabric at all times during construction from contamination by surface runoff. Remove and replace fabric so contaminated with uncontaminated fabric. Repair any damage to the fabric during its installation or during placement of riprap by the Contractor at his expense.
- B. Repair fabric damaged during placing by placing a piece of fabric that is large enough to cover the torn or punctured area and to meet the overlap requirement.
- C. Damage to the fabric resulting from the Contractor's vehicles, equipment, or operations shall be repaired by the Contractor at his expense.
- D. Maintain a minimum of 6 inches of material between the fabric and Contractor's equipment. Do not operate or drive equipment or vehicles directly on the filter fabric.

END OF SECTION

SECTION 313700

RIPRAP

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes materials and installation of riprap for the protection of embankments, ditches, channels, stream banks, and at pipe discharges.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10
- B. Submit gradation of the material to be used and soundness test, (not older than 2 years).

1.3 QUALITY CONTROL

- A. Acceptance of quality and size of material will be made by visual inspection at the job site.

PART 2 PRODUCTS

2.1 NATURAL STONE

- A. Stone for riprap shall be quarry stone, well graded and angular. Stone shall be of such shape as to form a stable protection for the required section. Do not use flat or elongated shapes unless the thickness of the individual pieces is at least one-third the length. Material shall be clean and free from deleterious impurities including alkali, earth, clay, refuse, and adherent coatings with no more than 10 percent of soil, sand, shale or non-durable rock.
- B. Rock used for riprap and rock ditch liner shall meet requirements of MoDOT for each type listed in Plans.

PART 3 INSTALLATION

3.1 PLACEMENT

- A. Grade areas to a smooth surface. Place riprap on a filter blanket on the prepared slope in such a manner as to produce a well-graded mass with the minimum practical percentage of voids. Do not puncture or penetrate the geotextile liner if installed.
- B. Place the riprap to its full course thickness as shown on the Plans in one operation and in such a manner as to avoid displacing the underlying material and manipulated to eliminate large voids.
- C. Do not place rip rap over frozen or spongy subgrade surfaces.
- D. The finished surface of the blanket shall present an appearance free from segregation and with a proportionate quantity of the larger pieces showing. The rock shall be placed to the specified thickness, elevation and manipulated to eliminate large voids. The finished surface shall present a uniform appearance true to line, grade and section.

END OF SECTION

SECTION 321540
CRUSHED STONE PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provision of aggregate base course material consisting as a mixture of coarse and fine graded aggregate that is free of vegetation and other deleterious matter. Work consists of placing one or more lifts of aggregates, and specified additives, on prepared subgrade, as specified, using conventional equipment and methods for mixing, placement, and compaction of aggregates onto subgrade.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
 - 1. Section 013300.10 "Submittal Procedures".
 - 2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping[and stockpiling] topsoil, and removal of above- and below-grade improvements and utilities.
 - 3. Section 312000 "Earth Moving" for subgrade preparation and subgrade testing.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- D. Engineered Fill: Fill material allowing the required compaction density. Can be same material used for crushed stone paving.
- E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- F. Fill: Soil materials used to raise existing grades.
- G. Subbase Course: Aggregate layer placed between the subgrade and base course for pavement.
- H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10
- B. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles, if necessary.
- C. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each aggregate material proposed for paving as follows:
 - 1. Sieve gradation according to State DOT.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during paving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. For roadway crossings, maintain one lane of traffic at all times and follow plans for single lane closure and the latest edition of the MUTCD.

- B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning paving operations.

PART 2 - PRODUCTS

2.1 STONE MATERIALS

- A. General: Provide crushed stone materials meeting plan thickness.
 - 1. Aggregate for paving shall meet requirements of 2020 Missouri Standard Specification for Highway Construction (MSSHC), Section 304 - Aggregate Base Course. Materials for Aggregate Base and shall conform to Type 5 aggregate per Missouri Department of Transportation (MoDOT). Gradation for base to meet Type 5 aggregate. Surface aggregate to meet MoDOT Section 1006.
 - a. Engineer may request test results for material prior to and during paving construction to ensure quality control of materials.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by Crushed Stone Paving operations.
- B. Protect and maintain erosion and sedimentation controls during paving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. Subgrade to be excavated and compacted per Section 312000 "Earth Moving".
- E. If necessary, place Geotextile as required under crushed stone paving per manufacturers recommendations.
- F. Do not place crushed aggregate or geotextiles on excessively wet, frozen, rutted subgrade or any surface not in compliance with compaction density requirements in Section 312000 "Earth Moving".
- G. Aggregate to be uniformly mixed to form a homogeneous mixture of particles.

3.2 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
 - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches outside of edge of paving.

3.3 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or engineered fill material as directed.
- C. Proof-roll subgrade below pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or engineered fill as directed.

- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.4 SOIL MOISTURE CONTROL

- A. Uniformly moisten subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

3.5 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Layers of Crushed Stone Aggregate is to be placed in uniform layer thickness via a mechanical spreader such that no compacted layer exceeds 6 inches.
- B. Maximum thickness of one compacted layer is 6 inches. Minimum layer thickness of one compacted layer is 3 inches.
- C. Compacted aggregate surfacing is to be at 95 percent standard proctor at +/- 2 percent optimum moisture per ASTM D 698.

3.6 FIELD QUALITY CONTROL

- A. Final compacted surface is to be constructed to elevations on Drawings within 0.04 feet (1/2 inch). Ensure surface smoothness is within 0.04 feet (1/2 inch) in 10 feet. Test for smoothness with 10 foot long straightedge.
- B. Ensure an average compacted thickness within 0.02 feet (1/4 inch) of that detailed on drawing. Contractor to correct any thickness deficiencies by removing material, scarifying to a depth of 3 inches and adding material resulting in a minimum 3 inch compacted lift.
- C. Contractor to ensure uniform compaction of all crushed stone surfacing.

END OF SECTION

SECTION 329219

SEEDING

PART 1 GENERAL

1.1 Summary

- A. This section governs the furnishing of all labor, equipment, tools and materials, and the performance of all work for final seeding of lawns and non-maintained vegetation areas, disturbed by construction operations, and removal of rocks, debris and other foreign matter not suitable for a seed bed.
- B. Refer to SWPPP and Land Disturbance permit for temporary seeding and other erosion control products usage in conjunction with seeding and mulching.
- C. Alternative forms of seeding and mulching, such as hydro seeding and hydro mulching, may be submitted for review.

1.2 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Provide a mechanically printed seed mixture tag showing percentage of seed mix, year of production, net weight, germination rate, purity, date of packaging, and location of origin.
- C. Hydro mulch material, rolled erosion control product (RECP), and other manufactured products.
- D. Fertilizer: certification of analysis from a certified fertilizer dealer, and straw to be inspected in the field prior to application.

PART 2 PRODUCTS

2.1 Mulch

- A. Oat, rye or wheat straw, that are reasonably free from weeds, foreign matter detrimental to plant life, and in dry condition.

2.2 MANUFACTURED BMP PRODUCTS

- A. Rolled Erosion Control Product (RECP) may be used for temporary erosion control to hold seed until the newly seeded area is stabilized. The RECP shall be 100% agricultural straw stitched with degradable thread to a single UV accelerated photodegradable polypropylene netting, similar to North American Green S-75 on embankments and DS-75 in lawn areas.
- B. Other forms of RECP may be proposed, such as Bonded Fiber Matrix (BFM) and Turf Reinforcement Mat (TRM).

2.3 Fertilizer

- A. A commercial granular fertilizer, grade 13-13-13 total nitrogen (N), available phosphoric acid (P205), and soluble potash (K20), delivered in sealed bags and bearing the manufacturer's "Guaranteed Statement of Analysis."

2.4 Grass Seed

- A. Deliver to site in original containers showing analysis of seed mixture, percentage of pure live seed (% germination and % purity), year of production, net weight, date of packaging, and location of origin.

2.5 TOPSOIL

- A. Topsoil may be removed and stockpiled prior to trenching and grading operations.
- B. Topsoil furnished by the CONTRACTOR shall consist of a natural friable surface soil without admixtures of undesirable subsoil, refuse, or foreign materials. It shall be reasonably free from roots, hard clay, and coarse gravel, stones larger than one inch in any dimension, noxious weeds, grass, brush, sticks, stubble or other material which would be detrimental to the proper development of vegetative growth.
- C. Topsoil shall be pulveritized, ground, and screened.

PART 3 EXECUTION

3.1 TEMPORARY SEEDING

- A. Provide temporary seeding in areas prone to erosion and sediment transport.
- B. Install RECP in areas that are steeper than 6 (horiz): 1 (vert) according to manufacturer’s recommended method.
- C. Temporary Seed Mix: Apply the following temporary grass seed mix at the specified rate per acre.
 - 1.
 - a. Spring Planting

Location	Species	Pounds per Acre
Established Lawns	Oat or Rye	60
Non-Lawn Areas	N/A	N/A

- b. Fall Planting

Location	Species	Pounds per Acre
Established Lawns	Winter Wheat/Rye	60
Non-Lawn Areas	N/A	N/A

- 2. Fertilizing
 - a. Apply fertilizer at a rate of 150 pounds per acre.
 - 3. Reseeding
 - a. Reseed areas within 30 days of initial seeding where no stand of grass has occurred.

3.2 FINAL SEEDING

- A. GENERAL
 - 1. Planting Season: March 1 - April 30 or August 23 - October 16
 - 2. Mulched on the same day.
 - 3. Proceed with planting only when existing and forecasted weather conditions permit. Do not sow immediately following rain, when ground is too dry, or during windy periods.
 - 4. Areas to be seeded as a dormant seeding must be protected from erosion over winter by mulching.
- B. SURFACE PREPARATION
 - 1. Scarify subsoil to a depth of 6 inches by means of blading, chisel plowing, discing, rock picking, harrowing or any other operation necessary to return the ground surface as nearly as practical to its original condition. Remove foreign materials, plants, roots, stones one inch and larger, and debris from the disturbed area. Add suitable material to areas that settled excessively. Spread six inches of topsoil over the area. Rake until the surface is smooth and level with the surrounding ground.
 - 2. Topsoil: see 2.05.

3.3 Fertilizing for Established Lawns

- A. Apply fertilizer at a rate of 300 pounds per acre. Work the fertilizer into the topsoil.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Mix thoroughly into topsoil.
- D. Lightly water to aid the dissipation of fertilizer.
- E. If seeding with the drilling method, include a fertilizer attachment on the drill which allows the placement of fertilizer in a band on or near the drill row.

- F. If seeding by means of a hydraulic seeder, include the required amount of fertilizer to be mixed with the seed, cellulose fiber mulch and water and applied in the seeding operation.

3.4 Permanent Seeding for Established Lawns

- A. Apply seed evenly in two intersecting directions using mechanical power drills or seeders.
- B. Roll seeded area with cultipacker type roller at right angle to slopes not exceeding 112 lbs.
- C. Grass Seed Mix:

Species	% of Mix	PLS per Acre
K31 Fescue	80	340
Perennial Rye	20	60
Total	100	300

3.5 Mulching for Established Lawns

- A. Immediately following seeding and compacting, apply mulch to a thickness of not less than 1/8 inches (approximately 2 tons per acre). Approximately ten (10) percent of the soil surface shall be visible through the mulch blanket prior to mulch tiller (punching) operation. Maintain clearance from shrubs and trees.
- B. The mulching material shall be punched into the soil so that it is partially covered. The punching operation shall be performed longitudinally with a mulch tiller consisting of a series of dull, flat disks with notched or cutout edges. The disks shall be approximately 20 inches in diameter and 1/4-inch thick, shall be spaced approximately 8-inches apart, and shall be fitted with scrapers. The working width of the tiller shall not exceed six (6) feet per member, but may be operated in gangs of not over 3 members each (18 feet total width).
- C. Care shall be exercised to obtain a reasonably even distribution of mulch partially incorporated into the soil. It may be necessary to use weights or hydraulic pressure to insure that the mulch is punched into the soil adequately.
- D. On slopes too steep for disking, the mulching shall be "patted" with forks as it is placed on the slopes. Soil from the top of slope areas shall be placed by hand methods on the mulching material to reduce loss due to wind. Non-friable soil should be placed over the upper 1/3 of slopes and should average approximately one cubic foot of soil to each 25 square feet of area.
- E. When mulch is applied with a straw blower, it may be necessary to remove cutting knives to prevent cutting mulch too short.
- F. The Contractor shall arrange his work so that the mulch can be placed and punched immediately after each slope area is seeded. Mulching operations shall not lag behind seeding operations more than 24 hours during clear weather. When rain is threatening, the Contractor shall make every effort to mulch areas the same day as seeded. Mulch shall be replaced before seeds germinate when re-mulching wind or rain damaged areas.
- G. Apply potable water with a fine spray immediately after each area has been mulched

3.6 Hydroseeding

- A. Contractor may propose hydroseeding upon approval of the Engineer and Owner. Contractor shall submit a hydroseeding plan and product data.
- B. The hydrospray shall be applied in the form of a slurry consisting of cellulose fiber, seed, stabilizer additives, tackifier, commercial fertilizer, and water. When hydraulically sprayed on the soil surface, the mix shall form a blotter-like ground cover impregnated uniformly with seed and fertilizer and shall allow moisture to percolate to the underlying soil.
- C. Prior to hydroseeding, the site shall be measured and staked to identify the areas to be sprayed by each truckload of mix.

- D. Hydraulic equipment used for the application of the slurry shall be a 1500-gallon capacity agitator-mixer. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing not less than 40 pounds of fiber mulch, plus a combined total of 15 pounds of fertilizer solids for each 100 gallons of water or per the submitted soil fertility analysis, whichever is less.
- E. The slurry distribution hose lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge. Slurry tank shall be mounted on a traveling unit.
- F. Seeding rate to be hydroseeded shall be increased by 50 percent,
- G. Hydroseed Slurry Mix

PRODUCT	APPLICATION RATE (pound per acre)
Seed Mix	150% of grass seeding rate
Fiber Mulch	2000
Slow-Release Fertilizer: Up to this amount per soil fertility test.	
20-10-5	200
0-18-0 Single Super-Phosphate	150
Agricultural Gypsum	500
Soil Sulfur	100
Soil Binder	100

3.7 MAINTENANCE

- A. Reseed damaged grass areas showing root growth failure, deterioration, bare or thin spots and eroded areas.
- B. Contractor shall be responsible for controlling the growth of weeds in areas disturbed during construction until all seeding work has been completed.
- C. The Contractor shall re-landscape and properly reseed all areas damaged by their operations. Trenches which have settled within the warranty period, and which were previously seeded, shall be reshaped and reseeded by the Contractor at the Contractor's expense.

END OF SECTION

SECTION 330516
PRECAST CONCRETE UTILITY STRUCTURES

PART 1 GENERAL

1.1 Summary

- A. This section includes design, materials, testing, and installation of precast concrete manholes and vaults.

1.2 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog data on precast concrete manholes, steps and ladders, frames and covers. Show dimensions and materials of construction by ASTM reference and grade. Show lettering on manhole covers.
- C. Show on shop drawings for each structure all proposed pipe size openings at the proposed elevation and orientation of penetrations.
- D. Provide product data for waterproof material, steps, ladders, and all items identified in Part 2.
- E. The date of manufacture and name of manufacturer shall be marked inside each precast section.

1.3 Loading

- A. Access openings for vaults shall be designed for 300 pounds per square footing loading, unless otherwise indicated.
- B. Soil lateral loads shall be as determined by ASTM C857 or loadings specified in the project soils report, whichever is greater. Alternate design by the strength design method shall include a load factor of 1.7 times the lateral earth or hydrostatic pressures.

PART 2 PRODUCTS

2.1 Precast Circular Concrete Manholes

- A. Precast manholes and circular wet wells shall conform to the requirements of ASTM Designation C 478 with reinforcement of Grade 60 bars and the following modifications thereto.
- B. Minimum wall thickness shall be 6 inches unless otherwise noted on in the Drawings.
- C. Joints shall be a compression type, neoprene gasket joint meeting ASTM C923. The unfilled portion of the joint shall be filled with preformed plastic joint sealing compound that conforms to Federal Specification SS-S-0021 0.
- D. Concrete adjusting rings (4-inch maximum) shall be standard manufactured product of the precast manhole manufacturer and conform to the requirements of ASTM C 478. All grade rings shall have integral key.
- E. Minimum allowable steel shall be hoops of No. 4 wire cast into each unit.
- F. Precast top sections shall be flat slab, except where shown otherwise in the drawings.

2.2 Inserts

- A. Handling eyes, lifting inserts, and threaded inserts shall be galvanized steel. Design load capacity shall be 2,000 pounds unless shown otherwise in the drawings.
- B. No more than 3 lift holes may be cast or drilled in each section.

2.3 Steps and Rungs

- A. Cast structure with steps (ladder rungs). Steps shall be 1/2-inch minimum diameter steel reinforced bar with a copolymer polypropylene plastic covering (per ASTM D4101) resistant to 1,500 pounds pullout force, conform to ASTM C-478 and OSHA standards, and allow hand-driven installation into precast manholes. The tread shall be at least 3/4 inch wide.

- B. Minimum clear length of rungs shall be 14 inches. Space rungs vertically at 16 inches on center, set between 5 and 6 inches from the face of the concrete, and align with each other in a straight vertical line (both parallel and perpendicular to ladder rungs).

2.4 Manhole Frames and Covers

- A. Manhole frames and covers shall be made of cast iron conforming to ASTM A48, Class 35B. Castings shall be smooth, clean, and free from blisters, blowholes, and shrinkage. Frames and covers shall be designed for H20-44 traffic loads. The cover shall seat firmly into the frame without rocking.
- B. Manhole ring and cover shall be:
 - 1. Neenah No. R-1769-A, Deeter No. 1048, Clay & Bailey No. 2032M or approved equal (minimum wt. of cover 150 lbs., and ring 250 lbs.).
 - 2. Watertight manhole ring and cover shall be Neenah No. R1916-F with anchor bolt holes or approved equal, minimum total weight of 450 lbs.
 - 3. Manhole ring and cover for Type II manholes shall be slab type, Neenah No. R6065 for 6' deep and 6065A for 8" deep, Deeter No. 1180 for 6" deep or approved equal. Provide stainless steel bolts and fasteners.
- C. Grind or otherwise finish each cover so that it will fit in its frame without rocking. Frames and covers shall be match-marked in sets before shipping to the site.
- D. Manhole covers shall be designated as "Sanitary Sewer" and shall be cast in 2-½" high block letters flush with the traffic surface on all manhole covers as appropriate for the individual manhole's use.

2.5 Access Hatches

- A. Provide single leaf access hatch with dimensions as indicated in the Drawings.
- B. The hatch shall be furnished with locking lugs to receive a padlock and recessed lifting handles.
- C. All aluminum in contact with concrete, mortar, steel, or stainless steel shall be protected from direct contact through the use of bituminous coating or some other means.
- D. The hatch shall be provided with 316 stainless steel hardware throughout.
- E. The hatch shall be cast into the top slab

2.6 Concrete

- A. Cement for manholes shall conform to ASTM C150, Type II, 4000 psi compressive strength.

2.7 Sealing Compound and Mortar

- A. Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S.
- B. All grout used for sealing around pipe openings shall be of a type acceptable to the Engineer and designed for use in water. All openings and joints shall be sealed watertight.
 - 1. Nonsrink grouts shall have a minimum 28 day compressive strength of 5000 psi, shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827, and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
- C. Joint sealant shall be approved preformed mastic sealant. Sealant shall conform to the requirements of AASHTO M198 and shall be Kent seal or Ram Neck or pre-approved by the Engineer. Where specifically indicated, trowelable mastic sealant shall be a butyl rubber sealant, Trowelable EZ-Stik #3 as manufactured by Press-Seal Gasket Corporation or approved equal. Use Conseal CS 440 for fuel and oil resistant applications.

2.8 Pipe Connectors

- A. Flexible resilient watertight manhole and pipe connector shall meet all material and performance requirements of ASTM C923 for pipe outside diameter 4" through 60". Gasket material shall be

produced from a polyisoprene blend compound or chemically resistant neoprene EPDM flexible boot. Natural rubber gaskets will not be acceptable.

- B. Manhole to pipe connectors shall be cast into the manhole wall during the manufacturing process.
- C. Approved pipe connectors are:
 - 1. A-Lok X-CEL as manufactured by A-Lok Products, Inc.
 - 2. Z-Lok-XP (A-Lok Products, Inc.).
 - 3. Kor-N-Seal (Dukor Corporation),
 - 4. Storm sewer pipe connections shall be Quik-Lok or Z-Lok STM (A-Lok Products) or equal.

2.9 COATING

- A. Waterproofing. The interior and exterior walls of all sanitary manholes shall be given two coats, each 12-15 mils dry film thickness, of Uniseal 1600, as manufactured by Anchor Tite or approved equal.

PART 3 EXECUTION

3.1 Manhole Base

- A. Excavate for the manhole and install a base of 8 inches thick washed crushed rock (3/4" max.), or as shown on the Plan details. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete manhole base.
- B. Form and pour concrete bases as one monolithic pour. For sewer manholes, form the portion above the invert elevation of the sewer pipe to provide a smooth channel section. Channels shall vary uniformly in size and shape from inlet to outlet.

3.2 Installation

- A. Set each precast concrete manhole unit plumb on a bed of sealant or mortar to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Point the inside joint and wipe off the excess sealant or mortar. Secure the manhole frame to the grade ring with grout and cement mortar fillet. Backfill and compact.
- B. When working inside manholes, Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- C. Handle with care to avoid damage to joint ends of each section. Damaged sections may be subject to rejection at the discretion of the Engineer. All manhole and vault construction shall be watertight. The invert, walls and steps shall be cleaned of excess grout and laitance.
- D. Precast Sections: Precast-reinforced concrete sections shall be set so as to be vertical and with sections in true alignment.
- E. All holes in sections, used for their handling, shall be thoroughly plugged with mortar. The mortar shall be 1 part cement to 1-1/12 parts sand; mixed slightly damp to the touch (just short of "balling"): hammered into the holes until it is dense and an excess of paste appears on the surface; and then finished smooth and flush with the adjoining surfaces.
- F. Upon installation the exterior of all structures shall be given an asphaltic waterproofing. The exterior surfaces of precast and poured-in-place manholes shall be coated with two heavy coats of a water-based asphaltic coating. Application and curing shall be in accordance with the manufacturer's specifications and instructions. Coating shall be fully dried before backfilling
- G. Mortar
 - 1. All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar.

3.3 CONNECTION TO MANHOLES

- A. Connections to new manholes shall utilize flexible connections. Flexible connections allow for limited differential settlement to occur between the pipe and manhole. The uniform compaction of

the bedding material under the pipe and up to the spring line or top of the pipe as detailed is essential to the control of this differential settlement. Resilient connectors shall be used with all flexible connections. A flexible preformed mastic sealant shall be installed around the bottom half of the exterior pipe surface between the resilient connector and the invert. This flexible sealant shall be installed to separate the pipe from the invert to maintain the flexibility of the pipe/manhole connection. Pipes installed with flexible connections shall not have concrete encasement at the outside of the manhole.

B. DAMPPROOFING

1. Manholes shall be dampproofed on the exterior. Surfaces to receive coating shall be dry. Before backfilling is started, the exterior surfaces of precast and poured-in-place manholes shall be coated with two heavy coats of a water-based asphaltic coating. Application and curing shall be in accordance with the manufacturer's specifications and instructions. Coating shall be fully dried before backfilling.

3.4 Cleaning and Testing

- A. After all installations are complete, including all backfill and compaction, all structures and appurtenances shall be cleaned of foreign materials. Flushing of foreign materials from a newly completed section of sewer into section already in service will not be allowed. If the lining or coating system is damaged during either installation or cleaning it shall be repaired in strict accordance with and approved by the coating system manufacturer's technical field service personnel.
- B. Contractor shall furnish all labor, tools, potable water (if a hydrostatic test is allowed) and equipment necessary to perform all tests as specified herein.
- C. If inspection or test shows defects, such defective work or material shall be replaced and inspection and tests repeated. Repairs to piping and appurtenances shall be made with new material at no additional cost to the Owner.
- D. Manholes structure shall be either vacuum or hydrostatically tested. Vacuum or hydrostatic testing is recommended prior to backfilling, where feasible, to assist in locating leaks. The final test and acceptance shall be based only on a test after the manhole is backfilled and the cast manhole ring is in place. Existing manholes where new connections are made will not be required to be vacuum or hydrostatically tested. These manholes shall be visually inspected for water tightness with any leakage noted and corrected prior to manhole acceptance.
- E. Testing Methods
 1. Vacuum Test - Plug all manhole entrances and exits other than the manhole top access using suitably sized and rated pneumatic or mechanical pipeline plugs. Follow manufacturer's recommendations and warnings for proper and safe installation of such plugs, taking care to securely brace the plugs and the pipe. Attach the vacuum test device to the cast manhole ring and draw a vacuum to 10" of mercury. With the valve at the vacuum line connection closed and the vacuum pump off, measure the time required for the vacuum to drop to 9" of mercury. The manhole passes the test if the time is greater than 60 seconds for a 48" diameter manhole, 75 seconds for a 60" diameter manhole, and 90 seconds for a 72" diameter manhole. If the manhole fails the test, the Contractor shall locate the leak and make proper repairs with non-shrink grout. The manhole shall be retested until acceptable test results are obtained.

2. Hydrostatic Test - Manholes may be tested using internal or external hydrostatic pressure with prior approval by the Engineer. External hydrostatic testing shall only be used where the groundwater level is at least 4 feet above the invert of the manhole. In all other cases, the internal hydrostatic test procedures must be followed. Sewers connected to the manhole shall be adequately plugged. For the internal hydrostatic test, the manhole shall be filled with water to the top or to a maximum depth of 25-feet above the invert. Water gain or loss shall not exceed 1.14 gallons per day per vertical foot of manhole for either external or internal hydrostatic testing. Infiltration and exfiltration shall be determined after 24 hours of hydrostatic testing by determining the gain or loss of water in the manhole. Contractor shall be responsible for retrieving any plugs or material accidentally washed down a sewer.

END OF SECTION

SECTION 331253
FLOATING BAFFLE CURTAIN

PART 1 GENERAL

1.1 DESCRIPTION

- A. Scope:
1. Supplier shall furnish all baffle curtain materials, anchor forms, all hardware, and incidentals required for installing, completing, and readying for operation, the floating baffle curtain for Lagoon Cell #2 shown on the Drawings and as specified herein, with the exception of concrete anchors and anchor posts. Contractor shall provide and install concrete anchors and anchor posts in accordance with the suppliers requirements. Contractor and Supplier shall coordinate for the construction and installation of the baffle curtain.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
1. The manufacturer of the floating baffle curtain shall have at least ten years of experience in the construction of floating baffle curtains utilizing dielectric and/or hot wedge sealing fabrication methods. No sewn seams shall be permitted.
 2. The manufacturer of the floating baffle curtains shall have manufactured no less than five-thousand linear feet of baffle curtains for tanks, ponds, and open water applications.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submittals must first be approved by the Engineer and shall include the following:
1. Shop drawings with construction details of the floating baffle curtain.
 2. Floating baffle curtain manufacturer including contact name, address and
 3. telephone number.
 4. Product data and physical properties of the floating baffle curtain material along with fabric manufacturer name, contact, address, and telephone number.
 5. Product data with specifications covering all components used in the fabrication of the floating baffle curtain.
 6. Installation instructions.
 7. Operation and maintenance instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Packing, shipping, Handling and Unloading:
1. Deliver materials to the site to ensure uninterrupted progress of the work. Packaging of the floating baffle curtain shall be the responsibility of the floating baffle curtain manufacturer and so that the floating baffle curtains shall not be damaged during shipment.
- B. Storage and Protection:
1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

1.5 WARRANTY

- A. The baffle manufacturer shall warrant the floating baffle curtain against defects in workmanship and materials for a period of two years from the date of delivery.
- B. The floating baffle curtain material shall be warranted by the manufacturer against weathering for a period of ten years, prorated.

PART 2 PRODUCTS

2.1 EQUIPMENT PERFORMANCE

- A. Description:

1. The baffle curtains shall consist of a fabric wall that is anchored at the bottom by a galvanized chain in a sealed pocket and is floated at the top by buoyant logs that are also in a sealed pocket. The floating baffle curtains shall be constructed in multiple sections resulting in the specified dimension of each curtain. Weight and ease of handling at the job site shall be taken into account when determining the lengths of the prefabricated floating baffle sections. The floating baffle curtains shall be delivered to the jobsite ready to install and the only fabrication required at the jobsite shall be the connection of the floating baffle sections. The floating baffle curtains shall be floated into position for installation.
- B. Design Criteria:
1. A total of one (1) floating baffle curtain is required:
 - a. One 8 ft 4 inch deep by approximately 520 ft long (Contractor to verify lagoon dimensions) floating baffle curtain with 2 tapered ends to fit a 3 to1 slope. Ballast chain and / or cable connections to the shore anchor posts shall be constructed to a sufficient length to allow for installation.
 - b. Material of construction shall be compatible with wastewater.
 - c. Floating baffle curtain shall be designed for a peak flow of 1,728,000 gpd. There shall be a minimum of two reinforced windows to convey flow in a serpentine pattern. Each window shall have minimum dimensions of 5 foot length by 4 foot width. Window flowrate shall be a maximum of 30 gpm/ft².

2.2 DETAILS OF CONSTRUCTION

- A. Flotation:
1. The flotation shall consist of 6-inch diameter (minimum) flotation logs made of closed cell polyfoam logs, having the buoyancy of at least 60 pounds per cubic foot.
 2. The flotation shall be completely enclosed inside the floating baffle curtain by means of a thermal seal. Each flotation log shall be sealed in its own chamber along the top of the floating baffle curtain.
- B. Anchoring:
1. Bottom Ballast:
 - a. The floating baffle curtain shall be anchored in position by a galvanized chain thermally sealed into a pocket along the bottom of the curtain.
 - b. The chain shall be continuous from berm through each floating baffle curtain section, connected to each other with a 3/8" stainless steel rapid link. The ballast shall be 3/8" (minimum) galvanized proof coil chain.
 2. Concrete Anchors:
 - a. Concrete anchors shall be placed along the upstream side of the ballast chain at 18' intervals beginning at the toe of the lagoon.
 - b. The concrete anchors shall be attached to the ballast chain using a stainless steel rapid link or marine grade rope. The connection shall be secured to the ballast chain through cutouts in the ballast chain pocket forming an opening exposing the ballast chain for attachment of the concrete anchors. The concrete anchors shall be made using a five-gallon bucket, filled with concrete with a 3/8" x 9-inch-long or greater galvanized eyebolt, flat washer and two nuts, inserted into the concrete at least 6" to 7" to form an attachment. The eyebolt shall be of a size to accept a 3/8" stainless steel rapid link thru the eye of the eyebolt.
 3. Retrieval Rope:
 - a. The concrete anchors shall be made retrievable by securing one end of a 3/8" diameter marine grade rope through the ballast chain and the other end of the rope secured to a stainless-steel grommet paced in the flotation collar located at the top of the floating baffle curtain.
 4. Shore Anchor Post:
 - a. The shore anchors shall consist of a minimum of 3" diameter by 10' long 304 Galvanized schedule 40 pipe buried a minimum of six feet in concrete. Concrete should encase the post at a minimum diameter of 2'. The shore anchor post shall also

be filled with concrete. The shore anchor posts shall be located on the lagoon side slope approximately 1' to 2' off the top of the lagoon.

C. Cable

1. Tension Cable:
2. The cable shall be 3/8" diameter, stainless steel sealed in a pocket on the top side of the flotation collar and shall be continuous from berm through each floating baffle curtain section, connected to each other with 3/8" stainless steel rapid links.

D. Connections:

1. End Connection:
 - a. The end connections shall consist of 1/4" x 4" x 12" stainless steel predrilled plates that shall be attached to the floating baffle curtain with 3/8" diameter by 1-1/2" long stainless-steel bolts to "sandwich" the end of the floating baffle curtain between the end plates. The tension cable or connection chain shall connect the anchor posts to the stainless steel predrilled plates at both top and bottom of the curtain. No grommets shall be used for the connections to the shore anchor posts.
2. Baffle Connection:
 - a. The floating baffle curtain sections shall be joined with the use of 3/16" x 1-1/2" x 10" long stainless steel predrilled plates and 3/8" diameter by 1-1/2" long stainless-steel bolts. The plates shall be applied to the outside of each floating baffle curtain section, then bolted together to "sandwich" the joining sections together.
3. Miscellaneous Hardware:
 - a. All hardware provided for the floating baffle curtains shall be type 304 stainless steel. The galvanized ballast chain shall be the only exception.

E. Baffle Curtain Material

1. The baffle material shall be a reinforced synthetic material. The material supplied under these specifications shall be a first quality product specifically designed and manufactured for this application and demonstrated to be suitable and durable for the construction of floating baffle curtains.
2. Physical Specifications:
 - a. Color: Black
 - b. Base Type: Polyester
 - c. Fabric weight: 7 oz/yd²
 - d. Finished Coated Weight: 30.0 +/- 2.0 oz/yd²
 - e. Grab Tensile: 550/525 lbs/in
 - f. Minimum Adhesion: 10 lbs/in
 - g. Minimum Hydrostatic Resistance: 500 psi
3. The material shall be 6730 XR-5 as manufactured by the Seaman Corporation of Wooster, Ohio.

2.3 MANUFACTURERES

- A. Provide equipment from:
 1. Engineered Textile Products, Inc. of Mobile, Alabama or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Contractor to verify dimensions of the lagoon and to determine exact location of the shore anchor posts prior to ordering floating baffle curtain.
- B. The floating baffle curtain shall be installed into position as shown on the Drawings. The floating baffle curtains shall be installed in accordance to manufacturer's shop drawings, instructions and recommendations.

3.2 MANUFACTURER'S SERVICES

- A. Provide to Engineer, certification that the floating baffle curtain was installed in accordance with the Contract Documents.

END OF SECTION

SECTION 333100
GRAVITY SEWER PIPE

PART 1 GENERAL

1.1 REQUIREMENTS

- A. The Contractor shall furnish all pipe and fitting material, tools, equipment labor necessary for material handling, cutting, installation and jointing of various types and sizes of pipe at the locations shown on the drawings or detailed and in conformance with the specifications.

1.2 QUALITY ASSURANCE

- A. Items submitted for approval in accordance with requirements shown on the drawings and details shall be of the manufacturers indicated, or an approved equal, in compliance with materials, operations, physical assembly and performance as specified herein.
- B. Tests and certification of compliance for materials shall be furnished as specified.

1.3 APPLICABLE STANDARDS

- A. Specifications of the following listed standards will be referred to hereinafter by standards abbreviation and specification number. Products shall conform to the latest revisions thereof.
 - 1. ANSI - American National Standards Institute.
 - 2. ASTM - American Society for Testing and Materials.
 - 3. AWWA - American Water Works Association.

1.4 SUBMITTALS

- A. Submit detailed shop drawings under provisions of Section 013000. Clearly indicate make, model, location, type, size, class and pressure rating.

1.5 COORDINATION OF WORK

- A. All work shall be fully coordinated with other work and shop drawings must be checked with each of the various trades. Conflicts in the sequence of the work shall be coordinated through consultation with the Engineer.

1.6 WARRANTY

- A. In addition to guarantee requirement in General Conditions, the manufacturer's warranties shall be provided for equipment as standard with the manufacturer.

PART 2 PRODUCTS

2.1 GENERAL

- A. All products shall be new and unused and shall be the product of a reputable manufacturer regularly engaged in the manufacture of the product. Where two or more units of the same class are required, these units shall be products of a single manufacturer; however, the component parts of equipment need not be the products of the same manufacturer.

2.2 MATERIALS

- A. PVC Pipe and Fittings for Gravity Sewer and Service Laterals
 - 1. Pipe materials for 4"-15" diameters shall conform to ASTM D3034, Type PSM, SDR 26. Pipe with diameters 18"-36" shall conform to ASTM F679-PS115. Fittings shall be molded of PVC material suitable for use with ASTM D3034, SDR 26, PVC sewer pipe.
 - 2. Pipe and fitting material shall be made of PVC plastic having a cell classification of 12454-B or 12454-C and a minimum tensile modulus of 500,000 psi as defined in ASTM D1784.
- B. Pipe and fitting joints:
 - 1. Flexible gasketed joints shall be compression type. All joints to be integral bell, single gasketed and designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendations.
 - 2. Gaskets shall consist of a properly vulcanized high-grade elastomeric compound meeting the requirements of ASTM F 477 for low head applications. The basic polymer shall be a

synthetic rubber. The gasket shall provide an adequate compressive force so as to affect a positive seal under all combinations of joint tolerances, and to provide a positive seal against infiltration or exfiltration.

3. Joints shall be bell and spigot design conforming to ASTM D3212.
4. Fittings to be of same classification and compatibility as adjoining pipe.

2.3 ACCESSORIES

- A. Pipe Bedding – shall be Classes I, II, or III, as described in ASTM D2321.

2.4 Tracer Wire

- A. All gravity sewer pipes and new sections of laterals shall be installed with tracer wire to facilitate future location of the pipe.
- B. Locator wire shall be #12 gauge solid copper wire with PE-45 insulation as manufactured by Kris-Tech Wire Company or an approved equal. Alternative manufacturer wire must be specified as locator or tracer wire and shall not be conductor wire for other purposes.
- C. Locator wire shall be installed in such a manner to keep slices to an absolute minimum.
- D. All connections or splices shall be made with a Splice Kit equal to 3M-DBR-Part Number – 054007-09964 or approved equal.
- E. Wire shall be taped as shown on the Construction Plan details.
- F. Wire shall be installed along all lines and outside manhole structures, lampholes, and cleanouts as shown on the Construction Plan details and shall have enough slack to extend to 48" above ground.
- G. Contractor must prove continuity of locator wire after installation is complete. Owner's Representative must be present during continuity testing.
- H. Locator wire installation, including signal loss, shall be warranted for one year.

PART 3 EXECUTION

3.1 INSTALLATION OF BURIED PIPING

- A. General: The Contractor shall investigate all conditions affecting his work, arrange the work accordingly, and have such fittings and accessories as required on hand to meet the condition and provide a complete installation. The pipe lines shall be laid to the elevations shown on the plans.
- B. Excavation and backfill shall be as shown in the Construction Plan Details. Pipe shall be placed in a flat bottom trench accurately graded to uniformly support the entire length of the barrel of the pipe with bell holes excavated for the joints.
- C. Pipe Handling: Pipe fittings, valves and accessories shall be handled in a manner to insure installation of the material in an undamaged and structurally sound condition. Particular care shall be taken to not harm pipe coatings and lining. Handling equipment procedures shall be in accordance with the approved manufacturer's recommendations for proper handling of his products. Improper handling of pipe that results in damage to the cement lining or exterior coating will be grounds for rejection of the pipe for installation. Defective lines and coatings may be repaired by and at the expense of the Contractor and under the recommendations of the manufacturer of the pipe. The Engineer will be the final judge as to the acceptability of any material on the project.
- D. Pipe Cutting: Cutting of pipe is discouraged. The Contractor is urged to plan his job to minimize the necessity for cutting. Cutting that absolutely must be done shall be by use of approved mechanical or roller chain cutters. The work shall be done by workmen experienced in pipe cutting and shall be accomplished in such a manner as not to damage the lining or coating of the pipe. Field repair of cement lining and coal tar coating shall be in accordance with AWWA C104. Contractor shall smooth and grind to remove burrs and sharp edges. Contractor shall not leave discarded pipe segments on job site or buried in trench.

- E. Jointing: All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe.
- F. Temporary Plugs: Provide and install temporary plugs as indicated on the drawings or required in these specifications. Plugs shall be watertight against heads of up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.
- G. Cleaning: Prior to installation and while suspended for placement, each pipe and fitting shall be inspected for defects and cracks. The interior of all pipes and fittings shall be thoroughly cleaned of all foreign matter before installation and shall be kept clean thereafter until the line is put in service. All joint surfaces shall be kept absolutely clean during the jointing process.
- H. Gravity Sewer Alignment: Piping shall be laid to the lines and grades indicated on the drawings. Gravity sewers shall be laid with the use of a pipe laser, surveying instruments or batter board system approved by the Engineer.
- I. Testing of Sewer Lines: All sewer lines shall be tested in accordance with these specifications.

3.2 INSTALLATION OF EXPOSED PIPING

- A. Set piping plumb at the horizontal and vertical location shown on the drawings. Use pipe supports to maintain alignment.
- B. Inspect pipe before installation. Repair or patch any damaged areas on interior and exterior coatings with material matching the original lining and coating.
- C. Install piping without springing, forcing, or overstressing the pipe.
- D. Install pipe in walls and slabs before placing concrete.
- E. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Lubricate bolts with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and re-test the joints. Joints shall be watertight.

3.3 INSTALLATION OF INSULATED PVC PIPING

- A. Insulated PVC piping shall be installed per the manufacturer's recommendations
- B. Connections to Existing Lines
- C. Connections to the existing piping shall be made only after the new sewer main and treatment pond testing is complete.

3.4 TESTING OF GRAVITY SEWER LINE

- A. Visual Inspection:
 - 1. Sewer will be inspected by flashing a light or "Lamping" between manholes. Determine from the degree of illumination, the presence of any misaligned, displaced, or broken pipe and the presence of visible infiltration or other defects.
 - 2. Correct defects as required. Any length showing less than 75% open area during lamping shall be subject to correction or rejection.
- B. Deflection Testing:
 - 1. Flexible sewer pipes shall be checked for excessive deflection by pulling a rigid device or gauge through the pipe or by other methods acceptable to the Engineer. Deflection shall not exceed five (5) percent of the diameter of the pipe.
- C. Air Test:
 - 1. In addition to the visual inspection, the Contractor shall perform a low pressure air test on all pipe installed.
 - 2. Testing methods for PVC pipe shall conform to the applicable requirements of ASTM F1417.

3. Testing methods for concrete pipe shall conform to the applicable requirements of ASTM C 924.
4. Testing methods for vitrified clay pipe shall conform to the applicable requirements of ASTM C828.
5. For making the low pressure air tests, the Contractor shall use equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low pressure air. The equipment shall be provided with an air regulator valve or pressure relief valve set so that the internal air pressure in the pipeline cannot exceed 9 psig. All air used shall pass through a single control panel.
6. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
7. The Contractor shall be extremely cautious when testing with low pressure air. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. Inasmuch as a force of 250 lbf (112 N) is exerted on an 8-inch (230 mm) plug by an internal pipe pressure of 5 psi (34 kPa), it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
8. NO ONE shall be allowed in the manholes during testing.
9. The section of pipe between successive manholes shall be sealed with suitable plugs. Do not overpressure the line. Do not exceed 9.0 psig. One of the plugs shall have an orifice through which to pass air into the section of pipe being tested. The air supply source (air compressor) shall have a 9 psig pressure relief valve. The air supply line shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range of from 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of ± 0.04 psi.
10. The line under test shall be slowly pressurized to approximately 4 psi. Regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psig for at least 2 minutes. The air temperature should stabilize in equilibrium with the temperature of the pipe walls. Disconnect the air supply and decrease the pressure to exactly 3.5 psi before starting the test.
11. Determine the time required for the pressure to drop from 3.5 psi to 2.5 psi, and compare this interval to the required time to decide if the rate of air loss is within the allowable. Tables 1 and 2 show the minimum holding times for PVC pipe listed by diameter. If the pressure drops 1.0 psig before the appropriate time shown in Table 1 has elapsed, the air loss rate shall be considered excessive and the pipe section has failed the test. For testing of long sections (longer than 300 ft) or sections of larger diameter pipes (larger than 12" diameter), or both, a timed-pressure drop of 0.5 psig shall be used in lieu of the 1.0 psig drop as shown in Table 2.
12. Upon completion of the test, open the bleeder valve and allow all air to escape. Plugs should not be removed until air pressure in the test section has been reduced to atmospheric pressure.

3.5 SEPARATION of Water Mains, Sanitary Sewer and Storm Sewers

A. Parallel Installation

1. Water mains shall be laid at least 10 feet horizontally from any existing or proposed line carrying non-potable fluids such as, but not limited to drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.
2. In cases where it is not practical to maintain a ten foot separation, the Regulatory Agency may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water closer to a non-potable line,

provide that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the non-potable line and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line.

B. Crossings

1. Water mains crossing sewers, or any other lines carrying non-potable fluids shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipeline. The water main shall always be installed above the non-potable pipeline. 18-inch separation is a structural protection measure to prevent the sewer or water main from settling and breaking the other pipe.
2. At crossings, the full length of water pipe shall be located so both joints will be as far from the non-potable pipeline but in no case less than ten feet or centered on a 20-foot pipe.
3. In areas where the recommended separations cannot be obtained either the waterline or the non-potable pipeline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Special structures support for the water and sewer pipes may be required. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

3.6 Exception

- A. Any exception from the specified separation distances above (parallel and crossing) must be submitted to the Regulatory Agency for approval.

3.7 Force Mains

- A. There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches.
- B. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical joint pipe, cased in a continuous casing, or be jointless or fusion welded pipe.
- C. Where possible, the waterline shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line.
- D. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

3.8 Sewer Manholes

- A. No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole. Where the separation cannot be obtained, the waterline shall be constructed of mechanical restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.
- B. The full length of the water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than ten feet or centered on a 20-foot pipe.
- C. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.

3.9 Disposal Facilities

- A. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill.
- B. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.

END OF SECTION

SECTION 333817
REPAIRS TO CLAY LINED LAGOONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Special construction associated with lagoon facilities.
- B. The work under this section shall cover the repair of the clay lined earthen lagoon Cell #2 berm. The repair is also associated with modification activities at the lagoons where new piping is being installed.

1.2 RELATED SECTIONS

- A. Section 312333 Trenching and Backfilling.
- B. Section 321540 Crushed Stone Paving.

1.3 REFERENCES

- A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the reference thereto.
 - 1. American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards, Current Edition.
 - 2. American Water Works Association (AWWA) Standards, Current Edition.
 - 3. American National Standards Institute (ANSI) Standards, Current Edition.

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Permeability lab test for Lagoon Cell #2 berm repair.

PART 2 PRODUCTS AND MATERIALS

2.1 EARTH MATERIALS

- A. Earth fill shall consist of suitable soil materials and shall contain no deleterious materials such as logs, stumps, brush or other perishable material.
- B. Soils not suitable for dike construction may be placed in the dike backslope beyond a 1:1 slope extending outward from the outer top of dike line.
- C. Materials to be incorporated in the top one foot of the dikes shall be free of large stones, broken concrete and the like which would hinder scarifying, compacting, finishing the subgrade or installing the liner.

2.2 NATURAL SOIL LAGOON LINER

- A. Materials necessary for constructing the soil liner may or may not be found on the construction site. The material to be used shall be free from all organic matter and shall be approved by the Engineer and geotechnical engineer prior to installation.
- B. The liner thickness shall be determined according to Darcy's equation and shall include an appropriate safety factor for construction variability. The liner thickness shall be based on seepage rate of no greater than 500 gallons/acre/day or as required by DNR. In no case shall the liner thickness be less than 24 inches. The Contractor is responsible for determining the final liner thickness and providing design calculations for the thickness based on the clay soil proposed for use through coordination with a licensed geotechnical engineer in Missouri.
- C. A means shall be provided to prevent the liner from desiccating after the completion of construction and prior to placing the system in operation. This may require Contractor to bring water onsite from an offsite source. It is the Contractor's responsibility to provide this water.

2.3 BENTONITE

- A. Application of bentonite to lagoon bottoms and sides shall be necessary only if required permeability is not achieved using natural clay soils. Request approval by Engineer prior to proceeding.
- B. Application of bentonite to Lagoon Cell #2 berm repair trench shall be necessary as shown in the Drawings.
 - 1. Contractor shall provide a uniform application of high swelling and free flowing bentonite. The minimum estimated application rate shall be a 10 percent of the total backfill trench volume. Spread the bentonite with equipment that provides uniform application and minimizes wind drift. Bentonite quantities are raw quantities without consideration of variable soil conditions or any possible unforeseen unsuitable materials. The Contractor shall bid accordingly.
 - 2. Contractor shall be responsible for obtaining borrow material for the lagoon repair backfill.
 - 3. Contractor shall coordinate with Owner to perform work. Lagoon Cell #2 shall be drained completely to minimize seepage and to perform the lagoon repair work.
 - 4. Permeability shall be no more than 1.0×10^{-7} centimeters/sec (cm/sec). The Contractor shall test the lagoon backfill material to confirm it meets the permeability test and provide a submittal to the Engineer prior to backfilling. Contractor shall have the lagoon backfill material tested by a third party through shelly tube sampling and ATSM D5084 lab test method to confirm the permeability is acceptable. No backfilling shall be started until permeability test results are reviewed and approved by Engineer.
 - 5. The backfill shall be replaced in 6-inch lifts, compacted to a minimum of 95 percent standard proctor density each lift. Material below the lagoon repair shall also receive compaction to 95 percent standard proctor density.
 - 6. Cover the completed repair to match gravel drive existing conditions.

2.4 TOPSOIL

- A. Topsoil layer shall consist of stockpiled topsoil material that can be readily seeded and will support vegetation.
- B. Pulverized and free of large, extraneous material and contaminants.

2.5 SEED, FERTILIZER AND MULCH

- A. Seed shall be in accordance with Specifications.
- B. Fertilizer and mulch shall be in accordance with Specifications.

PART 3 EXECUTION

3.1 LAGOON EARTHWORK

- A. The following procedures generally describe special excavation and backfill procedures and requirements.
- B. Preparation of Excavation Site:
 - 1. Strip topsoil from excavation and borrow area(s) to minimum of 12 inches or as determined by Engineer to obtain suitable foundations; remove all topsoil, rubbish, vegetable matter, roots, grass and other organic material; stockpile topsoil for restoration of borrow area(s) and excavation area.
 - 2. Stockpile other stripping materials, which are suitable for use as fill in the opinion of the Engineer.
 - 3. Proof roll prior to placement of fill; remove or compact area of soft subgrade conditions.
 - 4. Scarify, harrow and roll embankment foundation areas as necessary to provide proper bond with first layer of new fill.
- C. Lagoon Bottom and Dikes (embankment): prepare site as directed above.
 - 1. Where in cut section (excavated to natural soils), over-excavate a minimum of one foot below bottom of finish grade; excavated subgrade shall be scarified an additional 6 inches and compacted to minimum 95% of standard Proctor density; extend over-excavation

- laterally minimum five (5) feet beyond intersection of lagoon floor and exterior lagoon side slope; place compacted, cohesive soil in over-excavation.
2. Where in fill section, place cohesive soil on prepared site in lifts with loose thickness of 6 inches or less and compact to minimum 95% of standard Proctor density.
 3. Construct minimum 18 inch thick soil liner on interior side of lagoon embankment and bottom as shown on plans; use select excavated material; compact to 95% standard Proctor density; maintain moisture content to within 0 to +3 percent of optimum.
 4. Construct to line and grade as shown, on plans; provide allowance for settlement: bottom of lagoon to be within 3 inches of elevation shown on plans.
 5. Place no roots, brush, grass or organic materials in embankments; place no material on embankment when material or foundation is frozen.
 6. Place fill material on scarified surfaces; avoid distinct changes in texture by scarifying and intermingling dissimilar fill materials; place no stones larger than 6 inches in embankment.
 7. Allow areas of fill to settle for 3 weeks; check elevation to top of dike and add fill as required.
 8. Place topsoil on top and outer surface of dikes in areas not to receive granular surfacing.
- D. Other areas receiving fill:
1. Place selected backfill material and compact each horizontal layer with tamping or sheeps-foot roller; place in layer compatible with compaction equipment used, but not to exceed 6 inches.
 2. Use roller designed to provide at least 250 psi distributed on one (1) row of knobs.
 3. Maintain optimum moisture content of soil within practical limits, uniformly distribute water over each layer to raise moisture content; scarify, harrow or work material to aerate if necessary to reduce moisture content.
 4. Place topsoil as appropriate.
- E. Grade borrow areas and excavation sites to uniform slope for drainage, place topsoil as appropriate, finish grade and prepare seedbed as appropriate.
- F. Cropland and pastureland, within construction easement, compacted by construction equipment, shall be subsoiled prior to preparation of seed bed.

3.2 SURPLUS MATERIAL

- A. Unless otherwise specified, dispose of surplus material off site in accordance with applicable ordinances and environmental requirements and in coordination with the Owner/Engineer. Contractor is responsible for determining material disposal sites. Dirt disposal sites may be subject to NPDES Stormwater Permits requirements. Contractor is responsible for obtaining any required stormwater permits for disposal sites.
1. Cost for removal and proper disposal of surplus material off site shall be incidental to excavation and no separate payment will be made for this work.
- B. Verify that sufficient material is available for completion of embankments before disposing of material off site. Premature disposal of material shall be replaced at the Contractor's expense.
- C. Maintain stability of soil adjacent to any excavation.

3.3 BORROW MATERIAL

- A. Import quantity of borrow material needed to complete embankments conforming to specified requirements.
1. Cost for importing borrow materials from off site shall be incidental to lagoon construction and no separate payment will be made for this work.
- B. Determination of borrow site(s) and quality of borrow materials shall be by Contractor with approval of the Engineer prior to use on site.

3.4 LAGOON BOTTOM AND SLOPES

- A. The bottom of the lagoons shall be graded to within the elevations indicated on the contract drawings with a maximum finished tolerance 0.25 feet. The slopes shall be within 0.35 feet of those so indicated similarly, and the slopes shall be no steeper than 3 horizontal to 1 vertical.

3.5 FINISHING AND TOPSOILING

- A. Finish grade all areas of the site which are disturbed. Provide slopes, swales and ditches as required to provide surface drainage and as shown on the contract drawings.

3.6 CONTROL STRUCTURES

- A. The structures for controlling lagoon water levels and discharge shall be constructed as shown on the contract drawings.
- B. Backfill of all piping and structure excavations within dikes or lagoons shall be compacted to 95 percent of the maximum dry density as determined for the materials in accordance with ASTM D1557.

3.7 SEEDING, FERTILIZING AND MULCHING

- A. After all excavation and grading operations are completed the Contractor shall seed, fertilize and mulch all areas within the lagoon site and areas disturbed by construction that are not to receive granular or stone surfacing.

END OF SECTION

SECTION 334213
PIPE CULVERTS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes materials and installation information for pipe culverts.

1.2 RELATED REQUIREMENTS

- A. Section 312333 - Trenching and Backfilling: Excavating of trenches, bedding, and backfilling.
- B. Section 313700- Riprap.

1.3 REFERENCE STANDARDS

- A. ASTM A929/A929M -Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe; 2001 (Reapproved 2013).

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10
- B. Product Data: Provide data on pipe, fittings and accessories.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- D. Accurately record actual locations of pipe runs, connections, and invert elevations.

PART 2 PRODUCTS

2.1 STEEL CULVERT PIPE

- A. Manufacturers:
 - 1. Thompson Culvert Co.or equal
- B. Corrugated Steel Pipe: Fabricated of ASTM A929/A929M galvanized steel sheet:
 - 1. Helical lock seam.
 - 2. Coated Inside and out with 0.050 inch thick bituminous coating.
 - 3. Tapered Ends: Same material as pipe, machine cut, for joining to pipe end.
 - 4. Coupling Bands: Galvanized steel, 0.052 inches thick x 10 inches wide; connected with two neoprene "O" ring gaskets and two galvanized steel bolts.

2.2 CONCRETE CULVERT PIPE

- A. Manufacturers:
 - 1. Hanson Pipe & Precast : www.hansonpipeandprecast.com or approved equal
- B. Concrete Pipe: Reinforced, ASTM C76 (ASTM C76M), Class IV with Wall Type A; mesh reinforcement; bell and spigot end joints:
 - 1. Shape: Circular with a nominal diameter of 18 inches.
- C. Reinforced Concrete Pipe Joint Device: ASTM C443 (ASTM C443M) rubber compression gasket joint.

2.3 BEDDING AND COVER MATERIALS

- A. Bedding and Cover: As specified in Section 312333.

2.4 ACCESSORIES

- A. Fill at Pipe Ends: Riprap as specified in Section 313700 and shown in construction plans

PART 3 EXECUTION

3.1 EXCAVATING

- A. See Section 312333 Trenching and Backfilling for additional requirements.
- B. Excavate culvert trench to 12 inches below pipe invert as shown in plan details. Hand trim excavation for accurate placement of pipe to elevations indicated.

3.2 INSTALLATION- PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe and accessories in accordance with manufacturer's instructions
- C. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
- D. Shore pipe to required position; retain in place until after compaction of adjacent fills. Ensure pipe remains in correct position and to required slope.
- E. Repair surface damage to pipe protective coating with two coats of compatible bituminous paint coating.
- F. Install culvert end gratings or flared end sections as shown in construction plans and details.

3.3 PIPE ENDS

- A. Place fill at pipe ends at embankment slopes, at concrete aprons, to adjacent construction, and as indicated.

3.4 TOLERANCES

- A. Lay pipe to alignment and slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- B. Maximum Offset of Pipe From True Alignment: 1 inch.

3.5 PROTECTION

- A. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 400500
GENERAL PIPING REQUIREMENTS

PART 1 GENERAL

1.1 Description

- A. This section describes the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

1.2 Submittals

- A. Submit shop drawings in accordance with the General Provisions, Conditions, and Section 013300.10.
- B. Provide data sheets for each type of piping and submit affidavits of compliance with referenced standards (e.g. AWWA, ANSI, ASTM, etc.).
- C. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).
- D. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
- E. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.
- F. Submit manufacturer's data sheet for flange insulating kits.
- G. Submit manufacturer's data sheet for insulating unions, showing recommended installation procedures.

1.3 Definitions of Buried and Exposed Piping

- A. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Piping encased in concrete is considered to be buried. Do not coat encased pipe.
- B. Exposed piping is piping in any of the following conditions or locations:
 - 1. Above ground.
 - 2. Inside buildings, vaults, or other structures.
 - 3. In underground concrete trenches or galleries.

1.4 Intent of Drawings and Specifications

- A. Except in details, piping is indicated diagrammatically. Sizes and locations are indicated on the Drawings. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings.
- B. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
 - 1. Modifications are intended to be of minor scope, not involving a change in the design concept or a change to the Contract Price or Contract Time.

PART 2 PRODUCTS

2.1 Materials Selection and Alternative Materials

- A. The piping materials for each piping service are indicated in the Drawings. The same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials unless shown on the Drawings. Stainless steel pipe may be used as an alternate to ductile iron pipe in "exposed piping" locations.

2.2 Bolts and Nuts for Flanges for PVC, Stainless Steel, Steel, and Ductile Iron Piping

- A. Bolts and nuts for all buried flanges and all flanges located indoors, outdoors, above ground, and in vaults and structures shall be Type 304 stainless steel conforming to SATM A193, Grade B8

Class 2, for bolts and ASTM A194, Grade 8, for nuts unless indicated otherwise. Fit shall be Class 2A and 2B per ASME B1.1 when connecting cast iron valves having body bolt holes.

- B. Hex head machine bolts for use with lugged valves shall comply with ASTM A193, Grade B7.
- C. Bolts for AWWA C207 Classes E and F flanges and ASME B16.5 and B16.47 Class 300 flanges located indoors, outdoors, above ground, and in vaults and structures shall conform to ASTM A193, Grade B7, with nuts conforming to ASTM A194, Grade 2H.
- D. Bolts and nuts used in flange insulation kits shall conform to the same requirements as described in the paragraph contained herein.
- E. Form threads for stainless steel bolts by means of rolling, not cutting or grinding.
- F. Provide washers for each nut and bolt head. Washers shall be of the same material as the nuts.

2.3 Lubricant for Stainless Steel Bolts and Nuts

- A. Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Huskyä Lube O'Seal, or approved equal.

2.4 GASKETS FOR FLANGES FOR STEEL and DUCTILE IRON PIPING AND FITTINGS IN AIR AND WATER SERVICE

- A. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 180°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Products: Garlock Style 19 or equal.
- B. Gaskets for Class 300 flanges with ring-joint facing shall conform to ASME B16.20, Type 304 stainless steel.

2.5 GASKETS FOR FLANGES FOR STEEL and DUCTILE-IRON PIPING AND FITTINGS IN RAW SEWAGE, SLUDGE, AND SCUM SERVICE

- A. Gaskets shall be full face, 1/8-inch thick, Buna-N having a hardness of 55 to 65 durometer. Gaskets shall be suitable for a water pressure of 200 psi at a temperature of 250°F. Gaskets shall have "nominal" pipe size inside diameters not the inside diameters per ASME B16.21. Provide Garlock Style 9122 or equal.

2.6 Gaskets for Flanges for PVC Piping

- A. Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material shall be EPR.

2.7 Gaskets for Flanges for Stainless Steel Piping

- A. Gaskets shall be full face, 1/8-inch thick. Gaskets shall be one of the following nonasbestos materials:
 1. Cloth-inserted rubber, with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 19 or equal.
 2. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400°F.

2.8 Threaded Caps for Protection of Nuts and Bolt Threads

- A. Caps shall be high-density polyethylene, color black. The caps shall be filled with an anticorrosive lubricant to prevent nuts and bolts from rusting and corroding. Lubricant shall be suitable for use in potable water. Caps shall withstand temperatures from 40 degrees F to 200 degrees F. Caps shall be suitable to use in exposed, buried, and submerged service conditions. Products: Sap-Seal Products, Inc.; Advance Products and Systems, Inc., "Radolid"; or approved equal.

2.9 Flange Insulation Kits

- A. Flange insulation kits shall consist of insulating gasket, an insulating stud sleeve for each bolt, insulating washers for each bolt, and a steel washer between each insulating washer and the nut.

The sleeves shall be one piece, integral with the insulating washer. Gaskets shall be full face. Provide double sleeve and washer sets for each bolt.

- B. Gasket material shall be phenolic, 1/8-inch thick. The flange insulating gasket shall be full diameter of the flange with a nitrile O-ring on each side of the gasket. Dielectric strength shall not be less than 500 volts per mil and a compressive strength of not less than 24,000-psi.
- C. Insulating flange bolt sleeves shall be high-density polyethylene or spiral-wrapped mylar. Dielectric strength shall not be less than 1,200 volts per mil.
- D. Insulating flange bolt washers shall be high-strength phenolic a minimum thickness of 1/8-inch. Dielectric strength shall not be less than 500 volts per mil and a compressive strength of not less than 25,000-psi.
- E. Steel flange bolt washers for placement over the insulating washers shall be a minimum thickness of 1/8-inch and be casmium plated.
- F. Flange insulation kits shall be as manufactured by Central Plastics Company, Advance Product Systems, or equal.

2.10 Insulating Unions

- A. Insulating unions shall consist of a molded nylon sealing sleeve mounted in a three-piece malleable-iron (ASTM A47 or A197) body. Ends shall be threaded (ASME B1.20.1) when connecting to steel piping and copper solder joint when connecting to copper piping. Minimum working pressure shall be 150-psi. Unions shall be as manufactured by Central Plastics Company, Capital Insulation, or equal.

PART 3 EXECUTION

3.1 Installing Pipe Spools in Concrete

- A. Install pipes in walls and slabs before placing concrete. See Sections 033000 and 400762.

3.2 Raised Face and Flat Face Flanges

- A. Use a flat-faced carbon steel, or alloy flange when mating with a flat-faced cast or ductile iron flanges.
- B. High pressure rated flanges as required to mate with equipment when equipment flange is of high pressure rating than required for piping.
- C. Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

3.3 Installing Aboveground or Exposed Piping

- A. Set piping plumb and at the horizontal and vertical location shown on the Drawings. Provide pipe hangers and supports to maintain alignment, as detailed in the drawings and as specified in Section 400764.
- B. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.
- C. Pipe penetrations through walls, slabs, and floors shall be as detailed on the Drawings or as allowed for alternate configurations as specified herein.
- D. Install pipe spools in walls and slabs before placing concrete.
- E. Inspection for Defects: Before installation, inspect pipe and appurtenances for defects and, when applicable, tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and appurtenances.
- F. Cutting: Cut pipe, when necessary, in a neat and workmanlike manner without damage to the pipe, interior lining, and exterior coating. Perform cutting with an approved mechanical cutter, using a wheel cutter when applicable and practicable.
- G. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- H. Beveling: Grind smooth and bevel cut ends and rough edges using methods recommended by the manufacturer and approved by Engineer.

- I. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Lubricate bolts and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- J. Provide a flange insulation kit at all flanges between dissimilar metals whether shown on the Drawings or not.
- K. Install access fittings to permit disinfection of water system.

3.4 Installing Flanged Piping

- A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.
- B. Inspection for Defects: Before installation, inspect pipe and appurtenances for defects and, when applicable, tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and appurtenances.
- C. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.
- D. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.
- E. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.
- F. Do not use more than one gasket between contact faces in assembling a flanged joint.
- G. Tighten the bolts to the manufacturer's specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.
- H. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- I. Install access fittings to permit disinfection of water system.
- J. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed, buried, and submerged piping.

3.5 Installing Blind Flanges

- A. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.
- B. Coat the inside face of blind flanges per Section 099000, System No. 12.

3.6 Installation of Stainless Steel Bolts and Nuts

- A. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.7 installation of schedule 80 pvc piping

- A. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent welded pipe ends as recommended by the pipe manufacturer.
- B. Wipe away loose dirt and moisture from the ID and OD of the pipe end and the ID of the fitting before applying solvent cement. Do not apply solvent cement to wet surfaces.
- C. Make up solvent welded joints per ASTM D2855.

- D. Allow at least eight (8) hours of drying time before moving solvent welded joints or subjecting the joints to an internal or external loads or pressures.
- E. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages.
- F. Cut threaded ends to the dimensions of ASME B1.20.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed. Pipe or tubing cutters shall be specifically designed for use on PVC pipe.
- G. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to protect from scratching the pipe.
- H. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
- I. Apply Teflon thread compound or Teflon tape lubricant to threads before screwing on the fitting.
- J. Provide unions on exposed piping 3-inches and smaller as follows:
 - 1. Provide a union 6 to 12-inches downstream of valves.
 - 2. Upstream and downstream of equipment which may need to be removed for maintenance.
 - 3. Where shown in the Drawings.

END OF SECTION

SECTION 400515
PRESSURE TESTING OF PIPING

PART 1 GENERAL

1.1 Description

- A. This section specifies the cleaning and hydrostatic, pneumatic, and leakage testing of pressure piping for pumping stations, wastewater treatment plants, and general water piping systems.

1.2 Related Work Specified Elsewhere

- A. General Piping Requirements: 400500.

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions, Provisions, and Section 013300.10.
- B. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.
- C. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

1.4 Test Pressures

- A. Test pressures for the various services and types of piping are shown in:
 - 1. Section 400501 Piping Schedule.
 - 2. Subsection on "Test Pressure and Test Fluids" in Part 3.

1.5 Testing Records

- A. Provide records of each piping installation during the testing. These records shall include:
 - 1. Date and times of test.
 - 2. Identification of process, pipeline, or pipeline section tested or retested.
 - 3. Identification of pipeline material.
 - 4. Identification of pipe specification.
 - 5. Test fluid.
 - 6. Test pressure at low point in process, pipeline, or pipeline section.
 - 7. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
 - 8. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 PRODUCTS

2.1 Manual Air-Release Valves for Buried Piping

- A. Provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

2.2 Test Bulkheads

- A. Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70 percent of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.3 Testing Fluid

- A. Testing fluid shall be water unless a pneumatic test is required.
- B. Contractor shall supply their own potable water since potable water is not available onsite.

2.4 Testing Equipment

- A. Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, and meters to perform the hydrostatic and pneumatic testing.

PART 3 EXECUTION

3.1 Testing Preparation

- A. Pipes shall be in place, backfilled, and anchored before commencing pressure testing.
- B. Conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, hangers, anchors, expansion joints, valves, and meters.
- C. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. Perform the final pressure test, however, after completely backfilling and compacting the trench.
- D. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.
- E. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing. Drain the pipes after they have been tested. Pipes shall remain full after testing.
- F. Prior to starting the test, the Contractor shall notify the Owner's Representative.

3.2 Cleaning

- A. Before conducting hydrostatic tests, flush pipes with water to remove dirt and debris. For pneumatic tests, blow air through the pipes. Maintain a flushing velocity of at least 3 fps for water testing and at least 2,000 fpm for pneumatic testing. Flush pipes for time period as given by the formula: $T=(2L)/3$, in which "T" is flushing time (seconds) and "L" is pipe length (feet).

3.3 Length of Test Section for Buried Piping

- A. The maximum length of test section for buried pipe of 12 inches or smaller in diameter is 3,500 feet; for buried pipe larger than 12 inches, 1 mile. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

3.4 Initial Pipeline Filling for Hydrostatic Testing

- A. Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

3.5 Hydrostatic Testing of Buried Piping

- A. Where any section of the piping contains concrete thrust blocks or encasement, do not perform the pressure test until at least 10 days after placing the concrete. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.
- B. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.
- C. Maintain the test pressure for the following duration by restoring it whenever it falls an amount of 5 psi:
 - 1. Pipe Diameter 18 inches and Less: 4 hours.
- D. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula: $L=(HND \times \text{Square Root}[P])/C$. Where L=Allowable leakage (gallons), H=Specified test period (hours), N=Number of rubber-gasketed joints in the pipe tested (use zero for welded or flanged pipe), D=Diameter of the pipe (inches), P=Specified test pressure (psig), and C=7,400.
- E. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume is defined by the formula: $L=(HSD \times \text{Square Root}[P])/C$. Where L=Allowable

leakage (gallons), H=Specified test period (hours), S=length of pipe tested (feet), D=Diameter of the pipe (inches), P=Specified test pressure (psig), and C=148,000.

- F. Test piping subject to the ICC Fire Code requirements per NFPA 24. Test such piping hydrostatically at not less than 200-psi pressure for two hours or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 gaskets or joints irrespective of pipe diameter. The piping subject to this testing requirement is shown in the Drawings.
- G. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.
- H. Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

3.6 Pneumatic Testing

- A. Perform pneumatic testing using dry air or nitrogen. Perform tests only after the piping has been completely installed including supports, hangers, and anchors. Protect test personnel and Owner's operating personnel. Secure piping to be tested to prevent the pipe from moving and to prevent damage to adjacent piping and equipment. Remove or isolate from the piping any appurtenant instruments or devices that could be damaged by the test prior to applying the test.
- B. Apply an initial pneumatic leakage test of 25 psig to the piping system prior to final leak testing. Examine for leakage, detected by soap bubbles, at joints and connections. After correcting visible leaks, gradually increase the pressure in the system to not more than one-half of the test pressure. Then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Continuously maintain the pneumatic test pressure for a minimum time of eight hours and for such additional time as may be necessary to conduct a soap bubble examination for leakage. The piping system shall show no leakage. Correct any visible leakage and retest.

3.7 Repetition of Test

- A. If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

3.8 Bulkhead and Test Facility Removal

- A. After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

3.9 Test Pressure and Test Fluids

- A. Testing and design pressures (psig) shall be as listed below.
 - 1. Gravity Flow Piping System:
 - a. Test pressure: 20 to 30 psi
 - 2. Low Pressure Air Piping System:
 - a. Test pressure: 10 to 20 psi
 - 3. Pumped Process Piping System:
 - a. Test pressure: 50 to 100 psi
- B. Test pressure shall be the difference between the test HGL elevation and the invert elevation multiplied by 0.433 (psi).

END OF SECTION

SECTION 400561
GATE VALVES

PART 1 - GENERAL

1.1 Description

- A. This section includes materials, testing, and installation of gate valves and accessories.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. Section 400500 "General Piping Requirements".
- D. Section 400515 "Pressure Testing of Piping".
- E. Section 400713 "Polyethylene Sheet Encasement".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog data and detailed construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.
- C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves.
- D. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- E. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.
- F. Provide additional O&M data per Section 013300.10, General Conditions and Supplementary Conditions..

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 - PRODUCTS

2.1 General

- A. Valves shall be installed complete with flange gaskets, nuts and bolts, operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.
- B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.
- C. Bronze or brass material requirements:
- D. For buried locations, valves with mechanical joint ends may be substituted for the flanged ends specified provided the mechanical joint ends are compatible with the pipe ends.

2.2 Valve Actuators/Operators

- A. Valves shall open by turning counterclockwise.
- B. Valve Boxes: Furnish valve boxes for all buried valves.

2.3 Bolts and Nuts for Flanged and Mechanical Joint Valves

- A. Bolts and nuts for flanged valves shall be as described in the detailed piping specifications.in Section 400500 "General Pipe Requirements".

- B. Buried Service Bolts (for valve installation) shall be fluorocarbon coated cor-ten steel t-bolts and nuts equal to NSS cor-blue or approved equal low allow corrosion-resistant high-strength steel in accordance with ANSI/AWWA C111/A21.11.

2.4 Gaskets for Flanges

- A. Gaskets for flanged end valves shall be as described in the detailed piping specifications in Section 400500 "General Pipe Requirements".

2.5 Lining and Coating

- A. Resilient seated valves shall be coated, interior and exterior, with fusion-bonded epoxy per Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- B. Coat floor stands per Section 099000 "Painting and Coating", System No. 29.
- C. Measure the thickness of the valve interior linings per Section 099000 "Painting and Coating". Repair areas having insufficient film thickness per Section 099000 "Painting and Coating".

2.6 Packing, O-Rings, and Gaskets

- A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:
 - 1. Teflon.
 - 2. Kevlar aramid fiber.
 - 3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.
 - 4. Buna-N (nitrile).

2.7 Rubber Seats

- A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

2.8 Valve End Connections

- A. Valve end connections for exposed valves shall be flanged unless shown otherwise. The Contractor shall verify the compatibility of valve ends, including class and drilling of flanges with the connecting pipe.
- B. Buried valve end connections shall be mechanical joint or a push-on unless shown otherwise in the Drawings .

2.9 Valves

- A. Gate Valves:
 - 1. Ductile-Iron Resilient Wedge Gate Valves 4 Inches Through 36 Inches (AWWA C515):
 - a. Valves shall comply with AWWA C515 and the following:
 - 1) The minimum rated working pressure shall be 200 psi.
 - 2) Valve body and gate shall be ductile iron.
 - 3) Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze.
 - 4) Provide operating nut for buried valves. Provide handwheel for exposed valves.
 - 5) Stem nuts shall be made of solid bronze.
 - 6) Bronze for internal working parts, including stems, shall not contain more than 2 percent aluminum nor more than 7 percent zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10 percent elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500).
 - 7) Resilient wedge shall be fully encapsulated by rubber. Styrene Butadiene Rubber (SBR). Styrene Butadiene Rubber (SBR).
 - 8) Body bolts shall be Type 316 stainless steel.

- 9) End connections for exposed valves shall be flanged. Flanges shall be Class 125 per ASME B16.1. End connections for buried valves shall be mechanical joint or push-on type.
- 10) Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.
- 11) Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils. Comply with AWWA C550 and NSF 61.
- 12) Manufacturers: Clow, AVK, American Flow Control, Waterous, Kennedy, or equal.

PART 3 - EXECUTION

3.1 Joints

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).
- D. Install grooved-end couplings for valves in accordance with Section 400500 "General Piping Requirements".

3.2 Installing Exposed Valves

- A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.3 Installing Buried Valves

- A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement, and place and compact the backfill to the height of the valve stem.
- B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.
- C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.
- D. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior of the extension pipe.

3.4 Field Coating Buried Valves

- A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 099000 "Painting and Coating", System No. 10.
- B. Wrap buried metal valves 6 inches and larger with polyethylene sheet per Section 400713 "Polyethylene Sheet Encasement".

- C. Wrap buried metal valves 6 inches and larger in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

3.5 Mounting Gear Actuators

- A. The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

3.6 Valve Leakage Testing

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

3.7 Valve Field Testing

- A. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.
- B. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 80 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

SECTION 400563

BALL VALVES

PART 1 GENERAL

1.1 Description

- A. This section includes:
 - 1. Materials, testing, and installation of general ball valves and accessories.

1.2 Related Work Specified Elsewhere

- A. Section 400500 "General Piping Requirements".
- B. Section 400515 "Pressure Testing of Piping".
- C. Section 400713 "Polyethylene Sheet Encasement".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Provisions, Conditions, and Section 013300.10.
- B. Submit manufacturer's catalog data and detailed construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.
- C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves.
- D. Provide additional O&M data per Section 013300.10, General Conditions and Supplementary Conditions..

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 General

- A. Valves and the required actuators are identified on the drawings, in the equipment legends, or in the Valve Schedule.
- B. Valves shall be installed complete with flange gaskets, nuts and bolts, operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.
- C. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

2.2 Valve Actuators/Operators

- A. Valves shall open by turning counterclockwise.

2.3 Valves

- A. Ball Valves:
- B. Double Union PVC Ball Valves 3 Inches and Smaller:
 - 1. Thermoplastic ball valves, 3 inches and smaller, for water and chemical service shall be rated at a pressure of 150 psi at a temperature of 105 degrees F.
 - 2. Body, ball, and stem shall be PVC conforming to ASTM D1784, Type 1, Grade 1. Seats shall be Teflon.
 - 3. O-ring seals shall be Viton.
 - 4. Valve ends shall be of the double-union design. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings.
 - 5. Valves shall have handle for manual operation.

6. Provide stem extensions when valves are installed in insulated piping. Stem extensions shall be of a length sufficient to bring the bottom of the operating handle above the outside of the insulation.
 7. Valves shall be as manufactured by Chemtrol, Hayward, R & G Sloan, Spears Manufacturing Company, Plast-O-Matic, IPEX Series VK or VKD, or equal.
- C. Full Port Threaded Stainless Steel Ball Valves 3 Inches and Smaller :
1. Stainless steel ball valves, 3 inches and smaller, for air service shall be rated at a minimum pressure of 1,000 psi WOG at a temperature of 100 degrees F.
 2. Provide full port ball and body design.
 3. Valve body, ball, and stem shall be Type 316 stainless steel, ASTM A276 or A351. Seat and seals shall be reinforced Teflon.
 4. Valves shall have lever actuators, plastic coated. Provide locking lever handle.
 5. Valves shall have threaded ends (ASME B1.20.1) and nonblowout stems.
 6. Clean valves for oxygen service per CGA Standard G-4.1-1996. Parts shall be free of burrs, chips, or other foreign materials. Wash, rinse, and then dry with oil-free filtered air. Assemble valves using only lubricants that are compatible with oxygen. Test valves on equipment using only tools that have been cleaned in the same manner as the valve components. Seal valves in clear plastic bags and tag to identify as having been processed for oxygen service.
 7. Valves shall be Worcester Series 59, Apollo 86-100 Series, or equal.

PART 3 EXECUTION

3.1 Shipment and Storage

- A. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping.
- B. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.
- C. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.
- D. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.
- E. If the valves are stored or installed outside or in areas subject to temperatures below 40 degrees F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Exercise each actuator from its fully open to fully closed position at least once every seven days.

3.2 Joints

- A. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3.3 Installing Exposed Valves

- A. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.
- B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault walls, or trench walls.

- C. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

3.4 Valve Leakage Testing

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

3.5 Valve Field Testing

- A. Actuators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.
- B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

END OF SECTION

SECTION 400565
CHECK VALVES

PART 1 GENERAL

1.1 Description

- A. This section includes materials, testing, and installation of check valves.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. Section 400500 "General Piping Requirements".
- D. Section 400515 "Pressure Testing of Piping".
- E. Section 400775 "Equipment, Piping, and Valve Identification".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Provisions, Conditions, and Section 013300.10 .
- B. Submit manufacturer's catalog data and detailed construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.
- C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves.
- D. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.
- E. Provide additional O&M data per Section 013300.10, General Conditions and Supplementary Conditions..

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 General

- A. Valves and the required actuators are identified on the drawings, in the equipment legends, or in the Valve Schedule.
- B. Valves shall be installed complete with flange gaskets, nuts and bolts, and operators required for operation.
- C. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.
- D. Bronze or brass material requirements:

2.2 Valve Tagging and Identification

- A. Provide identifying valve tags per Section 400775 "Equipment, Piping, and Valve Identification".

2.3 Bolts and Nuts for Flanged Valves

- A. Bolts and nuts for flanged valves shall be as described in the detailed piping specifications.in Section 400500 "General Piping Requirements".

2.4 Gaskets for Flanges

- A. Gaskets for flanged end valves shall be as described in the detailed piping specifications in Section 400500 "General Piping Requirements".

2.5 Lining and Coating

- A. Coat the exterior of metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 099000,

System No. 13 . Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats at the place of manufacturer or in the field. Finish coat shall match the color of the adjacent piping. Do not coat bronze, brass, or stainless steel valves.

- B. Coat the exterior of submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 099000 "Painting and Coating", System No. 13.
- C. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 099000 "Painting and Coating", System No. 13. Apply lining at the place of manufacture.
- D. Alternatively, line and coat valves with fusion-bonded epoxy per Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- E. Measure the thickness of the valve interior linings per Section 099000 "Painting and Coating". Repair areas having insufficient film thickness per Section 099000 "Painting and Coating".

2.6 Packing, O-Rings, and Gaskets

- A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:
 - 1. Teflon.
 - 2. Kevlar aramid fiber.
 - 3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.
 - 4. Buna-N (nitrile).

2.7 Rubber Seats

- A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

2.8 Valve End Connections

- A. Valve end connections for exposed valves shall be flanged unless shown otherwise. The Contractor shall verify the compatibility of valve ends, including class and drilling of flanges with the connecting pipe.

2.9 Valves

- A. Check Valves:
- B. Stainless Steel Swing Check Valves 2 Inches and Smaller:
 - 1. Check valves 2 inches and smaller shall be straight pattern, 316 stainless steel, ASTM A351, Grade CF8M, with threaded cap
 - 2. Ends shall be female threaded, ASME B1.20.1.
 - 3. Disc shall be stainless steel swing type.
 - 4. Minimum working pressure shall be 200 psi WOG at a temperature of 150 degrees F.
 - 5. Valves shall be Sharpe Valves Series. 20276-TE or equal.
- C. PVC Swing Check Valves, 3 Inches and Smaller:
 - 1. Swing check valves 3 inches and smaller shall be constructed of PVC per ASTM D1784, Type 1, Grade 1.
 - 2. Ends shall be flanged, ASME B16.5, Class 150.
 - 3. Seats and seals shall be Viton. Provide bolted bonnet.
 - 4. Valves shall have a pressure rating of 150 psi at a temperature of 73 degrees F.
 - 5. Products: Spears or equal.

PART 3 EXECUTION

3.1 Joints

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or

remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Install grooved-end couplings for valves in accordance with Section 400500.

3.2 Installing Exposed Valves

- A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.3 Valve Leakage Testing

- A. Test valves for leakage at the same time that the connecting pipelines are tested. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

3.4 Valve Field Testing

- A. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

END OF SECTION

SECTION 400713
POLYETHYLENE SHEET ENCASUREMENT

PART 1 GENERAL

1.1 Description

- A. This section includes materials and installation of a polyethylene sheet encasement (AWWA C105) for buried steel and iron pipe, fittings, and valves.

1.2 Submittals

- A. Submit shop drawings in accordance with General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical, and electrical properties of the encasement material.

1.3 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 Polyethylene Wrap

- A. The encasement shall consist of low-density polyethylene wrap of at least 4-mil thickness conforming to AWWA C105. Color: Blue.
- B. Polyethylene encasement for ductile-iron pipe shall be supplied as a flat tube meeting the dimensions of Table 1 in AWWA C105 and shall be supplied by the ductile-iron pipe manufacturer.

2.2 Plastic Adhesive Tape

- A. Tape shall consist of polyolefin backing and adhesive which bonds to common pipeline coatings including polyethylene.
- B. Minimum Width: 2 inches.
- C. Products: Canusa Wrapid Tape; Tapecoat 35; Polyken 934; AA Thread Seal Tape, Inc.; or equal.

PART 3 EXECUTION

3.1 Application of Moldable Mastic Filler to Irregular Adjacent Surfaces

- A. When the adjacent joints are bell-and-spigot or mechanical joints and any associated welding specifications do not require an external full fillet weld, apply a moldable mastic filler per Section 400500 "General Piping Requirements" at the step-down area prior to the application of the sheet encasement and tape.

3.2 Applying Sheet Coating to Buried Piping and Fittings

- A. Apply wrapping per AWWA C105 as modified herein.
- B. Apply a single wrapping.
- C. Install the polyethylene to completely encase the pipe and fittings to provide a watertight corrosion barrier. Continuously secure overlaps and ends of sheet and tube with polyethylene tape. Make circumferential seams with two complete wraps, with no exposed edges. Tape longitudinal seams and longitudinal overlaps, extending tape beyond and beneath circumferential seams.
- D. Minimize voids beneath polyethylene. Place circumferential or spiral wraps of polyethylene tape at 2-foot intervals along the barrel of the pipe to minimize the space between the pipe and the polyethylene.
- E. Overlap adjoining polyethylene tube coatings a minimum of 1 foot and wrap prior to placing concrete anchors, collars, supports, or thrust blocks. Hand wrap the polyethylene sheet, apply two complete wraps with no exposed edges to provide a watertight corrosion barrier, and secure in place with 2-inch-wide plastic adhesive tape.

3.3 Applying Sheet Coating to Buried Valves

- A. Wrap with a flat sheet of polyethylene. Place the sheet under the valve and the flanges or joints with the connecting pipe and fold in half. Extend the sheet to the valve stem and secure the sheet in place with 2-inch-wide plastic adhesive tape. Apply a second layer and secure with tape. Make two complete wraps, with no exposed edges, to provide a watertight corrosion barrier. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of water and soil. Place concrete anchor and support blocks after the wrap has been installed.

3.4 Applying Sheet Coating to Buried Flexible Pipe Couplings

- A. Apply two layers or wraps around the coupling. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with tape. Provide sufficient slack in polyethylene to allow backfill to be placed around fitting without tearing polyethylene. Apply tape around the entire circumference of the overlapped section on the adjoining pipe or fitting in two complete wraps, with no exposed edges, to provide a watertight corrosion barrier.

3.5 Repair of Polyethylene Material

- A. Repair polyethylene material that is damaged during installation. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch-wide plastic adhesive tape.

3.6 Applying Sheet Coating to Existing Buried Piping

- A. When connecting polyethylene-encased pipe or fittings to existing pipe, expose existing pipe, thoroughly clean the surface, and securely tape the end of the polyethylene to the existing as specified above. When the existing pipe is polyethylene encased, wrap new polyethylene encasement over the existing, with overlap of at least 2 feet. Tape securely as specified above.

3.7 Backfill for Polyethylene-Wrapped Pipe, Valves, and Fittings

- A. Place backfill around pipe, valves, and fittings wrapped with polyethylene encasement per Section 312333 "Trenching and Backfilling".

END OF SECTION

SECTION 400722
FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 GENERAL

1.1 Description

- A. This section includes materials and installation of:
 - 1. flexible gasketed sleeve-type compression pipe couplings for steel and ductile-iron pipe
 - 2. thermal expansion compensators and expansion joints 4 inches in diameter and smaller for steel, PVC, and copper pipe.
 - 3. Flexible expansion joints and couplings for connecting different pipe materials.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. Section 400500 "General Piping Requirements":
- D. Section 400762 "Wall Pipes, Seep Rings, and Penetrations".
- E. Section 400764 "Pipe Hangers and Supports".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog data on flexible pipe couplings, thermal expansion compensators, restrained flange adapters, expansion loops, and expansion joints. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.
- C. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.
- D. Show materials of construction by ASTM reference and grade. Show dimensions.
- E. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 Coupling System Design and Component Unit Responsibility

- A. The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package the manufacturer's printed installation instructions with each pipe coupling.

2.2 Steel Flexible Pipe Couplings

- A. Steel couplings shall have center sleeves and end rings made of carbon steel conforming to AWWA C219, Section 4. Minimum center sleeve length shall be 5 inches for pipe sizes 3/4 inch through 4-1/2 inches, 7 inches for pipe sizes 5 inches through 24 inches, and 10 inches for pipe sizes larger than 24 inches.
- B. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 304 stainless steel per AWWA C219, Section 4.
- C. Steel end rings shall be cast, forged, or hot rolled in one piece. Do not use rings fabricated from two or more shapes.

- D. Wall thickness of sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.

2.3 Ductile-Iron Flexible Pipe Couplings

- A. Couplings shall have center sleeves and end rings made of ductile iron conforming to AWWA C219, Section 4.
- B. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 304 stainless steel per AWWA C219, Section 4.

2.4 Joint Harnesses

- A. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H. Lug material shall conform to ASTM A36, ASTM A283, Grade B, C, or D, or ASTM A285, Grade C. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.
- B. Lugs for steel pipe shall be Type P for pipes 6 through 10 inches and Type RR for pipes 12 inches and larger.
- C. Manufactured lugs shall incorporate a three-hole design that utilizes two flange bolts to hold each lug in place for each tie-rod. Lug shall be steel A36.
- D. Select number and size of bolts based on the test pressure shown in the Piping Schedule in the drawings. Stagger bolts equally around pipe circumference. Where odd number is tabulated, place odd bolt at top. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.
- E. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8 inch.

2.5 Flexible Pipe Couplings for Plain-End Steel Pipe

- A. Couplings shall be steel, Dresser Style 38, Smith-Blair Type 411, Baker Series 200, or equal.

2.6 Flexible Pipe Couplings for Plain-End Ductile-Iron Pipe

- A. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 253 or 253 long sleeve, Smith-Blair Type 441, Baker Series 228, or equal.
- B. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 153, Smith-Blair Style 411, Baker Series 228, or equal.

2.7 Transition Couplings

- A. Couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal.
- B. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

2.8 Flanged Coupling Adapters for Steel Pipe

- A. Adapters for steel pipe shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

2.9 Flanged Coupling Adapters for Cast- and Ductile-Iron Pipe

- A. Adapters for cast- and ductile-iron pipe 12 inches and smaller shall be cast iron: Dresser Style 127, Smith-Blair Series 912, or equal.
- B. Adapters for cast- and ductile-iron pipe larger than 12 inches shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal.
- C. Flange ends shall match the flange of the connecting pipe.

2.10 Restrained Flange Adapter for ductile iron pipe

- A. Restrained flange adapter shall be made of ductile iron conforming to ASTM A536.

- B. Flange bolt circle of the adapter shall be compatible with Class 125 flanges per AWWA C115.
- C. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges.
- D. Restrained flange adapter shall be Series 2100 Megaflange as produced by EBAA Iron, Inc., or approved equal.
- E. Restrained flange adapters shall only be used specifically where shown on the Contract Documents or with written approval from the Engineer for additional locations.

2.11 Dismantling Joints

- A. The dismantling joint shall consist of a flanged steel spigot piece, a flanged sleeve, a center ring welded onto the sleeve, and a follower ring containing a gasket through which the spigot piece slides into the sleeve. The joint shall accommodate up to 2 inches of longitudinal movement. The longitudinal adjustability shall be provided by a telescopic action of a flanged spigot and associated sleeve, which inserts into the spigot. A system of tie bolts or rods shall connect the center ring of the sleeve to the end flange on the spigot piece. Provide washers and nuts on the tie bolts on both sides of the center ring and the spigot end flange to allow for adjustment of the extension length for the sleeve.
- B. The minimum design pressure shall be the same as the adjacent piping. Design stresses shall not exceed 40% of the yield strength of the materials. Minimum factory test pressure shall be 150% of the design pressure.
- C. The gasket shall be compressed by a separate bolting and gland system, independent of the tie bolts. Gasket shall be isoprene, Buna-N, or EPDM.
- D. Dismantling joints shall have a spigot piece made of steel conforming to ASTM A36, A53 (Type E or S), or A283, Grade C having a minimum yield strength of 30,000 psi and a flange adapter and follower ring made of ductile iron conforming to ASTM A536, Grade 65-45-12.
- E. Sleeve and follower ring bolts shall have a minimum yield strength of 105,000 psi, a minimum tensile strength of 125,000 psi, and shall conform to ASTM A193, Grade B7.
- F. Steel flanges[, center ring,] and gasket follower rings shall be cast, forged, or hot rolled in one piece. Do not use flanges or rings fabricated from two or more shapes. Flanges shall conform to ANSI Classes 125 and 150.
- G. Wall thickness of spigot piece and sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.
- H. Manufacturers: Romac Industries Style DJ400 or equal.

2.12 SEGMENTED RESTRAINED SLEEVE COUPLINGS AND FLANGED ADAPTER COUPLINGS FOR STAINLESS STEEL PIPE

- A. The coupling shall be of the split or segmented sleeve type with a double arch cross-section, which closes around plain steel pipe ends. The design pressure and wall thickness of the body shall be at least that specified for the size of pipe on which the coupling is to be used. Provide welded steel restraint rings on the pipe ends for end restraint. As the coupling closes, it shall confine an elastomeric gasket on each pipe end to create a radial seal. The axial seal shall be affected at the closure plates as bolts pull the coupling snug round the pipe. Provide shoulders on each end of the couplings. Flanged adapter couplings shall incorporate a flange on one end (instead of an end ring and shoulder) to match the flange on the connecting pipe or valve. Products: Victaulic "Depend-O-Lok" Model F x F Type 2 for sleeve couplings or Victaulic "Depend-O-Lok" Model F x F flanged adapter coupling for flanged adapter couplings.
- B. Coupling body, flange, and closure plates for couplings used with stainless steel pipe shall be Type 304 or 304L stainless steel per ASTM A240 or A666.
- C. End restraint rings for couplings used with stainless steel pipe shall be Type 304 or 304L stainless steel per ASTM A276. Provide end restraint rings on each of the connecting pipes. The end rings shall be welded to the pipe ends using a welding procedure complying with the

ASME Pressure Vessel Code, Section IX. The welded end restraint rings shall have at least the pressure rating of the pipe to which the coupling is attached.

- D. Fasteners for couplings used with stainless steel pipe shall be Type 304 stainless steel per ASTM A276, F593, or F738 with stainless steel nuts per ASTM F594 or F836
- E. Gaskets shall be isoprene, Buna-N, or EPDM conforming to ASTM D2000 for water and sewage service and having a temperature range of -20°F to +180°F.

2.13 Type 1 Expansion Joints: For Copper Pipe

- A. Expansion joints for copper pipe shall be all bronze: Metraflex Model HPMF expansion compensator, Hyspan Model 8509 or 8510 expansion compensator, or equal. Expansion compensators shall have antitorque devices to protect the bellows. Minimum working pressure shall be 175 psig.

2.14 Type 2 Expansion Joints: For Steel Pipe 4 Inches and Smaller

- A. Expansion joints for steel pipe 4 inches and smaller shall be carbon steel: Hyspan Model 8503 or 8504 expansion compensators, Metraflex Model HP expansion compensator, or equal. Expansion compensators shall have antitorque devices to protect the bellows. Minimum working pressure shall be 150 psi.

2.15 Type 3 Expansion Joints: Teflon Bellows Type

- A. Expansion joints shall be Teflon bellows type having three convolutions, ductile-iron flanges, Monel reinforcing ring, and a Teflon facing on the flanges. Minimum working pressure shall be 110 psi. Provide thrust harnesses. Flanges shall be Class 125, ASME B16.1. Products: Peabody-Dore Style E-1608-B, Resistoflex No. R6905, or equal.

2.16 Type 4 Expansion Joints: Spherical Expansion Joints

- A. Spherical design expansion joints shall be chlorobutyl with polyester fiber reinforcing and be provided with steel retaining rings and Type 304 stainless steel gusset plates and control rods. Expansion joints shall have flat-face flanges integral with the body to match 125/150-pound flanges. Expansion joints for hot water service shall be rated at a minimum of 150 psig at 212°F.

Joint Size	Flange to Flange Length (inches)	Minimum Pressure Rating (150°) (psi)
4-8	6	225
10-12	8	225
14-20	10-12	125

- B. Expansion joints shall be manufactured by Metraflex Metrasphere, Proco Series 240, or equal.

2.17 TYPE 5 EXPANSION JOINTS: SINGLE ARCH RUBBER TYPE (24 INCHES AND SMALLER)

- A. Expansion joints shall be rubber, single arch type, with integral flat-face ANSI Class 125/150 flanges.
 - 1. Cover Elastomer: Butyl.
 - 2. Tube Elastomer: Butyl.
 - 3. Arch Type: Open.
 - 4. Fluid: Potable water.
 - 5. Fluid Temperature Range: 40°F to 105°F.
 - 6. Ambient Temperature Range: 30° F to 120°F.
- B. Minimum working pressure shall be 150 psi for joints 12 inches and smaller, 120 psi for 14- and 16-inch joints, 110 psi for 18- and 20-inch joints, and 100 psi for 24-inch joints. Provide steel thrust plates, retaining rings, and control rods. Products: Proco Style 220, General Rubber Style 1075, or equal.

2.18 Type 6 Expansion Joints: Flexible Expansion Joints

- A. Each flexible expansion joint shall consist of two ball joints and two expansion sleeves. Each expansion sleeve shall allow an expansion capability of at least 4 inches. Material of

construction shall be ductile iron conforming to the material requirements of AWWA C153. Minimum deflection shall be 15 degrees in both vertical and horizontal planes. Minimum pressure rating of the flexible coupling joint assembly shall be 350 psi. Provide stop collars on the sleeves to restrain the lateral travel. Provide synthetic rubber gaskets in sleeves and balls. Ends of assembly shall be flanged or mechanical joint to match the connecting piping.

- B. Line flexible expansion joint assemblies with fusion bonded epoxy per Section 099761. Coat exposed assemblies the same as the lining. Color of finish coat shall match the connecting piping.
- C. Coat buried assemblies per Section 099000, System No. 21
- D. Flexible expansion joints shall be EBAA Iron, Inc., "Flex-Tend"; Romac Industries "FlexiJoint"; or equal.

2.19 Type 7: Elastomeric Coupling

- A. Provide elastomeric couplings suitable for the pipe types and sizes to be connected. Elastomeric coupling shall consist of an elastomeric plastic sleeve and Type 304 or 305 stainless steel pipe clamps. Provide a minimum of two clamps for pipes up to 15 inches in outer diameter. Provide a minimum of four clamps on a sleeve 10 inches long for pipes larger in diameter than 15 inches.

2.20 Type 8 Couplings: For Connecting Vitrified Clay Pipe to Plastic or Ductile-Iron Pipe

- A. Couplings shall consist of a styrene butadiene (SBR) or neoprene rubber body with stainless steel bands, housings, and clamps. The clamping device for couplings 10 inches and larger shall be cold-rolled steel or stainless steel. Products: Calder Couplings for pipes 3 through 8 inches and Ceramicweld Coupling for pipes 10 through 42 inches.

2.21 Type 9: Expansion Loops for Compressed Air Piping

- A. Expansion loops shall consist of two flexible sections of Type 300 stainless steel hose and braid, two 90-degree elbows, and one 180-degree return with drain valve. Fittings shall be Schedule 40 carbon steel with male NPT connections. Expansion loops shall provide a minimum of 1-1/2 inches of axial movement in all directions and shall have a minimum pressure rating of 455 psi at 70°F. Install pipe guides within four pipe diameters of each side of the loop, as recommended by the expansion loop supplier. Manufacturers: Flexicraft, Metraflex, or equal.

2.22 Type 10: Flexible Hose Connectors 3 Inches and Smaller

- A. Flexible hose connectors 3 inches and smaller shall be of the corrugated metal hose type with an external braid. Connectors shall have a minimum pressure rating of 300 psi at a temperature of 150°F. Corrugation tubing material shall be Type 316 stainless steel with Type 316 or 321 stainless steel braid material. End connections shall be ground joint female union with ANSI/ASME B1.20.1 NPT threads. Length shall be 24 inches unless otherwise indicated. Flexible connectors shall be American BOA, Flexonics, Metraflex, or equal.

2.23 Type 11: Flexible Elastomeric Internal Joint

- A. Rubber Joint Liner: EPDM.
- B. Bands, Shims, and Setscrews:
 - 1. Stainless steel bands, spacers, shims, and setscrews for securing rubber membrane across piping joints shall be Type 316 per ASTM A240.
 - 2. Welding: Perform welding with coated electrode 316L, AWS Class A5.4, AC-DC-16, with tensile strength of 70,000 psi.
- C. Liquid Joint Lubrication:
 - 1. Liquid joint lubricant to assist in installation of the rubber joint seal and bands shall be a nontoxic vegetable-based lubricating gel.
 - 2. Required Properties:
 - a. Shall not deteriorate or decompose while in storage for a minimum of two years.
 - b. Shall have a soft pasty consistency suitable for use intended from 0°F to 120°F.
 - c. Shall not have any deteriorating effect on natural or synthetic rubber gaskets.
 - d. Shall not impart taste or odor to water.

- e. Shall have no objectionable odor.
 - f. Shall be nontoxic and does not support the growth of bacteria.
 - g. pH: 9.6 minimum and 11 maximum (pH meter).
 - h. Method of Test: ASTM D562.
 - i. Shall not contain any petroleum-based oils or grease.
 - j. Shall not contain any materials considered toxic.
- D. Filling Materials for Gaps Between Joints: The filling material shall be an injected elastomeric joint filler.
- E. Epoxy:
- 1. Coating Appearance: Smooth, white, thixotropic liquid.
 - 2. Gel Appearance: Smooth, white mastic of stiff consistency.

Description	Method	Result
Flexural strength	ASTM D790	6,000 psi
Flexural modulus	ASTM D790	550,000 psi
Compressive strength, yield	ASTM D695	4,275 psi
Tensile strength	ASTM D638	3,700 psi
Tensile ultimate elongation	ASTM D638	1.4%
Hardness, Shore D	ASTM D2583	85
Hardness, Pencil	ASTM D3363	6H
Impact, IZOD	ASTM D256	0.19 ft-lb/inch of notch
Temperature resistance	Steel, unprimed	250°F
Temperature resistance	Concrete	250°F
Solids content	-----	100%
Solvents present	-----	None
Volatile organic compounds (VOC)	-----	0.0 grams per liter

- 3. Service Temperature Range: 50°F to 200°F.
- F. Thread Sealing Compound:
- 1. Thread sealing compound shall be a nontoxic paste type with Teflon.
 - 2. Teflon Components Required Properties--Physical Data:
 - a. Flash Point: 410°F closed cup.
 - b. Specific Gravity: 1.4 to 1.42.
 - c. Viscosity: 200,000 to 275,000 centipoises.
 - d. Temperature Range: -50°F to 500°F.
 - e. Pressure Application: Maximum 10,000 psi.
- G. Products: EPDM rubber material shall be AMEX-10/WEKO-SEAL from Miller Pipeline Corporation, telephone 317-293-0278; HY-FLEX from Lineal Industries, telephone 1-877-787-9461; or equal.

2.24 Type 12 Expansion Joints: Metal Bellows Pump Connection Joints 1-1/2 Through 24 Inches

- A. Provide multiple bellows, annular, flanged expansion joint constructed from single or multiple metal laminations. Provide flow liner. Provide thrust restraining rod system. Minimum pressure rating shall be 275 psi at a temperature of 200°F. Flanges shall be Class 150 per ASME B16.5. Provide fixed, flat-face flanges. Materials of construction shall be as follows:

Item	Material	Specification
Bellows, flow liner	Stainless steel	ASTM A240 or A666, Type 304 or 321

Flanges	Steel	ASTM A285, Grade C
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- B. Products: Hyspan Model 5501 R, Keflex Type 151-TR or equal.

2.25 Pipe Alignment Guides for Expansion Joints and Expansion Compensators (Types 1, 2, and 3)

- A. For copper pipes, use Hyspan Series 9500 Copper Tube Alignment Guides, Metraflex Style I, B-Line, Anvil International, or equal.
- B. For bellows-type expansion joints and expansion loops in steel, PVC, and CPVC pipe, use Hyspan Series 9500 Pipe Alignment Guide, Metraflex Style I, B-Line, Anvil International, or equal.

2.26 Bolts and Nuts for Flanges

- A. See Section 400500 "General Piping Requirements".

2.27 THREADED CAPS FOR PROTECTION OF NUTS AND BOLT THREADS

- A. See Section 400500 "General Piping Requirements".

PART 3 EXECUTION

3.1 Installation of Flexible Pipe Couplings, Segmented Sleeve Couplings, and Expansion Joints

- A. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.
- B. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.
- C. Lubricate bolt threads with graphite and oil prior to installation.
- D. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on exposed, buried, and submerged flexible pipe couplings, transition couplings, flanged coupling adapters, dismantling joints, and segmented restrained sleeve couplings.

3.2 Installation of Type 11 Flexible Elastomeric Internal Joint

- A. Store the membranes in a cool, dry environment away from direct sunlight. Do not remove the rubber joint seals from the plastic bags prior to use. Store seals in a cool, dry environment and do not remove from their plastic bags until required for use. Do not allow them to remain in direct sunlight.
- B. Surface Preparation of Joint Area: Prepare the area of pipe either side of the joint where the actual lip seals make contact with the pipe to a finish that will allow the lip seals to bed consistently and so provide a permanent seal.
- C. Surface Lubrication: Immediately prior to fitting the seal, clean the area with a dry brush and coat with lubricant that is a nontoxic vegetable soap compatible with the composition of the flexible joint seal. Apply the lubricant using a paintbrush over the ground area. Do not pick up dust deposits from the unground surface into the lubricant and therefore onto the ground surface.
- D. Positioning the Seal: Prior to placing the seal, coat the area of pipe which will be covered with the seal with an epoxy coating and allow to partially set up prior to seal installation. Check the seal for damage. Check that the test unit is tight before fitting the seal in place. Place the flexible joint seal in position bridging the joint gap, guided by the marks. Position the seal accurately on the ground areas. The test unit in the seal should be located at either 9 o'clock or 3 o'clock position. Position the seal parallel to the joint gap.
- E. Positioning Retaining Bands: Place two stainless steel radiused shims, 6 inches long and 3/64 inch thick, underneath the wedge area in the grooves, to provide a bridge that will transmit the radial load evenly to the flexible joint seal, as the bands are expanded. Then place the stainless steel bands in the grooves provided in the seal. Temporarily lock both bands in position.
- F. Expanding the Seal into Position: Use the hydraulic expanding device to apply a set pressure to the retaining bands of the flexible joint seal.

1. When positioning the expander in line with the retaining band, ensure that the band remains in the groove of the flexible joint seal and does not become moved or dislodged. Ensure the expander is positioned correctly on the band.
 2. The expander is expanded which radially transmits a load against the retaining band and flexible joint seal. Hold this pressure for at least two minutes. The range of pressure registered on the expander shall be 4,000 psi minimum and 5,000 psi maximum.
 3. A space is provided at bottom dead center position of the expander that exposes the grooved-end cleats of the retaining band. Fit a radiused locking wedge piece between the exposed gap of the expanded band ends. Select a size of wedge having a slight interference fit between the band ends, and tap the wedge (leading edge first) into position, locking in the compression of the flexible joint seal. The radius of the wedge shall equal the radius of the pipe.
 4. Release the hydraulic pressure from the expander and repeat the procedure on the second retaining band of the seal.
 5. Repeat this entire operation (i.e., re-expanded) not before 30 minutes have elapsed after the first expansion. This allows for any seal relaxation that may take place and usually a slightly larger wedge can be fitted. The load forces transmitted by the expander have been determined from test data and should not be altered by changing the pressure used to activate the expander.
- G. Testing the Seal, Test 1: Apply two individual pressure tests to the seal before closing the pipeline. Apply the first test after each section has been completed and not before 30 minutes have elapsed after the final fitting of the seal. Apply a pressure of 10 psig. Because of the excessive ballooning to the center membrane of the seal (that will occur at this higher pressure), lock a restraining device called a "test band" in its expanding position during testing. If the pressure test indicates leakage, determine the cause and repeat from Step E.
- H. Testing the Seal, Test 2: In the second test, introduce 5 psig through the valve in the flexible joint seal. Sustain this pressure while applying a soap and water test to the outer edge and entire body of the seal. Inspect for leakage. If pressure test indicates leakage, determine the cause and repeat from Step E.
- I. Testing Valve Assembly: After the final test of 5 psig, seal the test valve of the flexible joint seal with a countersunk hex head completion plug using a nontoxic thread-sealing compound on the threads. Remove installation hardware, test band, and pressure gauges from the pipe.

3.3 Painting and Coating

- A. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section 099000 "Painting and Coating". Coat buried bolt threads, tie bolt threads, and nuts per Section 099000. Then wrap the buried couplings with polyethylene wrap per Section 400713 "Polyethylene Sheet Encasement".
- B. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 099000 "Painting and Coating". Apply prime coat at factory.
- C. Line carbon steel and iron flexible pipe couplings and segmented sleeve couplings per Section 099000 "Painting and Coating".
- D. Alternatively, line and coat carbon steel and iron flexible pipe couplings and segmented sleeve couplings with fusion-bonded epoxy per Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- E. Coat Couplings, expansion joints, expansion compensators, and alignment guides located above ground or in vaults and structures with the same coating system as specified for the adjacent pipe.

3.4 Hydrostatic Testing

- A. Hydrostatically test flexible pipe couplings, expansion joints, segmented sleeve couplings, and expansion compensators in place with the pipe being tested. Test in accordance with Section 400515 "Pressure Testing and Piping".

3.5 PIPE HANGERS AND SUPPORTS FOR EXPANSION JOINTS AND EXPANSION COMPENSATORS (TYPES 1, 2, AND 3)

- A. At each expansion compensator or bellows-type expansion joint located on horizontal piping runs, provide a pipe alignment guide within four pipe diameters of each end of the expansion joint or compensator. Provide a second pipe alignment guide within 14 pipe diameters of each end of the expansion joint or compensator.
- B. Mount pipe alignment guides on wall brackets or steel channels as manufactured by Anvil International, B-Line, or equal.

END OF SECTION

SECTION 400762
WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 GENERAL

1.1 Description

- A. This section includes materials, installation, and testing of steel, cast-iron, and ductile-iron wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

1.2 Related Work Specified Elsewhere

- A. Section 033000 "Concrete".
- B. Section 099000 "Painting and Coating".
- C. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings"
- D. Section 400500 "General Piping Requirements".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.
- C. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.
- D. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.
- E. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.
- F. List materials of construction, with ASTM material reference and grade.
- G. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.
- H. Submit six copies of the results of the leakage test for cast-iron sleeves having shrink-fit steel collars or collar halves bottomed in a groove and steel sleeves having welded steel collars.

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 General

- A. Use cast-iron, ductile-iron, or fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes.
- B. Use only cast-iron or ductile-iron wall pipes when connecting to cast-iron and ductile-iron pipe. Use only fabricated steel or stainless steel wall pipes when connecting to steel or stainless steel pipe, respectively.
- C. Cast-iron flanges shall conform to ASME B16.1, Class 125 or 250, to match the flange on the connecting pipe.
- D. Class 150 steel flanges shall conform to AWWA C207, Class D. Class 300 steel flanges 48 inches and smaller shall conform to AWWA C207, Class F. Class 300 flanges larger than 48 inches shall conform to the dimensions of ASME B16.1 Class 250 flanges. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.
- E. See Section 400500 for flange bolts and gaskets.

2.2 Cast-Iron or Ductile-Iron Wall Pipes and Sleeves

- A. Provide cast- or ductile-iron wall pipes with ends as shown in the drawings for connection to adjacent cast-iron and ductile-iron pipe or for containing pipes where they pass through

concrete walls, ceilings, and floor slabs. Provide seepage ring on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Locate collars such that the collar is at the center of the wall or floor slab, unless otherwise shown in the drawings.

- B. Wall pipes and sleeves shall be of the following types:
 - 1. Pipe or sleeve with integrally cast seep ring.
 - 2. Pipe or sleeve with shrink-fit steel collar attached.
 - 3. Pipe or sleeve with steel collar halves bottomed in a groove provided in the pipe or sleeve.
 - 4. Pipe or sleeve with ductile iron collar welded continuously around pipe (360 degrees) on both sides of collar. Welding shall be done in pipe manufacturer's shop by a qualified welder.
- C. Minimum wall thickness for pipes and sleeves having integrally cast seep rings shall be as follows:
 - 1. Pipe or Sleeve Size 3 inches: Minimum Wall Thickness 0.48 inches.
 - 2. Pipe or Sleeve Size 4 inches: Minimum Wall Thickness 0.52 inches.
 - 3. Pipe or Sleeve Size 6 inches: Minimum Wall Thickness 0.55 inches.
 - 4. Pipe or Sleeve Size 8 inches: Minimum Wall Thickness 0.60 inches.
 - 5. Pipe or Sleeve Size 10 inches: Minimum Wall Thickness 0.68 inches.
 - 6. Pipe or Sleeve Size 12 inches: Minimum Wall Thickness 0.75 inches.
- D. Minimum wall thickness of pipes or sleeves having shrink-fit collars shall be special Class 52. Cut shrink-fit collars from a 1/4-inch-thick steel ring. Attach the collar to a cast-iron or ductile-iron pipe or sleeve by heating the steel collar and allowing it to shrink over the pipe at the necessary location. Provide an epoxy bond (Keysite 740 or 742 or Scotchkote 302) between the pipe and collar. Sandblast the area of the pipe to be epoxy coated per SSPC SP-10.
- E. Wall pipes or sleeves having steel collar halves bottomed in a groove shall be ductile iron Special Class 54 minimum unless otherwise shown. Wall flanges shall consist of 1/4-inch-thick steel seep ring halves for pipes through 24-inch and 3/8-inch-thick halves for pipe 30 inches and larger, bottomed in a groove provided on the pipe. The pipe groove shall be machine cut to a depth of 1/16 to 5/64 inch to provide a press fit for the seep ring. Seep ring halves shall be welded together after fit into groove but shall not be welded to pipe. Seep rings shall be sealed completely around the pipe with silicon sealant manufactured by Dow-Corning No. 790, General Electric Silpruf, or equal.
- F. The material used in cast- or ductile-iron wall flanges, wall sleeves, and wall penetrations shall conform to ASTM A395, A436, A536, A48 (Class 35), or A126 (Class B).
- G. Pressure test at least one of each size of cast-iron pipes or sleeves having shrink-fit steel collars or collar halves installed in a groove in the pipe at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours' duration and shall show zero leakage.

2.3 Fabricated Steel Wall Pipes and Sleeves

- A. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ASME B36.10 for sleeves 72 inches and smaller and 1/2 inch for sleeves greater than 72 inches through 96 inches.
- B. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a 1/4-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ASME B31.3, Chapter V.
- C. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTM A53 (Type E or S), Grade B; ASTM A135, Grade B; ASTM A139, Grade B; or API 5L or 5LX. Wall pipes

connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A36, A105, A181, or A182.

- D. Stainless steel pipe used in fabricating wall pipes shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A240.
- E. Pressure test at least one of each size of fabricated steel wall sleeve or penetration and collar assemblies at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours' duration and shall show zero leakage.

2.4 Rubber Annular Hydrostatic Sealing Devices

- A. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.
- B. Materials of construction shall be as follows:
 - 1. Pressure plate: Delrin plastic.
 - 2. Bolts and nuts for links: Type 303 or 316 stainless steel.
 - 3. Sealing element: EPDM rubber.
- C. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.
- D. Provide centering blocks in 25 percent of the sealing elements on pipelines larger than 12 inches in diameter.
- E. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation; Innerlynx as manufactured by Advance Products & Systems, Inc.; or equal.

2.5 Bolts, Nuts, and Gaskets for Flanged-End Wall Pipes

- A. See Section 400500.

2.6 Polyethylene Foam Filler for Pipe Penetrations

- A. Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2 inch larger in diameter than the annular space.

2.7 Polyurethane Sealant for Pipe Penetrations

- A. Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer. Products: SIKA Sikaflex 2C or equal.

2.8 Painting and Coating

- A. Line and coat sleeves and pipes (except stainless steel) with fusion-bonded epoxy per Section 099761.
- B. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 099000, System No. 29 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.
- C. Coat submerged sleeves and penetrations per Section 099000, System No. 12 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.
- D. Coat buried sleeves and penetrations per Section 099000, System No. 10 unless fusion-bonded epoxy coatings per Section 099761 are shown in the drawings or specified elsewhere.
- E. Do not coat stainless steel sleeves and penetrations.

PART 3 EXECUTION

3.1 Location of Pipes and Sleeves

- A. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.
- B. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless steel pipe 3 inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.
- C. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless steel pipe 3 inches and smaller, or stainless steel or copper tubing passes through a wall. Provide a single rubber annular seal when the wall is 8 inches thick or less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8 inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.
- D. Where wall sleeves are installed in which water or soil is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).
- E. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.2 INSTALLATION IN EXISTING CONCRETE WALLS AND SLABS

- A. Core drill holes 1 to 2 inches larger in diameter than the outside diameter of the wall flange or collar. Install wall pipe and collar assembly axially aligned with the piping to which it will be connected or will contain. Pack the void space between the sleeve and concrete with grout. See Section 033000 for grouting specification.

3.3 Installation in New Concrete Walls and Slabs

- A. Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

3.4 Installation in Dry Floors and Slabs

- A. Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2 inches above the floor or slab unless shown otherwise in the drawings.

3.5 Installation of Wall Pipes Having Flanged End Connections

- A. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.
- B. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3.6 Qualifications of Welders

- A. Welder qualifications shall be in accordance with AWS D1.1.

3.7 Installation of Rubber Annular Hydrostatic Sealing Devices

- A. Install in accordance with the manufacturer's instructions.

3.8 Field Testing

- A. Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 033000. Penetrations shall show zero leakage.

END OF SECTION

SECTION 400764
PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 Description

- A. This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, pipe spiders, neoprene isolation pads, cable trays for hoses, and drip guards.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. Section 400722 "Flexible Pipe Couplings and Expansion Joints"
- D. Section 400762 "Wall Pipes, Seep Rings, and Penetrations".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.
- C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.
- D. Submit layout drawings for the drip guards, showing dimensions and thicknesses. Show design of seam or joint where field connections will be made between sections and pieces of drip guards. Submit a certificate listing the type of resin to be used, describing the manufacturer's brand name or designation, composition, and characteristics.

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 - PRODUCTS

2.1 Design Criteria.

- A. Pipe supports, anchors, and expansion joints have been indicated on the Drawings in certain locations, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. The Contractor shall design anchors, pipe supports, expansion joints, and flexible couplings not already shown on the Drawings, in accordance with the requirements specified herein. Additional pipe supports may be required adjacent to expansion joints, couplings, valves, meters, and equipment. Contractor shall not delete or relocate supports, expansion joints, or couplings shown in the Drawings without the Engineer's approval.
- B. Absence of pipe supports and details on the Drawings shall not relieve the Contractor of responsibility of providing them throughout the plant.
- C. The Contractor's design shall include pipe supports, bracing, and anchorage adjacent to expansion joints, couplings, valves, in-line devices, equipment, wyes and tees, or changes in direction as required for dismantling piping, removing valves or other in-line devices, disconnecting piping from equipment, and pipe support, in addition to supports in accordance with the maximum spacing specified herein.
- D. Pipe support and hanger components shall withstand hydrostatic loads, up-lift forces, dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and internal test pressures, and shall have a minimum safety factor of five based on material ultimate strength.

- E. All piping shall be rigidly supported so there is no visible movement or visible sagging between supports. The system shall comply with specified code requirements.
- F. Provide anchors to resist thrust due to temperature changes, changes in diameter or direction, or dead-ends. Anchors shall be located as specified to force expansion and contraction to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellow type expansion joints may be located adjacent to the joint.
- G. When expansion joints are required, pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the Drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first joint. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Pipe guides shall be provided at locations as recommended by the manufacturer.
- H. Pipe supports for insulated cold piping systems shall be sized for the outside diameter of the insulated pipe, and an insulation protection shield shall be installed between the support and the insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields for piping larger than 2-inches or when needed to prevent crushing of the insulation. Inserts shall be of the same thickness as the adjacent insulation and shall be vapor sealed.
- I. When supports for the FRP piping systems are in contact with less than 180-degrees of the pipe surface or when the width of the support is less than one-third the nominal pipe diameter (4-inches minimum), and FRP saddle, shaped to the outside diameter of the pipe, shall be bonded to at least the bottom 120-degrees of the pipe.
- J. Supply design criteria to the precast concrete manufacturer for any piping supported from the precast members.
- K. Hanger and Support Systems.
 - 1. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.
 - 2. Pipe hangers and supports shall comply with MSS SP-58 for the standard types referenced in the drawings. Construct special hangers and supports if detailed in the drawings. Type numbers for standard hangers and supports shall be in accordance with MSS SP-58 as listed below:
 - a. Type 1: Adjustable steel clevis.
 - 1) Manufacturer and Model: Anvil Fig. 590 or 260 or approved equal.
 - b. Type 3: Steel double-bolt pipe clamp.
 - 1) Manufacturer and Model: Anvil Fig. 295A or 295H or approved equal.
 - c. Type 4: Steel pipe clamp (pipes smaller than 3 inches).
 - 1) Manufacturer and Model: Anvil Fig. 212 or approved equal.
 - d. Type 4: Steel pipe clamp (pipes 3 inches and larger).
 - 1) Manufacturer and Model: Anvil Fig. 216 or approved equal.
 - e. Type 5: Pipe hanger support plate.
 - 1) Manufacturer and Model: Anvil Fig. 49 or approved equal.
 - f. Type 6: Adjustable swivel pipe ring.
 - 1) Manufacturer and Model: Anvil Superstrut 714, Anvil Fig. 104, or approved equal.
 - g. Type 7: Adjustable steel band hanger.
 - 1) Manufacturer and Model: Anvil Fig. 69 or approved equal.
 - h. Type 8: Trapeze Beam.
 - 1) Manufacturer and Model: Anvil Fig. 45 or approved equal.
 - i. Type 9: Adjustable band hanger.
 - 1) Manufacturer and Model: Anvil Fig. 97 or approved equal.
 - j. Type 10: Adjustable swivel ring band hanger.

- 1) Manufacturer and Model: Anvil Fig. 70 or approved equal.
- k. Type 11: Split pipe ring with adjustable turnbuckle.
 - 1) Manufacturer and Model: Anvil Fig. 108 or approved equal.
- l. Type 13: Steel turnbuckle.
 - 1) Manufacturer and Model: Anvil Fig. 230 or approved equal.
- m. Type 14: Steel clevis.
 - 1) Manufacturer and Model: Anvil Fig. 299 or approved equal.
- n. Type 15: Swivel turnbuckle.
 - 1) Manufacturer and Model: Anvil Fig. 114 or approved equal.
- o. Type 16: Malleable iron socket.
 - 1) Manufacturer and Model: Anvil Fig. 110R or approved equal.
- p. Type 17: Steel weldless eye nut.
 - 1) Manufacturer and Model: Anvil Fig 290 or approved equal.
- q. Type 18: Steel or malleable iron concrete insert.
 - 1) Manufacturer and Model: Anvil Fig. 281, Superstrut 452 or approved equal.
- r. Type 19: Top beam C-clamp.
 - 1) Manufacturer and Model: Anvil Fig. 92 or approved equal.
- s. Type 20: Side I-beam or channel clamp.
 - 1) Manufacturer and Model: Anvil Fig. 14 or 217 or approved equal.
- t. Type 21: Center I-beam clamp.
 - 1) Manufacturer and Model: Anvil Figure 134 or approved equal.
- u. Type 22: Welded attachment type.
 - 1) Manufacturer and Model: Anvil Fig. 66 or approved equal.
- v. Type 23: C-clamp.
 - 1) Manufacturer and Model: Anvil Fig. 86 or approved equal.
- w. Type 24: U-bolt.
 - 1) Manufacturer and Model: Anvil Fig. 137 or approved equal.
- x. Type 26: Clip.
 - 1) Manufacturer and Model: Anvil Fig. 262 or approved equal.
- y. Type 28: Steel I-beam clamp with eye nut.
 - 1) Manufacturer and Model: Anvil Fig. 228 or approved equal.
- z. Type 29: Steel wide flange.
 - 1) Manufacturer and Model: Anvil Fig. 228 clamp with eye nut or equal.
- aa. Type 30: Malleable iron beam clamp with extension piece.
 - 1) Manufacturer and Model: Superstrut CM-754 or approved equal.
- ab. Type 31: Light welded steel bracket.
 - 1) Manufacturer and Model: Anvil Fig. 194 or approved equal.
- ac. Type 32: Medium welded steel bracket.
 - 1) Manufacturer and Model: Anvil Fig. 195 or approved equal.
- ad. Type 33: Heavy welded steel bracket.
 - 1) Manufacturer and Model: Anvil Fig. 199 or approved equal.
- ae. Type 34: Side beam bracket.
 - 1) Manufacturer and Model: Anvil Fig. 202 or approved equal.
- af. Type 36: Pipe saddle support.
 - 1) Manufacturer and Model: Anvil Fig. 258 or approved equal.
- ag. Type 37: Pipe stanchion saddle.
 - 1) Manufacturer and Model: Anvil Fig. 259 or approved equal.
- ah. Type 38: Adjustable pipe saddle support.
 - 1) Manufacturer and Model: Anvil Fig. 265 or approved equal.
- ai. Type 39: Steel pipe covering.
 - 1) Manufacturer and Model: Anvil Fig. 160, 161, 162, 163, 164, or 165; Superstrut A 789; or approved equal.
- aj. Type 40: Insulation protection shield.
 - 1) Manufacturer and Model: Anvil Fig. 167 or approved equal.

- ak. Type 41: Single pipe roll.
 - 1) Manufacturer and Model: Anvil Fig. 171 or approved equal.
- al. Type 43: Adjustable roller hanger with swivel.
 - 1) Manufacturer and Model: Anvil Fig. 181 or approved equal.
- am. Type 44: Pipe roll, complete.
 - 1) Manufacturer and Model: Anvil Fig. 271 or approved equal.
- an. Type 45: Lateral Brace Clamp.
 - 1) Manufacturer and Model: Anvil Fig. 775 or approved equal.
- 3. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories shall be hot-dipped galvanized per ASTM A153 carbon steel (ASTM A36, A575, or A576) unless noted otherwise.
- 4. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories in treatment process, pumping, and chemical storage/feed areas and rooms shall be stainless steel or FRP.
- 5. Submerged hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories in wet wells, tanks, channels or tank covers shall be Type 316 stainless steel.
- L. Offset Pipe Clamp.
 - 1. Anvil Figure 103 or equal. Material shall be carbon steel.
- M. Miscellaneous Pipe Supports and Hangers.
 - 1. Pipe Anchor Chair: Anvil Figure 198 or equal.
 - 2. One Hole Clamp: Anvil Figure 126 or equal.
 - 3. Roller Chair: Anvil Figure 175 or equal.
- N. Steel Channel Framing System.
 - 1. Steel channel frames shall be 1-5/8 inches wide by 1-5/8 or 3-1/4 inches high by 12-gauge metal thickness, unless otherwise shown in the drawings. Material shall conform to ASTM A36, A570 (Grade 33 minimum), or A653 unless stainless steel is indicated in the drawings. Stainless steel shall be Type 304. One side of the channel shall have a continuous open slot with inturned clamping ridges. Maximum allowable stress under any combination of applied uniformly distributed loads and concentrated loads shall not exceed those recommended in the AISC or AISI. Deflection shall not exceed 1/240 of span. Use multiple back-to-back channels to achieve these criteria if single channels are not sufficient. Products: Unistrut P1000 or P5000 Series, B-Line B11 or B22 Series, or equal.
 - 2. Steel channels shall be hot-dipped galvanized per ASTM A153, plain, coated with 20 mils of white PVC per ASTM D1784, or coated with fusion-bonded epoxy per Section 099761.
 - 3. Nuts shall be machined and case hardened. Provide rectangular nuts with the ends shaped to permit a quarter turn crosswise in the framing channel. Provide two serrated grooves in the nut to engage the inturned edges of the channel.
 - 4. Pipe clamps (including attachment screws and nuts) shall be Unistrut P1100 or P2000 Series, B-Line B2000 Series, or equal. Material shall be Type 304 stainless steel.
 - 5. Hanger rods for trapezes shall be hot dipped galvanized carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.
 - 6. Accessory fittings and brackets shall be the same material as the channel or trapeze. Provide coating on carbon steel fittings and brackets as specified for the channels and frames.
 - a. Flat Plate Fittings: Unistrut P1065, P1066, P1925; Superstrut AB-206, AB-207; or equal.
 - b. Post Bases: Unistrut P2072A, Superstrut AP-232, or equal.
 - c. 90-Degree Brackets: Unistrut P1326, P1346; Superstrut AB-203; or equal.
 - d. Rounded-End Flat Plate Fittings: Unistrut P2325, Superstrut X-240, or equal.
 - 7. Parallel pipe clamps shall be Unistrut P1563 through P1573, Superstrut AB-719, or equal. Material shall be hot-dipped galvanized carbon steel, coated as specified for channels and frames.

O. FRP Channel Framing System.

1. FRP pipe hangers and supports shall be Aickinstrut, Inc., or equal.
2. Material properties shall be as follows:
 - a. Longitudinal Direction:
 - 1) Ultimate Tensile (psi): 35,000 minimum.
 - 2) Ultimate Compressive (psi): 35,000 minimum.
 - 3) Ultimate Flexural (psi): 35,000 minimum.
 - 4) Tensile Modulus (psi): 3.0×10^6 minimum.
 - 5) Flexural Modulus (psi): 2.0×10^6 minimum.
 - 6) Ultimate Shear Strength (psi): 6,000 minimum.
 - 7) Izod Impact (ASTM D256) Ft-lb/inch notch: 30 minimum.
 - b. Transverse Direction:
 - 1) Ultimate Tensile (psi): 10,000 minimum.
 - 2) Ultimate Compressive (psi): 20,000 minimum.
 - 3) Ultimate Flexural (psi): 14,000 minimum.
 - 4) Tensile Modulus (psi): 1.0×10^6 minimum.
 - 5) Compressive Modulus (psi): 1.4×10^6 minimum.
 - 6) Flexural Modulus (psi): 1.0×10^6 minimum.
 - 7) Ultimate Shear Strength (psi): 5,500 minimum.
 - 8) Ultimate Bearing Stress (psi): 35,000 minimum.
 - 9) Izod Impact (ASTM D256) Ft-lb notch: 5 minimum.
 - c. Hardness:
 - 1) Barcol Test: 50 minimum.
3. Glass fiber reinforced composites and plastic products shall have a flame spread rating of 25 or less when tested per ASTM E84.
4. Channel framing shall be 1-5/8 inches deep by 1-5/8 inches wide and shall be made using vinylester resin equal to Derakane 411, Ashland Hetron 922, or Reichhold Dion 9800. It shall have a nexus polyester surfacing veil over 100% of the surface which, along with a filler system, will protect against degradation from ultraviolet light. Channel shall be supplied with integral notches 1 inch on center. Notches shall be located on the interior flange to prevent slippage of pipe clamps and fittings after installation. In place of notched channel, unnotched channel may be used if the vertical channel sections supporting the horizontal piping are provided with stop lock hardware at each pipe clamp to prevent slippage. Channel framing shall be Aickinstrut G.R.P. Type V 200 series or equal.
5. Channel framing connections shall be made with vinylester glass fiber composite nuts, bolts, all threaded rods, channel fittings, bases, and hanger assemblies. Nuts, bolts, and rods shall be Aickinstrut 4200 series, Strut Tech PVCG, or equal. Channel fittings shall be Aickinstrut 2800 style or equal.
6. Load-bearing pipe clamps and nonload-bearing pipe straps shall be nonmetallic and nonconductive and shall be made by the injection molding process using polyurethane base resin. Pipe clamps and straps shall be Aickinstrut 3100 series or equal.
7. Clevis hangers shall be made with vinylester glass fiber and be Aickinstrut 1500 series or equal.
8. Hanger rods for trapezes shall be hot dipped galvanized carbon steel (ASTM A36, A575, or A576) unless stainless steel is indicated in the drawings. Stainless steel hanger rod material shall comply with ASTM A276, Type 304.

P. Pipe Spiders.

1. Superstrut S-794 or equal.

Q. Waffle Isolation Pads.

1. Mason Type "W"; Machinery Installation Systems "Unisorb" Type S, SB, F, or FB; or equal. Provide minimum 1/4-inch thickness.

R. Neoprene Isolating Sleeves for Metal Pipe 6 Inches and Smaller.

1. Unistrut P2600, B-Line "Vibrocushion," or equal.

- S. Cable Trays for Support of Chemical Hoses.
1. Provide PVC-coated aluminum, 3-inch loading depth ladder-type cable trays with 6-inch rung spacing. Width shall be 12 inches unless otherwise shown in the drawings. Cable tray shall have a capacity of 56 pounds per foot at 12-foot spacing with a 1.73-inch-capacity deflection. Side members shall have outward flanges. Design loading with a safety factor of 1.5 per NEMA VE-1. Conform to NEMA Class 12A.
 2. Cable tray shall be P-W Western, Inc., No. 06-4D03-0012-12; T. J. Cope, Inc., No. 3338-12-SL-12-06; or equal.
 3. Provide aluminum support brackets, holddown clamps (P-W Western, Inc., No. 9988-1B23-01; T. J. Cope, Inc., No. 9018; or equal), and cable clamps (P-W Western, Inc., No. 9996-1911-21; T. J. Cope, Inc., No. SCC-400; or equal) for support of cable trays.
- T. Drip Guards.
1. Drip guards shall be minimum 1/4 inch thick, PVC or FRP. Color shall be white.
 2. PVC shall conform to ASTM D1784, Cell Classification 12454-B and ASTM D1927, Type I.
 3. Seams or joints between sections and pieces shall be leak free. Design joints so that liquid can flow across the joint and not form ponds.
 4. FRP drip guards shall include a corrosion-resistant layer on the side of the drip guard exposed to piping. The exposed corrosion-resistant layer shall be resin rich, shall consist of Type C glass monofilament surfacing mat or Nexus organic fiber, and shall be a minimum of 20 mils thick. Glass content in the corrosion-resistant layer shall not exceed 23% by weight. The structural layer shall be composed of chopped strand mat having a minimum glass content of 30% by weight. The overall glass content of the finished laminate shall be at least 30% by weight. Provide resin throughout the laminate. Determine glass content per ASTM D2584. Resin shall be Derakane 411, Reichhold Dion 9800, Ashland Hetron 922, or equal. Construction shall comply with ASTM D2563, Level II. Hardness shall be at least 90% of the resin manufacturer's recommended Barcol hardness, with a minimum Barcol hardness of 30, with the resin fully cured. Maximum strain in the laminate shall be 0.001 inch/inch. Maximum air bubble size in the laminate shall be 1/16 inch. Maximum frequency of air bubbles shall be 10 per square inch of laminate. Construction shall comply with NBS Voluntary Product Standard PS 15-69.
 5. Provide nylon washers (minimum 1/8 inch thick) on both sides of holes where pipe hangers penetrate the drip guard. Provide Type 316 stainless steel nuts to connect the drip guards to pipe hangers and supports.
- U. Anchor Bolts, Screws, and inserts.
1. Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be hot-dipped galvanized steel, ASTM A307. Nuts shall be galvanized steel, ASTM A563.
 2. Concrete inserts or anchor bolts shall be used to support piping from new cast-in-place concrete. Adhesive anchors shall be used to fasten supports to existing concrete and masonry.
 3. Inserts:
 - a. Reference building structural concrete drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and side of reinforced concrete beams. It shall be the Contractor's responsibility to accurately locate and attach inserts to concrete forms.
 - b. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. X-ray locate existing reinforcement before drilling.

PART 3 - EXECUTION

3.1 Pipe Hanger and Wall Support Spacing

- A. Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes

shown or detailed in the drawings. If no spacing or rod sizes are given in the drawings or in the specifications for a particular piping system, use the following:

- B. Pipe Hanger and Wall Support Spacing for Steel and Ductile-Iron Pipe (Section 402040):
1. Pipe Size (inches): 3/8 and smaller.
 - a. Support/Hanger Max Spacing (feet): 4
 - b. Minimum Rod Size (inches): 3/8
 - c. Pipe Size (inches): 1/2 through 1.
 - 1) Support/Hanger Max Spacing (feet): 6
 - 2) Minimum Rod Size (inches): 3/8
 - d. Pipe Size (inches): 1-1/4 through 2.
 - 1) Support/Hanger Max Spacing (feet): 8
 - 2) Minimum Rod Size (inches): 3/8
 - e. Pipe Size (inches): 2-1/2 and 3.
 - 1) Support/Hanger Max Spacing (feet): 10.
 - 2) Minimum Rod Size (inches): 1/2
 - f. Pipe Size (inches): 3-1/2 and 4.
 - 1) Support/Hanger Max Spacing (feet): 10
 - 2) Minimum Rod Size (inches): 5/8
 - g. Pipe Size (inches): 6.
 - 1) Support/Hanger Max Spacing (feet): 12
 - 2) Minimum Rod Size (inches): 3/4
 - h. Pipe Size (inches): 8.
 - 1) Support/Hanger Max Spacing (feet): 12
 - 2) Minimum Rod Size (inches): 7/8
 - i. Pipe Size (inches): 10 and 12.
 - 1) Support/Hanger Max Spacing (feet): 14
 - 2) Minimum Rod Size (inches): 7/8
 - j. Pipe Size (inches): 14 and 16.
 - 1) Support/Hanger Max Spacing (feet): 16
 - 2) Minimum Rod Size (inches): 1
 2. Pipe Hanger or Wall Support Spacing for PVC and CPVC Pipe (Sections 402090):
 - a. Pipe Size (inches): 3/4.
 - 1) Support/Hanger Max Spacing (feet): 4
 - 2) Minimum Rod Size (inches): 3/8
 - b. Pipe Size (inches): 1.
 - 1) Support/Hanger Max Spacing (feet): 4
 - 2) Minimum Rod Size (inches): 3/8
 - c. Pipe Size (inches): 1-1/4.
 - 1) Support/Hanger Max Spacing (feet): 4-1/2
 - 2) Minimum Rod Size (inches): 3/8
 - d. Pipe Size (inches): 1-1/2.
 - 1) Support/Hanger Max Spacing (feet): 5
 - 2) Minimum Rod Size (inches): 3/8
 - e. Pipe Size (inches): 2.
 - 1) Support/Hanger Max Spacing (feet): 5
 - 2) Minimum Rod Size (inches): 3/8
 - f. Pipe Size (inches): 2-1/2.
 - 1) Support/Hanger Max Spacing (feet): 5
 - 2) Minimum Rod Size (inches): 1/2
 3. For piping services not described, provide hangers and supports per MSS SP-58 and SP-69.
 4. Provide bracing for piping 8 inches and smaller that is installed on hangers or trapezes per MSS SP-127, except provide lateral bracing at maximum 10-foot center-to-center

spacings. Provide sway bracing for hangers for piping larger than 8 inches as detailed in the drawings.

- C. Pipe Support Spacing for Supports on Top of Slabs or Grade
1. Install pipe supports on horizontal runs at the spacing shown or detailed in the drawings. Provide supports of the type shown or detailed in the drawings. If no spacings are given in the drawings or in the specifications for a particular piping system, use the following:
 2. Pipe Support Spacing for Steel and Ductile-Iron Pipe (Sections 402040):
 - a. Pipe Size (inches): 3/8 and smaller.
 - 1) Support/Hanger Max Spacing (feet): 4.
 - b. Pipe Size (inches): 1/2 through 1.
 - 1) Support/Hanger Max Spacing (feet): 6.
 - c. Pipe Size (inches): 1-1/4 through 2.
 - 1) Support/Hanger Max Spacing (feet): 8.
 - d. Pipe Size (inches): 2-1/2 and 3.
 - 1) Support/Hanger Max Spacing (feet): 10.
 - e. Pipe Size (inches): 3-1/2 and 4.
 - 1) Support/Hanger Max Spacing (feet): 10.
 - f. Pipe Size (inches): 6.
 - 1) Support/Hanger Max Spacing (feet): 12.
 - g. Pipe Size (inches): 8.
 - 1) Support/Hanger Max Spacing (feet): 12.
 - h. Pipe Size (inches): 10 and 12.
 - 1) Support/Hanger Max Spacing (feet): 14.
 3. Pipe support spacing for other pipe materials shall be the same as described above in paragraph entitled "Pipe Hanger and Wall Support Spacing."
- D. Installing Pipe Hangers and Supports
1. Pipe hangers, brackets, and supports shall be furnished complete with all necessary inserts, anchor bolts, bolts, nuts, washers, and other accessories.
 2. All piping shall be supported in a manner which will prevent undue stress on any valve, meter, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown in the Drawings. Pipe supports and hangers shall not be installed in equipment access areas.
 3. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.
 4. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each non-rigid joint or flexible pipe coupling.
 5. Where horizontal piping is arranged with two or more parallel pipe runs, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods. All pipe runs shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.
 6. Adjust pipe hangers per MSS SP-89, paragraph 10.6.
 7. Install leveling bolts beneath support baseplates. Provide 3/4 to 1-inch thick non-shrink, non-staining grout pad beneath each base.
 8. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.
 9. Do not support piping from other piping.

- E. Installing Steel Channel Frames
 - 1. Use 1-5/8-inch-high channel frames unless 3-1/4-inch is needed to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.
 - 2. Seal the ends of cut FRP channel frames with the channel manufacturer's sealant or resin.
- F. Installing Neoprene Isolating Pads or Sleeves
 - 1. Install a sleeve around each metal pipe 6 inches and smaller at the point of bearing or contact with the pipe hanger or support.
 - 2. Install isolating pad between each metal pipe larger than 6" at the point of bearing or contact with the pipe hanger or support.
- G. Installing Cable Trays for Chemical Hoses
 - 1. Provide cable tray supports at 8-foot centers, maximum. Locate a support within 2 feet of each fitting extremity. Provide one support under each of the three side rails for horizontal tees. Allow for thermal expansion based on 50 degrees F temperature variation.
 - 2. Attach chemical hoses to rungs of cable tray at 6-foot intervals using cable clamps.
- H. Painting and Coating
 - 1. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.
 - 2. Exposed pipe hangers and supports are to be provide with hot dip galvanized coating. For areas where the pipe supports are cut, welded, or any other case where the integrity of the galvanized coating is affected due to erection on site, touch up and repair the affected area per Section 099000 "Painting and Coating".
 - 3. Paint exposed pipe hangers and supports to match the color of the adjacent wall using System No. 12 per Section 099000 "Painting and Coating". If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.
 - 4. Submerged pipe hangers are to be provided as 316 Stainless Steel. No coating required.
 - 5. Coat submerged pipe hangers and supports per Section 099000 "Painting and Coating", System No. 12.
 - 6. If the ferrous metal pipe hangers and supports are not galvanized or Stainless Steel, the pipe supports shall be coated per Section 099000 "Painting and Coating", System No. 34.

END OF SECTION

SECTION 400775
EQUIPMENT, PIPING, AND VALVE IDENTIFICATION

PART 1 GENERAL

1.1 Description

- A. This section includes materials and installation of markers, labels, and signs for pipes and valves; for mechanical equipment; for hazardous materials warnings; and for miscellaneous plant services.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 400500 "General Piping Requirements".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog data and descriptive literature describing materials, colors, letter size, and size of labels.
- C. Submit a listing of all equipment, pipes, and valves to be labeled with the proposed content of each label.

PART 2 PRODUCTS

2.1 Labels for Exposed Piping

- A. Labels for piping shall bear the full piping system name as shown in the in the Drawings. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather- and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.
- B. Alternatively, provide preprinted, semirigid, snap-on, color-coded pipe markers. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Label shall cover 360 degrees (minimum). Labels shall be fabricated of weather- and UV-resistant acrylic plastic. Labels shall be Seton Nameplate Corporation SetMark pipe marks or equal.
- C. Alternatively, Stencils for piping shall bear the full piping system name as shown in the in the Drawings. Provide separate flow directional arrows next to each stencil. Stenciled labels shall be in a contrasting color and letter height shall adhere to the minimum requirements of ASME A13.1.
- D. Provide 1-inch-thick molded fiberglass insulation with jacket for each plastic pipe label or marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

2.2 Labels for Exposed Valves

- A. Provide each valve of size 3 inches and larger with an identification tag. Tag shall be 2-inch-square or circular aluminum or 1/16-inch-thick fiberglass: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Aluminum tags shall have black-filled letters. Tag shall show the valve tag number and/or name or designation as given in the drawings.

2.3 Yard Hydrant Sign-Reclaimed Water

- A. Provide a rigid sign labeled "CAUTION: RECLAIMED WATER--DO NOT DRINK" for the yard hydrant. Size and lettering shall conform to CAL/OSHA requirements. Signs shall be Seton Nameplate Company 20-gauge baked enamel, minimum size 7 inches by 3 inches; Brady B-120 Fiber-Shield fiberglass, minimum size 7 inches by 3 inches, 1/8 inch thick; or equal.

2.4 Labels for Automatic Start/Stop Equipment

- A. Provide a sign reading "CAUTION--EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on each piece of equipment that automatically starts and stops . Signs shall be pressure-sensitive

vinyl with adhesive for application to equipment. Signs mounted on adjacent walls are also acceptable. Size shall be 10 inches by 7 inches minimum. Products: Seton, Brady, or equal.

1. Equipment Type: Pumps.
2. Equipment Type: VFDs.

2.5 Underground Plastic Warning Tape for Metallic Pipe

- A. Provide permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service, not less than 6 inches wide by 3.5 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe. Provide the following colored tape for the various piping services:
 1. Cable TV Service: Orange.
 2. Chemical Service: Yellow.
 3. Electrical Service: Red.
 4. Fuel Oil or Gasoline Service: Yellow.
 5. Gas Service: Yellow.
 6. Reclaimed Water Service: Violet.
 7. Sewer Service: Green.
 8. Telephone Service: Orange.
 9. Water Service: Blue.

2.6 Underground Detectable Metallic Pipe Warning Tape for Nonmetallic Pipe

- A. Provide permanent, bright-colored, continuous-printed tape consisting of an aluminum or steel foil sheathed in a plastic laminate, not less than 2 inches wide by 3 mils thick. Provide tape with printing which most accurately indicates type of buried service. Provide the following colored tape for the various piping services:
 1. Cable TV Service: Orange.
 2. Chemical Service: Yellow.
 3. Electrical Service: Red.
 4. Fuel Oil or Gasoline Service: Yellow.
 5. Gas Service: Yellow.
 6. Reclaimed Water Service: Violet.
 7. Sewer Service: Green.
 8. Telephone Service: Orange.
 9. Water Service: Blue.

PART 3 EXECUTION

3.1 Installing Pipe Labels

- A. Provide label and flow arrow at each connection to pumps or other mechanical equipment, at wall boundaries, at tees and crosses, and at 20 foot centers on straight runs of piping.
- B. On piping having external diameters less than 6 inches (including insulation, if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.
- C. On piping having external diameters of 6 inches and larger (including insulation, if any), provide either full-band or strip-type pipe markers but not narrower than three times letter height (and of required length), fastened by one of the following methods:
 1. Laminated or bonded application of pipe marker to pipe or insulation.
 2. Strapped-to-pipe or insulation application of semirigid type with Type 304 or 305 stainless steel bands.

3.2 Installing Valve and Equipment Labels

- A. Attach labels to the valve or piece of equipment with Type 304 or 316 stainless steel chains or wires.
- B. Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

3.3 Installing Miscellaneous Signs

- A. Attach per sign manufacturer's recommendations and per OSHA requirements.

3.4 Installing Labels for Automatic Start/Stop Equipment and Hazardous Materials Warning Signs for Equipment

- A. Attach signs for exposed equipment directly to the equipment.
- B. Attach signs for sump pumps on the adjacent wall.

3.5 Installing Underground Plastic Warning Tape for Metal Pipe

- A. During backfilling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches above the top of the pipe. Where multiple small lines are buried in common trench and do not exceed overall width of 16 inches, install single line marker. For tile fields and similar installation, mark only edge pipelines of field.

3.6 Installing Underground Detectable Metallic Pipe Warning Tape

- A. Install tape 4 to 6 inches below finished ground surface, located directly over buried pipelines. Where multiple small pipelines are buried in a common trench and do not exceed an overall width of 16 inches, install a single marker tape. For tile fields and similar installations, mark only the edge pipelines of the field.

END OF SECTION

SECTION 402040
DUCTILE-IRON PROCESS PIPE

PART 1 GENERAL

1.1 Description

- A. This section describes materials, testing, and installation of ductile-iron process pipe and fittings 24 inches and smaller.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 400713 "Polyethylene Sheet Encasement".
- C. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- D. Section 312333 "Trenching and Backfilling".
- E. Section 400500 "General Piping Requirements".
- F. Section 400762 "Wall Pipes, Seep Rings, and Penetrations".
- G. Section 400764 "Pipe Hangers and Supports".
- H. Section 400775 "Equipment, Piping, and Valve Identification".
- I. Section 400722 "Flexible Pipe Couplings and Expansion Joints".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Provide an affidavit of compliance with standards referenced in this specification, e.g., AWWA C151. Submit copy of report of pressure tests for qualifying the designs of all sizes and types of AWWA C153 fittings that are being used in the project. The pressure test shall demonstrate that the minimum safety factor described in AWWA C153, Section 5.5 is met.
- C. Submit piping layout profile drawings showing location and dimensions of pipe and fittings; submit after equipment and valve submittals have been reviewed and marked "Resubmittal not required." Include laying lengths of valves, meters, in-line pumps, and other equipment determining piping dimensions. Label or number each fitting or piece of pipe. Piping having identical design pressure class, laying lengths, and bell-and-spigot dimensions that is to be placed in long straight reaches of alignment may have the same identifying label or number.
- D. Provide the following information:
 - 1. Mortar lining thickness.
 - 2. Wall thickness.
 - 3. Outside coating.
 - 4. Material test data for this project.
 - 5. Show deflections at push-on and mechanical joints.
 - 6. Submit joint and fitting details and manufacturer's data sheets.
- E. Submit calculations and test data proving that the proposed restrained joint arrangement can transmit the required forces with a minimum safety factor of 1.5.
- F. Submit certificate that cement for mortar lining complies with ASTM C150, designating type.
- G. Submit test report on physical properties of rubber compound used in the gaskets.
- H. Submit drawing or manufacturer's data sheet showing flange facing, including design of facing serrations.
- I. Submit weld procedure specification, procedure qualification record, and welder's qualifications prior to any welding to ductile-iron pipe.

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 Pipe

- A. Pipe shall be cast ductile (nodular) iron, conforming to AWWA C151. Provide pipe in nominal 18- or 20-foot laying lengths.
- B. All pipe shall be manufactured in the United States. The Material Supplier and/or Contractor shall furnish data certified by the Manufacturer that all pipe is of domestic manufacture.
- C. Gas Service Pipe: ANSI A21.52, ductile iron. In addition to pipe marking required by ANSI A21.52, conspicuously stamp each pipe with words "AIR TESTED".

2.2 Pipe Marking

- A. Plainly mark each length of straight pipe and each fitting at the bell end to identify the design pressure class, the ductile-iron wall thickness, and the date of manufacture, and the proper location of the pipe item by reference to the layout schedule. Mark the spigot end of restrained joint pipe to show clearly the required depth of insertion into the bell.

2.3 Pipe Wall Thickness

- A. Minimum wall thicknesses for pipe having grooved-end joints shall be as follows:
 - 1. Pipe Size 4 to 16-Inch: Thickness Class 53
- B. Minimum wall thickness for pipe having push-on or mechanical joints, restrained joints, plain ends, or cast flange ends shall be Class 50, unless otherwise shown in the drawings.
- C. Minimum wall thickness for pipe having threaded flanges shall be Special Class 53 or Pressure Class 350.
- D. Minimum pipe wall thickness required for corporation stops and tapped outlets shall be in accordance with Table A.1 of AWWA C151 for three full threads for design pressures up to 250 psi and four full threads for design pressures over 250 to 350 psi. Provide threaded weld-on boss for tapped outlets where indicated in the drawings.

2.4 Fittings

- A. Fittings 48 inches and smaller shall conform to AWWA C110 with a minimum pressure rating of 250 psi. Material shall be cast or ductile iron. Flanges shall be flat faced.
- B. Mechanical joint fittings conforming to AWWA C153 may be used in lieu of AWWA C110 fittings. Mechanical joint ductile-iron fittings 18 through 48 inches conforming to AWWA C110 (except for laying length) with a minimum pressure rating of 250 psi may also be used.
- C. Fittings 54 inches and larger shall be ductile iron, Grade 70-50-05 as specified in ASTM A536.
- D. Grooved-end fittings shall conform to AWWA C110 with grooved ends conforming to AWWA C606, radius cut rigid joints. Fitting material shall conform to ASTM A48, Class 30; ASTM A126, Class B; or ASTM A536, Grade 65-42-10. Wall thickness of ductile-iron (ASTM A536) fittings shall conform to AWWA C110 or C153; wall thickness of cast-iron fittings shall conform to AWWA C110. Fittings and couplings shall be furnished by the same manufacturer.
- E. Material for fittings with welded-on bosses shall have a Charpy notch impact value of minimum 10 ft-lbs under the conditions defined in AWWA C151. Test completed welds by the liquid penetrant method per ASTM E165.

2.5 Flanges

- A. Flanges shall be solid back, Class 125 per AWWA C115, or Class 250, flat faced per ASME B16.1 with serrated facings. Flanges on pipe shall be either cast or threaded. Material shall be ductile iron.
- B. Flanged pipe and fittings shall be shop fabricated, not field fabricated. Assembly of flange on pipe outside of manufacturer's shop is unacceptable. Threaded flanges shall comply with AWWA C115. Flanges shall be individually fitted and machine tightened in the shop, then machined flat and perpendicular to the pipe barrel. Flanges shall be back-faced parallel to the face of flange. Prior to assembly of the flange onto the pipe, apply a thread compound to the

threads to provide a leak-free connection. There shall be zero leakage through the threads at a hydrostatic test pressure of 250 psi without the use of the gasket.

- C. Flanged pipe for gas service shall be in accordance with AWWA C115 and ANSI A21.52. In addition to pipe marking specified in AWWA C115 and ANSI A21.52, conspicuously stamp each flanged pipe with words "AIR TESTED".
- D. Material for blind flanges shall be ductile iron or as indicated on the Drawings.

2.6 PIPE LINING

- A. , The inside coating of ductile iron pipe and fittings shall be Protecto 401 ceramic epoxy lining or equal to a minimum thickness of 40 mils. The epoxy coating shall be installed and tested in strict accordance with AWWA C 116/ANSI A21.16 and as supplemented in these specifications.
- B. Pipe and fittings for air and gas service shall be unlined.
- C. Maintain a moist environment inside the lined pipe and fittings by sealing the ends with polyethylene sheet.

2.7 Grooved-End Couplings

- A. Grooved-end pipe couplings shall be ductile iron, ASTM A536 (Grade 65-45-12). Gaskets shall be halogenated butyl rubber or EPDM and shall conform to ASTM D2000.
- B. Bolts in exposed service shall conform to ASTM A183, 110,000-psi tensile strength. Bolts in buried or submerged service shall be ASTM A193, Grade B8, Class 2.
- C. Couplings for pipe 24 inches and smaller shall conform to AWWA C606 for flexible radius ductile-iron pipe, except where rigid radius couplings are required to connect to fittings. Couplings for pipe sizes 30 and 36 inches shall be in accordance with the coupling manufacturer's published literature for tolerances and dimensions for flexible and rigid radius cut joints. Couplings shall be Victaulic Style 31, Gustin-Bacon No. 500, or equal.
- D. Couplings for pipe larger than 36 inches shall conform to AWWA C606 for shouldered end pipe. Couplings shall be Victaulic Style 44 or equal.
- E. Grooved-end adapter flanges for piping 24 inches and smaller having an operating pressure of 150 psi and less shall be Victaulic Style 341 or 342 or equal. Flange dimensions shall conform to ASME B16.1, Class 125.
- F. Grooved-end transition couplings for connecting ductile-iron pipe 12 inches and smaller to steel pipe shall be Victaulic Style 307 or equal.

2.8 Gaskets for Flanges

- A. See Section 400500.

2.9 Gaskets for Mechanical, Push-On, and Restrained Joints

- A. Synthetic in accordance with AWWA C111.
- B. Selected by pipe manufacturer. Suitable for service and maximum operating temperature of piping system.

2.10 Bolts and Nuts for Flanges

- A. See Section 400500.

2.11 Bolts and Nuts for Mechanical and Restrained Joints

- A. Bolts, nuts and washers for mechanical and restrained joints shall conform to ANSI/AWWA Standard C111/A21.11 and shall be Type 304 or 316 stainless steel tee head bolts and hex nuts with Teflon coated nuts.

2.12 Outlets and Nozzles

- A. Provide outlets 2-inches and smaller by using a threaded weld-on boss or as indicated in the Drawings.
- B. For outlets larger than 2 inches in exposed piping, use a tee with a flanged outlet.
- C. For outlets larger than 2 inches in buried piping, use a tee with a restrained joint outlet.

2.13 Joints

- A. Joints in aboveground or submerged piping or piping located in vaults and structures shall be flanged as shown in the Drawings.
- B. Joints in buried piping shall be of the restrained, push-on, or mechanical-joint type per AWWA C111 except where flanged joints are required to connect to valves, meters, and other equipment. Provide unrestrained buried joints except where restrained joints are specifically shown in the drawings.
- C. Restrained joints for piping 6 inches and larger shall be American Cast Iron Pipe "Lok-Ring" or "Flex-Ring," U.S. Pipe "TR-Flex," or equal. Weldments for restrained joints shall be tested by the liquid penetrant method per ASTM E165. Restrained joints for field closures shall be "Megalug" by EBAA Iron.
- D. Restrained joints in 4-inch-diameter buried piping shall be American Cast Iron Pipe Company "Fast-Grip," U.S. Pipe Field-lok gasket within Tyton joint pipe and fittings, or equal. Joint restraint shall be certified to four times rated pressure of 200 psi by Factory Mutual.
- E. Where thrust restraint is called for in the drawings, provide pipe with restrained joints capable of transmitting 1.5 times the thrust, as calculated by the following equation:
- F. where:
- G. P = Pressure class of pipe in psi. D = Outside diameter of pipe in inches. T = Thrust in pounds.

2.14 Mechanical Joint Restraint System Using Follower Ring and Wedges

- A. The restraining mechanism shall consist of a follower gland having a seal gasket and individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The system manufacturer shall provide all the components (follower ring, wedges, and gaskets) for the restraining device. The device shall be capable of full mechanical joint deflection during assembly, and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be constructed of ductile iron conforming to ASTM A536, Grade 60-42-10. The wedges shall be ductile iron, heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. The design shall use torque limiting twist-off nuts to provide actuation of the restraining wedges. The mechanical joint restraint shall be available in the size range of 3 through 48 inches. Minimum rated pressure shall be 350 psi for sizes 16 inches and smaller and 250 psi in sizes 18 inches and larger. Products: Megalug Series 1100 as manufactured by EBAA Iron, Inc., or equal.

2.15 Ductile-Iron Pipe Weldments

- A. All welding to ductile-iron pipe, such as for bosses, joint restraint, and joint bond cables, shall be done at the place of manufacture of the pipe. Perform welding by skilled welders experienced in the method and materials to be used. Welders shall be qualified under the standard qualification procedures of the ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.
- B. Welds shall be of uniform composition, neat, smooth, full strength, and ductile. Completely grind out porosity and cracks, trapped welding flux, and other defects in the welds in such a manner that will permit proper and complete repair by welding.
- C. Completed welds shall be inspected at the place of manufacture by the liquid penetrant method. Conform to the requirements specified in ASTM E165, Method A, Type I or Type II. The materials used shall be water washable and nonflammable.

PART 3 EXECUTION

3.1 Delivery, Unloading, and Temporary Storage of Pipe at Site

- A. Limit onsite pipe storage to a maximum of one week(s).
- B. Use unloading and installation procedures that avoid cracking of the lining. If necessary, use plastic sheet bulkheads to close pipe ends and keep cement-mortar lining moist.

- C. Deliver the pipe alongside the pipelaying access road over which the pipe trailer-tractors can travel under their own power. Place the pipe in the order in which it is to be installed and secure it from rolling.
- D. Do not move pipe by inserting any devices or pieces of equipment into the pipe barrel. Field repair linings damaged by unloading or installation procedures.

3.2 Sanitation of Pipe Interior

- A. During laying operations, do not place tools, clothing, or other materials in the pipe.
- B. When pipe laying is not in progress, close the ends of the installed pipe by a child- and vermin-proof plug.

3.3 Installing Flanged Pipe and Fittings

- A. Install in accordance with Sections 400500 "General Piping Requirements" . Cut the bore of the gaskets such that the gaskets do not protrude into the pipe when the flange bolts are tightened.

3.4 Installing Grooved-End Pipe and Fittings

- A. See Section 400500.

3.5 Installing Buried Piping

- A. Install in accordance with AWWA C600, Section 312333 "Trenching and Backfilling", the Contract Drawings, and as follows.
- B. When installing piping in trenches, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure for grade at the pipe invert.
- C. Provide thrust blocks at fittings per Section 312333 "Trenching and Backfilling".
- D. Inspection for Defects: Before installation, inspect pipe and appurtenances for defects and, when applicable, tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and appurtenances.
- E. Push-On Joints: Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately 1/4 IN back.
- F. Push-On Joints: Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe. Assure the gasket groove is thoroughly clean. For cold weather installation, warm gasket prior to placement in bell.
- G. Cutting: Cut pipe, when necessary, in a neat and workmanlike manner without damage to the pipe, interior lining, and exterior coating. Perform cutting with an approved mechanical cutter, using a wheel cutter when applicable and practicable.
- H. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- I. Depth of Cover: The depth of cover over water mains from the top of the pipe to the ground surface shall be sufficient to prevent freezing. The minimum depth shall be 5'-0", or otherwise as shown on the Drawings.
- J. Install access fittings to permit disinfection of water system.
- K. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
- L. Assemble restrained joints per manufacturer's instructions.
- M. Do not exceed the joint deflection angles recommended by the Manufacturer.

3.6 Installing Aboveground or Exposed Piping

- A. See Sections 400500 "General Piping Requirements" .
- B. Support exposed pipe in accordance with Section 400764 "Pipe Hangers and Supports".

3.7 Painting and Coating

- A. Coat pipe located above ground and in vaults and structures per Section 099000 "Painting and Coating", System No. 29. Apply prime coat in the shop before transporting pipe to the jobsite. As an alternate to the specified prime coat, pipe supplier/manufacturer may utilize Tnemec Series N140, or equal, as the prime coat. Apply prime coats in the field before installing the pipe, then touch up after installation.
- B. Provide asphaltic coating on buried pipe per AWWA C151. Coating shall be approximately 1 mil thick in accordance with applicable AWWA and ANSI standards.
- C. Coat buried piping per Section 099000 "Painting and Coating", System No. 10.
- D. Coat buried flanges and buried mechanical and restrained joint bolts, nuts, and glands per Section 099000 "Painting and Coating", System No. 10.
- E. Coat submerged pipe per Section 099000 "Painting and Coating", System No. 13 or with fusion-bonded epoxy per Section 099761.
- F. Line and coat exposed grooved-end couplings the same as the pipe exterior coating.
- G. Line and coat submerged and buried grooved-end couplings per Section 099000 "Painting and Coating", System No. 13 or with fusion-bonded epoxy per Section 099761.

3.8 Polyethylene Encasement of Buried Pipe and Fittings

- A. Wrap buried pipe, fittings, grooved-end couplings, and joints with a minimum of 8-mil low-density polyethylene wrap conforming to AWWA C105.
- B. Polyethylene encasement for ductile-iron pipe shall be supplied as a flat tube meeting the dimensions of Table 1 in AWWA C105 and shall be supplied by the ductile-iron pipe manufacturer.

3.9 Interior Joint Recesses for Buried Piping 30 Inches and Larger

- A. Point interior joint recesses of 30-inch and larger nominal diameter pipes with cement-mortar. Do not point interior joints until after backfilling the pipe section.
- B. Working inside the pipe, remove foreign substances from joint recesses and pack with cement-mortar. Finish the surface with a steel trowel to match adjoining pipe.

3.10 Cleaning Pipe

- A. After interior joints have been pointed and mortar has hardened, sweep pipe clean of all dirt and debris. If hardened mud exists in the pipe, remove with the use of pressurized water hoses.

3.11 Field Hydrostatic Testing

- A. Test pressures are shown in Section 400515 "Pressure Testing of Piping". Test in accordance with Section 400515 "Pressure Testing of Piping".

3.12 Pipe Labeling

- A. Label exposed pipe above grade or in buried vaults per Section 400775 "Equipment, Piping, and Valve Identification".

3.13 Buried Warning and Identification Tape

- A. Provide detectable warning tape per Section 400775 "Equipment, Piping, and Valve Identification". Warning and identification shall read "CAUTION BURIED WATER PIPING BELOW" or similar wording.

END OF SECTION

SECTION 402076
STAINLESS STEEL PIPE

PART 1 GENERAL

1.1 Description

- A. This section includes materials and installation of stainless steel pipe and fittings 10 inches in diameter and smaller conforming to ASTM A312 or A778 and having a maximum design pressure of 20 psi. The stainless steel pipe shall be provided for the blower air discharge piping which provides low pressure air to the aerators.

1.2 Related Work Specified Elsewhere

- A. Section 099000 "Painting and Coating".
- B. Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. Section 312333 "Trenching and Backfilling".
- D. Section 400500 "General Piping Requirements".
- E. Section 400515 "Pressure Testing of Piping".
- F. Section 400722 "Flexible Pipe Couplings and Expansion Joints".
- G. Section 400762 "Wall Pipes, Seep Rings, and Penetrations".
- H. Section 400764 "Pipe Hangers and Supports".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Provisions, General Conditions, and Section 013300.10.
- B. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's certificate of compliance with referenced standards. Show piping service (fuel, oil, gasoline, water, air, etc.).
- C. Manufacturer's catalog data marked to indicate materials being furnished.
- D. Weight and support requirements.
- E. Certificate of compliance, signed by the Manufacturer, stating that the equipment offered is in full compliance with the specifications.
- F. Pickling and passivating procedure.
- G. For piping 6-inches and larger, submit detailed piping layout drawings showing location and dimensions of pipe, fittings, taps, and outlets in full detail, location of pipe hangers and supports, large-scale details of all special castings, and locations and types of restraint to prevent joints from pulling apart. Include laying lengths of flanges, gaskets, valves, meters, inline pumps, and other equipment determining piping dimensions. **FIELD VERIFY DIMENSIONS PRIOR TO PREPARATION OF LAYOUT DRAWINGS. DO NOT FABRICATE PIPE UNTIL SUBMITTAL HAS BEEN RETURNED STAMPED "RESUBMITTAL IS NOT REQUIRED" OR "MAKE CORRECTIONS NOTED."** Label or number each fitting or piece of pipe and provide the following information for each item:
 - 1. Material of construction, with ASTM reference and grade.
 - 2. Wall thickness of stainless steel cylinder.
 - 3. Manufacturer's certificate of compliance with referenced pipe standards.
 - 4. Show weld sizes and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

1.4 Quality Assurance

- A. Welder Qualifications
 - 1. Stainless steel piping systems welding shall be by welders qualified and certified under provisions of AWS to weld austenitic chromium-nickel stainless steel pipe and tubing.
 - 2. Welders shall be certified by an independent, acceptable testing agency not more than 12 months prior to commencing work.

3. Perform certification with machines and electrodes similar to those used in the work.
4. Certify welders at no additional cost to the Owner.

1.5 Warranty

- A. Full warranty against defects in materials and workmanship for two (2) years after final acceptance by the Owner, including all parts, labor, and expenses.
- B. Owner, Owner's Representative, and Contractor shall conduct a 23-month warranty inspection of the stainless steel pipe to ensure that it is free from defects, pitting, and corrosion. All defective areas shall be repaired according to manufacturer's recommendations or replaced.

PART 2 PRODUCTS

2.1 Pipe

- A. Pipe smaller than 3 inches shall conform to ASTM A312, Grade TP 304L. Pipe 3 inches and larger shall conform to ASTM A312 or A778, Grade TP 304L .
- B. Pipe sizes and wall thicknesses shall conform to ASME B36.19 as follows:
 1. Pipe size 1 inch and smaller: Schedule 10S.
 2. Pipe size 1-1/4 inches through 3 inches: Schedule 10S .
 3. Pipe size 3-1/2 inches through 8 inches: Schedule 10S .
 4. Pipe size larger than 8 inches, through 10 inches : Schedule 10S .

2.2 Fittings

- A. Fittings 3 inches and smaller shall be threaded or socket welded, conforming to ASME B16.11, 3,000-pound CWP.
 1. Material for threaded fittings shall conform to ASTM A403, Class WP304 or ASTM A182, Grade F304 .
 2. Material for socket welded fittings shall conform to ASTM A403, Class WP304L or ASTM A182, Grade F304L .
- B. Fittings for buried or submerged pipe larger than 3 inches through 24 inches shall be butt-welded, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ASME B16.9. Elbows shall be long radius unless indicated otherwise on the Drawings.
- C. Fittings for aboveground or exposed pipe larger than 3 inches through 24 inches shall be butt-welded or flanged, conforming to ASTM A403, Class WP or ASTM A774, same material and wall thickness as the pipe, conforming to ASME B16.9. Elbows shall be long radius unless indicated otherwise on the Drawings.

2.3 Pickling, Passivating, and Final Cleaning

- A. After fabrication, mechanically clean/descale the welded surface, to remove all thick visible oxide scale with wire brushes and/or non-metallic devices. Brushes shall be stainless steel and used only on stainless steel.
- B. After descaling is completed, all pipe and fittings shall be immersed in a pickling solution to remove all weld heat tinted layers from the surface of the stainless steel, ensure removal of all free iron, weld scale, and other impurities and to insure the establishment of a passive surface prior to passivation. Pickling solution shall be a nitric-hydrofluoric bath at the proper temperature and length of time per ASTM A380. Perform a complete neutralizing operation by immersion in a trisodium phosphate rinse followed by a clean water rinse.
 1. Chemical clean shall completely remove the surface contamination but will not significantly affect the stainless steel itself.
 2. After final cleaning, wet surfaces with water and inspect for rust spots after 24-hours. Reclean if there is any evidence of rusting.
 3. Contractor may submit alternate pickling and passivating procedure other than the full immersion bath for review by the Engineer. Alternate pickling and passivating procedure shall be in accordance with ASTM A380. Submittal of alternate procedure does not ensure approval.

- C. After descaling and pickling, the stainless steel piping/fabrication shall be fully passivated to enhance the corrosion resistance of the stainless steel, through forming a chemically inactive surface when exposed to air or oxidizing agent. Passivation shall be completed per ASTM A380, and A967.

2.4 Quality Control

- A. Include the "Hydrostatic Test" and "Flattening Test" requirements described in ASTM A999. A nondestructive electric test per ASTM A999 may be substituted for the hydrostatic test.

2.5 Unions

- A. Unions shall be 3,000-pound WOG forged stainless steel, with dimensions conforming to MSS SP-83. Ends shall be threaded per ASME B1.20.1 or socket-welded type.
 - 1. Material shall conform to ASTM A182, Grade F304 for threaded end unions.
 - 2. Material shall conform to ASTM A182, Grade F304L for socket-welded type unions.

2.6 Joints

- A. Joints for pipes 3 inches and smaller shall be threaded or socket welded, same material as specified for fittings, 3,000-pound WOG, conforming to ASME B16.11.
- B. Joints for buried or submerged pipe larger than 3 inches shall be butt-welded.
- C. Joints for aboveground or exposed pipe larger than 3 inches shall be flanged or butt-welded.
- D. Provide plain-end pipe where flexible pipe couplings are to be provided. Provide lugs for thrust harnesses where shown in the drawings, per Section 400722.
- E. Where piping connects to wall pipes, meters, valves, or other equipment, the pipe ends shall match the ends of the wall pipes, meters, valves, or equipment, unless indicated otherwise.

2.7 Outlets and Nozzles

- A. Outlets of size 3 inches and smaller in piping 4 inches and larger shall be of the Thredolet type, per MSS SP-97 and AWWA Manual M11 (1989 edition), Figure 13-23. Outlets shall be 3,000-pound WOG stainless steel per ASTM A182, Grade F304L or ASTM A403, Grade WP304L. Threads shall comply with ASME B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.
- B. For outlets 3-inches and smaller in piping smaller than 4-inches, use a tee with threaded outlet.
- C. For outlets larger than 3-inches, use a tee with a flanged outlet (unless indicated otherwise on the Drawings). Side outlets are not considered equivalent to fabricated tees and shall not be used without written permission.

2.8 Grooved-End Couplings

- A. Grooved-end couplings for piping 24 inches and smaller shall be Type 304 stainless steel. Couplings shall be flexible type, square-cut grooved, per AWWA C606. Couplings shall be Victaulic Style 77, Gustin-Bacon Figure 100, or equal.
- B. Gaskets shall be suitable for service and maximum operating temperatures of the piping systems as specified in Section 400500 "General Piping Requirements". Gaskets shall be nitrile, Buna-N, or Viton (unless indicated otherwise) and shall conform to ASTM D2000.
- C. Gaskets shall be suitable for service and maximum operating temperatures of the piping systems as specified in Section 400500 "General Piping Requirements," and conform to ASTM D2000. Gasket material shall be selected by the pipe, fitting, and coupling manufacturer and submitted to the Engineer for review.
- D. Bolts in exposed service shall conform to ASTM A183, 110,000-psi tensile strength. Bolts in buried or submerged service shall be ASTM A193, Grade B8, Class 2.

2.9 Thread Lubricant

- A. Use Teflon thread lubricating compound or Teflon tape.

2.10 Flanges

- A. Provide weld-neck flanges (conforming to ASME B16.5) for piping 3 inches and smaller to connect to flanged valves, fittings, or equipment. Provide weld-neck or Van Stone flanges (per ASTM F2015) for piping larger than 3 inches. Flanges shall be Class 150 per ASME B16.5. Flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment. Flanges shall be flat face.
- B. Material for weld-neck flanges shall conform to ASTM A182, Grade F304L (as indicated on the Drawings).
- C. Material for Van Stone flanges shall be as follows (unless indicated otherwise on the Drawings):
 - 1. Exposed Applications: Ductile iron; ASTM A536, Grade 60-42-10 or Grade 65-45-12, Carbon steel; ASTM A216, Grade WGA or WGB, Stainless steel; ASTM A351, Grade CF8, or Stainless steel; ASTM A351, Grade CF8M.
 - 2. Submerged or Buried Applications: Stainless steel; ASTM A351, Grade CF8 or CF8M (as indicated on the Drawings).
 - 3. In Wet Well Applications (or where indicated in the Drawings): Stainless steel; ASTM A351, Grade CF8 or CF8M (as indicated on the Drawings).

2.11 Bolts and Nuts for Flanges

- A. See Section 400500 "General Piping Requirements".

2.12 Lubricant for Stainless Steel Bolts and Nuts

- A. See Section 400500 "General Piping Requirements".

2.13 Gaskets for Flanges

- A. See Section 400500 "General Piping Requirements".

2.14 Wye Strainers

- A. Strainers 2 inches and smaller shall be stainless steel, wye pattern, with minimum pressure rating of 300-psi WOG. Material shall conform to ASTM A351 or A743, Grade CF8M. Screen shall be 20 mesh and same material as the strainer. Provide pet cock of the same material as the strainer body in the blowoff connection. Ends shall be threaded conforming to ASME B1.20.1. Provide one spare screen for each strainer. Strainers shall be Sarco Type 316, Muessco No. 861, or equal.

2.15 Protective End Caps

- A. Provide protective end caps on each piece of pipe or fabricated section, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

2.16 Shop Fabrication

- A. General
 - 1. Shop fabricate 4-inch and larger stainless steel pipe and fittings in sections as large as practical.
 - 2. Pipe and fitting joints in shop fabrication shall be weld joints. Ends of shop fabrications shall have flanges or plain ends. Plain ends shall be prepared for field installed couplings.
- B. Shop Welding
 - 1. Shop welding procedures for stainless steel pipe shall meet requirements of ANSI/AWS D10.4.
 - 2. Prepare edges by machine shaping or cutting. Bevel ends of pipe and fittings with wall thickness of 3/16-inch and larger. Bevel ends of stainless steel pipe to meet requirements of ANSI/AWS D10.4. Separate abutting pipe ends before welding, and completely fuse inside walls of pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be single "V" butt type, of sound weld metal thoroughly fused into the ends of pipe and into bottom of "V". Welds shall be free from cold spots, pin holes, oxide inclusions, burrs, snags, rough projections or other defects.

3. Use an inert shielding gas welding method. Do not use oxygen fuel welding. Purge the interior of the pipe with inert gas prior to root pass.
4. Welded butt joints (both longitudinal and circumferential) shall comply with AWWA C220 and AWWA C226, Section 4. Do not use backing rings. Provide full penetration and smooth internal diameters for the root bead of welds. Grind the inside weld of socket welds flush with pipe internal diameter. Welds shall be of smooth finish. Use anti-spatter compounds specifically formulated or designed for use with stainless steel. Do not allow heat tint to form in the heat-affected zone or remove heat tint completely from the heat-affected zone of the finished weld. The maximum depth of grinding or abrasive blasting to remove defects shall not exceed 10-percent of the wall thickness. Do not perform abrasive blasting with steel shot, grit, or sand.
5. No iron or steel surfaces shall come into contact with the stainless steel. This includes placing on steel tables, racks, pipe supports, etc. Do not use carbon steel wire brushes or grinders.
6. Welding electrodes shall comply with AWS A5.4. Bare wire shall comply with AWS A5.9. Use electrodes as follows:
 - a. Type 304 Pipe Material: E 308 Welding Electrode Material.
 - b. Type 304L Pipe Material: E 347 Welding Electrode Material.
 - c. Type 316 Pipe Material: E 316 Welding Electrode Material.
 - d. Type 316L Pipe Material: E 318 Welding Electrode Material.

PART 3 EXECUTION

3.1 Shipping, Storage, and Handling

- A. Ship, store, and handle piping (including both pipe and fittings) per AWWA C220, Section 6.2 and AWWA C226, Section 6.3 and the following.
- B. When loading piping for shipment to the project site, use spacers and other protective devices to separate pipes to prevent damaging the surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the pipe surfaces after separation. Use padded chains or ribbon binders to secure the loaded pipe and minimize damage.
- C. Cover piping 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Provide stulls, braces, and supports during shipping and storage such that out-of-roundness or deflection does not exceed 0.5% of the pipe diameter.
- E. Handle piping with care during unloading, installation, and erection operations to minimize damage. Do not place or store pipe on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place pipe above the ground upon platforms, skids, or other supports.
- F. Store piping at the site on pallets to prevent direct contact with ground or floor. Cover pipe during storage with protective coverings or tarpaulins to prevent deposition of rainwater, salt air, dirt, dust, and other contaminants.
- G. Do not allow piping to contact carbon steel surfaces during storage, handling, or installation and erection at the site.
- H. Piping supplier during manufacturing, fabrication and handling stages, and the Contractor during handling and installation steps, shall use extreme care to avoid contact of any ferrous materials with the stainless steel piping. Pipe storage and fabrication racks shall be non-ferrous, stainless steel, or rubber lined. Nylon slings or straps shall be used for handling stainless steel piping. Slings or straps used for stainless steel piping shall not be used with any other materials. Contact with ferrous items may cause rusting or iron particles embedded in the piping walls. After installation, the Contractor shall wash and rinse all foreign matter from the piping surface. If rusting of embedded iron occurs, the Contractor shall pickle the affected surface with Oakite Deoxidizer SS, or equal, scrub with stainless steel brushes and rinse clean.

3.2 Shop Testing of Fabricated or Welded Components

- A. After completion of fabrication and welding in the shop, test each component according to the referenced standards. Test fabricated fittings per AWWA C220. Test the same in fittings which have not been previously shop hydrostatically tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix B. In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested. Use a hydrostatic pressure of 150-percent of the design pressure.
 - 1. Perform tests of production welds in fabricated stainless steel piping in accordance with AWWA C220 and C226, Section 4.

3.3 Field Weld Joints for Stainless Steel Pipe and Fittings

- A. General
 - 1. Do not field weld stainless steel pipe or fittings, unless field welding is approved in writing by the Engineer.
 - a. Welding in field shall be performed only when requested on shop drawings and accepted by Owner and Owner's Representative in writing as specified in this Section.
 - b. Field welding of stainless steel pipe or fittings will only be considered by the Engineer if:
 - c. Contractor submits documentation of welder's certification to perform welding and documentation of welder's experience in welding stainless steel pipe; and Contractor can demonstrate that pipe can be welded to meet requirements of reference standards.
 - d. If field welding is not approved by the Engineer, provide clamp type coupling joints or flange joints, as specified in this Section and the appropriate piping material Section, at no additional cost to the Owner.
- B. Field Weld Joints for Stainless Steel Pipe and Fittings, if Field Weld Joints are Allowed:
 - 1. Welding procedures for stainless steel pipe and fittings shall meet requirements of ANSI/AWS 10.4.
 - 2. Separate abutting pipe ends before welding, and completely fuse inside walls of pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be single "V" butt type, of sound weld metal thoroughly fused into the ends of pipe and into bottom of "V". Welds shall be free from cold spots, pin-holes, oxide inclusions, burrs, snags, rough projections, or other defects.
 - 3. Protect and finish stainless steel weld joints as follows:
 - a. Wire brush outside weld area. Remove weld splatter. Brushes shall be stainless steel and used only on stainless steel.
 - b. Remove surface oxidation by brushing, or grinding and brushing.
 - c. Pickle the weld and heat-affected zone with field applied paste. Follow manufacturer's recommendations.

3.4 Installing Threaded Piping

- A. Ream, clean, and remove burrs from threaded piping before making up joints. Apply thread lubricant to threaded ends before installing fittings, couplings, unions, or joints.

3.5 Installing Flanged Piping

- A. See Section 400500 "General Piping Requirements".

3.6 Installation of Stainless Steel Bolts and Nuts

- A. See Section 400500 "General Piping Requirements".

3.7 Installing Grooved-End Piping

- A. See Section 400500 "General Piping Requirements".

3.8 Installing Unions

- A. Provide unions on exposed piping 3 inches and smaller as follows:
- B. At every change in direction (horizontal and vertical).

- C. 6 to 12 inches downstream of valves.
- D. Every 20 feet in straight piping runs.
- E. Where shown in the drawings.

3.9 Installing Submerged, Aboveground, or Exposed Piping

- A. See Section 400500 "General Piping Requirements".

3.10 Installing Buried Piping

- A. Install in accordance with Sections 312333 "Trenching and Backfilling".

3.11 Field Hydrostatic Testing

- A. Hydrostatically test pipe and fittings in the field in accordance with Section 400515 "Pressure Testing of Piping".
- B. Do not allow test water to remain in the pipe for more than five days. Drain and dry the piping after completing the testing.

3.12 Painting and Coating

- A. Coat exposed grooved-end couplings and Van Stone flanges with fusion-bonded epoxy per Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- B. Coat submerged or buried grooved-end couplings and Van Stone flanges with fusion-bonded epoxy per Section 099761 "Fusion-Bonded Epoxy Linings and Coatings".
- C. See Section 099000 "Painting and Coating" for requirements.
- D. Do not coat stainless steel grooved-end couplings and Van Stone flanges.
- E. Coat buried piping per Section 099000 "Painting and Coating", System No. 10.
- F. Do not coat stainless steel pipe.

3.13 Installing Wrapped or Coated Pipe

- A. Install buried pipes having wrapped coatings by extending the wrapping to the first joint after entering a building, penetrating a slab, or 6 inches above finished grade. Wrap joints spirally with a minimum overlap of 50 percent of the tape width.

3.14 Coating Buried and Submerged Bolts, Nuts, and Tie Rods

- A. Coat buried bolts, nuts, and tie rods per Section 099000. Provide threaded polyethylene nut protection caps per Section 400500.
- B. Coat submerged bolts, nuts, and tie rods per Section 099000 "Painting and Coating", System No. 13. Provide threaded polyethylene nut protection caps per Section 400500.

END OF SECTION

SECTION 402090
PVC & CPVC PIPE (3 INCHES AND SMALLER)

PART 1 GENERAL

1.1 Description

- A. This section includes:
 - 1. Materials, installation, and testing of PVC pipe and fittings of size 3 inches and smaller for use in process piping having a maximum design pressure of 150 psi and having a maximum design temperature of 105 degrees F.

1.2 Related Work Specified Elsewhere

- A. Section 312333 "Trenching and Backfilling".
- B. Section 400500 "General Piping Requirements".
- C. Section 400515 "Pressure Testing of Piping".
- D. Section 400764 "Pipe Hangers and Supports".

1.3 Submittals

- A. Submit shop drawings in accordance with the General Provisions, General Conditions, and Section 013300.10.
- B. Submit materials list showing materials of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM D1784, D1785 (PVC), F441 (CPVC), F439 (CPVC), and D2467 (PVC). Show wall thickness of pipe and fittings. Show fitting dimensions.
- C. Submit data sheets for solvent cement and demonstrating compliance with ASTM D2564, F493 (CPVC), and F656.

1.4 WARRANTY

- A. Full warranty against defects in materials and workmanship for one year after FINAL ACCEPTANCE, including all parts, labor, and expenses.

PART 2 PRODUCTS

2.1 Pipe

- A. PVC Pipe shall be Schedule 80, Type I, Grade 1 (Class 12454-B), conforming to ASTM D1784 and D1785.

2.2 PVC PIPE COLORING AND MARKING FOR RECLAIMED WATER SERVICE

- A. PVC pipe shall be purple (Pantone 522) and shall be marked on both sides of the pipe with the wording "CAUTION: RECLAIMED WATER--DO NOT DRINK." The lettering shall be minimum 1-inch-high black letters and shall be repeated at intervals not exceeding 36 inches. The purple coloring shall be achieved by adding pigment to the PVC material as the pipe is being manufactured.

2.3 Fittings

- A. PVC Fittings shall be Schedule 80 and shall conform to ASTM D2464 for threaded fittings and ASTM D2467 for socket-type fittings.

2.4 Flanges

- A. PVC and CPVC flanges shall be of the one-piece solid socket design and shall be made of the same material as the pipe. Pressure rating shall be at least 150 psi at a temperature of 73 degrees F. Minimum burst pressure shall be 500 psi. Flanges shall match the dimensions of ASME B16.5, Class 150, steel flanges for outside diameter, bolt circle, and bolt holes. Do not use Van Stone flanges.

2.5 Unions

- A. PVC Unions shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.

- B. Union connections to other metal piping materials shall comply with MSS SP-107. The fitting end for connection to CPVC pipe shall be a female socket. Provide wrought or cast copper tailpieces for connection to copper piping and tubing. Provide Type 316 stainless steel tailpieces for connection to steel piping.

2.6 Joints

- A. Pipe and fitting joints shall be socket welded except where threaded and flanged joints are required to connect to valves and equipment.

2.7 SOLVENT CEMENT

- A. PVC Solvent cement for socket joints shall comply with ASTM D2564 and F656.

2.8 Gaskets for Flanges

- A. See Section 400500 "General Piping Requirements".

2.9 Bolts and Nuts for Flanges

- A. See Section 400500 "General Piping Requirements".

2.10 Lubricant for Stainless Steel Bolts and Nuts

- A. See Section 400500 "General Piping Requirements".

PART 3 EXECUTION

3.1 General

- A. Do not install PVC or CPVC pipe when the temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors or installed outdoors until the pipe is filled with water.
- B. Store fittings indoors in their original cartons.
- C. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.
- D. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section of pipe.
- E. Do not drag PVC or CPVC pipe over the ground, drop it onto the ground, or drop objects on it.

3.2 Solvent-Welded Joints

- A. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air at the same temperature conditions as the pipe for at least one hour.
- B. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.
- C. Wipe away loose dirt and moisture from the inside and outside of the pipe end and the inside of the fitting before applying solvent cement. Clean the surfaces of both pipes and fittings that are to be solvent welded with a clean cloth moistened with acetone or methylethyl ketone. Do not apply solvent cement to wet surfaces.
- D. The pipe and fitting socket shall have an interference fit. Perform a dry fit test at each joint before applying solvent cement. The pipe shall enter the fitting socket between one-third and two-thirds of the full socket depth when assembled by hand.
- E. Make up solvent-welded joints per ASTM D2855 (PVC) or F493 Appendix X1 (CPVC). Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire joint perimeter.
- F. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.
- G. Acceptance criteria for solvent-welded joints shall be as follows:
 - 1. Unfilled Areas in Joint: None permitted.

2. Unbonded Areas in Joint: None permitted.
3. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50 Percent.

3.3 Flanged Joints

- A. Lubricate carbon steel bolt threads with graphite and oil before installation.
- B. Tighten bolts on PVC and CPVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as follows:
 1. Pipe Size of 1/2 to 1-1/2 Inches: 10 to 15 foot-pounds Final Torque.
 2. Pipe Size of 2 to 3 Inches: 20 to 30 foot-pounds Final Torque.

3.4 Installation of Stainless Steel Bolts and Nuts

- A. See Section 400500.

3.5 Threaded Joints

- A. Cut threaded ends on PVC or CPVC to the dimensions of ASME B1.20.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed.
- B. Pipe or tubing cutters shall be specifically designed for use on PVC or CPVC pipe. Use cutters manufactured by Reed Manufacturing Company, Ridge Tool Company, or equal.
- C. If a hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to avoid scratching the pipe.
- D. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
- E. Apply Teflon® thread compound or Teflon® tape lubricant to threads before screwing on the fitting.

3.6 Installing Unions

- A. Provide unions on exposed piping 3 inches and smaller as follows:
- B. At every change in direction (horizontal and vertical).
- C. Six to twelve inches downstream of valves.
- D. Every 40 feet in straight pipe runs.
- E. Where shown in the drawings.

3.7 Installing Buried Pipe

- A. Install in accordance with Section 312333 "Trenching and Backfilling" and as follows.
- B. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.
- C. After the pipe has been solvent-welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.
- D. Do not backfill the pipe trench until the solvent-welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.
- E. Install buried PVC and CPVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Backfill materials in the pipe zone shall be imported sand per Section 312333 "Trenching and Backfilling".

3.8 Installing Aboveground or Exposed Piping

- A. See Section 400500 "General Piping Requirements".
- B. Fill empty piping with water and provide temporary shading or other means to keep the surface temperature of the pipe below 100 degrees F.

3.9 Hydrostatic Testing

- A. Perform hydrostatic testing for leakage in accordance with Section 400515 "Pressure Testing of Piping".

END OF SECTION

SECTION 409721
MAGNETIC FLOWMETERS

PART 1 GENERAL

1.1 SCOPE

- A. This section includes the materials of construction, fabrication, installation and testing of electro-magnetic flow meter for wastewater service, remote flow transmitter and remote mounted recording station.
- B. The Contractor shall furnish, install, test, calibrate and place in satisfactory operation the magnetic flow meter, transmitter, totalizer and recording station, including all spare parts, accessories, and appurtenances as specified herein, shown on the Drawings or required for proper installation and operation.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 013300.10.
- B. Submit manufacturer's catalog cuts in accordance with Section 01300, Submittals, showing dimensions, coatings, and materials of construction by ASTM reference and grade, for each component or device identified.
- C. Submit operation and maintenance manuals for equipment in accordance with Section 013300.10.

PART 2 PRODUCTS

2.1 GENERAL

- A. Accuracy
 - 1. Plus or minus 0.2% of the actual flowrate over the range of flows.
- B. Flowtube shall be wet calibrated with transmitter to verify their specified accuracy with traceability to the U.S. National Institute of Science and Technology (NIST).
- C. Minimum Pressure Rating
 - 1. In accordance with ASME B16.5 Class 150
- D. Flanges
 - 1. Provide ANSI Class 150 pound flanges unless otherwise specified
- E. Power Supply
 - 1. 120 VAC, 60 Hz
- F. Electrode Materials
 - 1. 316 Stainless Steel
- G. Outputs
 - 1. Isolated 4-20 mA signal
- H. Lining and Coating
 - 1. Metering tube liner shall be Perfluoroalkoxy (PFA) that is permanently retained with a welded SS housing or PTFE-Teflon.
 - 2. The liner shall be designed to withstand movement, severe temperature, vibration, and pressure/vacuum applications.
- I. Pulse Width
 - 1. Scalable up to 10kHz, passive open collector up to 10 kHz, active switched 24V DC. Up to two outputs (forward and reverse). Pulse width programmable from 1-1000 ms or 50% duty cycle.
- J. Processing
 - 1. 32-bit DSP
- K. Empty Pipe Detection
 - 1. Field tunable for optimum performance based on specific application

- L. Noise Dampening
 - 1. Programmable
- M. Galvanic Separation
 - 1. 250V
- N. Ambient Temperature Range
 - 1. -4 through 140 degrees Fahrenheit
- O. Flow Direction
 - 1. Unidirectional or bidirectional with two separate totalizers (programmable)
- P. Totalization
 - 1. Programmable/resettable
- Q. Amplifier Housing
 - 1. Cast aluminum, powder-coated paint
- R. Detector Housing
 - 1. 316 stainless steel
- S. Pipe Spool Material
 - 1. 316 stainless steel
- T. Mounting
 - 1. Meter mount or remote wall mount (bracket supplied)
- U. Meter Enclosure Classification
 - 1. NEMA 4X (IP66)
- V. Cable Entries
 - 1. 1/2 in. NPT cord grip

2.2 MANUFACTURERS

- A. Magnetic flow meter shall be model Sitrans F M MAG 5100W as manufactured by Siemens or engineer approved equal.
 - 1. Provide remote, rack mounted panel with transmitter with digital readout of instantaneous flow for flow meter and totalized flow. Readout should display gallons per min for instantaneous flow and U.S. gallons in 1,000 gallon increments for totalized flow. The panel shall be installed at the UV pad.

2.3 MAGNETIC FLOWTUBE

- A. The Flowtube shall be used with an intelligent transmitter to measure the volumetric flow rate of virtually any conductive liquid. The flow metering tube shall be constructed of AISI type 304 stainless steel with ANSI Class 150 flanges and 316 stainless steel electrodes. The Magnetic Flowtubes shall conform to the face to face overall lengths defined in ISO/CD Standard 13359.
- B. The Flowtube shall be designed to operate in harsh in-plant or outdoor environments. The enclosure shall be weatherproof as defined in IEC EP66, and provides the watertight and corrosion-resistant protection of NEMA Type 4X.
- C. The Flowtube shall be calibrated for use with pulse dc coil excitation.
- D. The Flowtube shall have a factory 2 year warranty.
- E. Grounding electrodes shall be built integral with the tube or grounding rings and straps shall be provided with each flowtube.

2.4 MAGNETIC FLOW TRANSMITTER

- A. The Magnetic Flow Transmitter shall have intelligent microprocessor-based electronics with automatic zeroing and built-in calibration. Mechanical adjustments or external calibration equipment will not be accepted. The microprocessor shall include diagnostic software to provide external indication of a fault and the fault location.

- B. The keypad/display shall consist of a 32 alphanumeric character, 2-line, back-lighted LCD display and 5-button keypad. The display shall indicate positive total, negative total, net total, net inventory, total, and rate in conventional flow units. A (+) or (-) indicator shows flow direction.
- C. Transmitters shall be factory-calibrated to their specified accuracy with calibration equipment with traceability to U.S. National Institute of Science and Technology (NIST).
- D. The analog output signal shall be a 4-20mA and can be configured to operate in unidirectional (single range), unidirectional (multiple range), bidirectional, and bidirectional split range. The Transmitter shall be programmable for up to three different flow ranges when measuring flow in one direction. For bidirectional flow, the Transmitter shall allow a separate flow range for the forward and reverse flow directions.
- E. The Transmitter shall provide two programmable relay outputs which can be used to indicate High or Low flow rate, reverse flow and to indicate alarm conditions.
- F. The Transmitter shall be compatible with the flowtubes.
- G. The inputs span adjustment shall be continuous from 0-1.65 and 0-33 feet per second. The accuracy shall be + or - .5% of reading as system accuracy. The pulse rate shall be adjustable from 10 - 10,000HZ.
- H. Digital communication shall allow for remote reconfiguration and the receiving of continuous self-diagnostic data over the same two wires used for the measurement signal without disturbing the measurement signal. Reading of:
 1. Engineering Units (gpm)
 2. Flow Upper Range Value(s)
 3. Flow Rate in Engineering Units
 4. Displayed Upper Range Value(s)
 5. Pulse Output Upper Range Value(s)
 6. Electronic Damping Factor
 7. Data Transfer Rate (600 or 4800 Baud)
 8. Line Size (Nominal)
 9. Meter Factor (Calibration Factor)
 10. Tag Number or Tag Name
 11. Geographical Location
 12. Device Name
 13. In addition, the configuration from the transmitter may be copied with a Hand Held Terminal or PC10 laptop and downloaded to another transmitter or saved for future reference.
- I. The Flow Transmitter shall provide mounting features to include pipe and/or surface mounting and shall be housed in a NEMA type 4X enclosure.
- J. The Transmitter shall withstand 1000 V common mode and 500 V normal mode, 1.2 x 20µs impulse per ANSI/IEEE Standard C62.41-1980 and IEC Standard 801-5.
- K. The Transmitter shall withstand a high frequency transient of 2000 V common mode, 5 x 50 ns impulse, per IEC Standard 801-4.
- L. The Transmitter shall withstand application of 6000 V contact discharge or 8000 V air discharge of an electrostatic field per IEC Standard 801-2.
- M. All wiring (cables) between Magnetic Flowmeter and transmitter shall be provided by the instrument manufacturer.
- N. The Magnetic flowmeter system shall be designed to consume less than 24W of power at reference voltage and frequency.
- O. The transmitter shall have a 2 year warranty.
- P. The Magnetic Flowmeter Transmitter shall be Model Sitrans F M MAG 5000/6000 for remote mounting as manufactured by Siemens, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install meter, totalizer, and grounding rings in accordance with manufacturers written instructions and as shown in the Drawings.

3.2 HYDROSTATIC TESTING

- A. Hydrostatically test the installed meters at the same time the piping system is tested per Section 400515.

3.3 MANUFACTURERS' FIELD SERVICES

- A. Coordinate date of manufacturer's field services so that electrical specialists, Engineer's representative, and Owner's operating personnel are present.
- B. Provide equipment manufacturer's services at the job site for a minimum of one man-day to check the installation, supervise start-up, perform testing, calibration, and adjustments of equipment, and instruct the Owner's personnel in the operation and maintenance of the equipment.
- C. Provide adequate training to Owner's personnel in the proper operation and maintenance of the equipment.

END OF SECTION

SECTION 444475

ULTRAVIOLET DISINFECTION CLOSED SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and appurtenances to provide a complete in-line pipe flanged, low pressure high intensity (LPHO) Ultraviolet (UV) non-contact disinfection system to provide required disinfection of plant effluent prior to plant discharge.
- B. The UV system shall be furnished by a single manufacturer.
- C. The equipment shall be automatic in operation, with no automated cleaning apparatus. Separate cleaning apparatus', integrated wiper mechanisms, quartz sleeves, O-rings, or lifting cranes shall not be required for the non-contact UV disinfections system.
- D. The system shall be complete with power enclosures, power distribution and system controls shown on the Drawings and specified herein.
- E. The system shall be installed in the location shown on the Drawings. The Contractor shall be responsible for revised structural equipment pad, piping, valves, appurtenances as necessary to accommodate the selected equipment after approval of the required submittals.
- F. The system shall be able to continue providing disinfection while replacing UV lamps, quartz sleeves, electronic ballasts and while cleaning UV lamp quartz sleeves, as applicable.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualification Requirements
 - 1. The equipment manufacturer shall be regularly involved in the manufacture and supply of low-pressure high output UV Disinfection systems for a minimum period of ten (10) years, and with a history of at least fifty (50) successful Municipal Wastewater installations of non-contact UV systems.

1.3 DESIGN CRITERIA

- A. Head Loss
 - 1. Head loss thru the reactor shall be as follows:
 - a. Peak Disinfection Flow: < 14.75 inches (flange to flange head loss at peak flow through UV reactor)
 - b. Average flow: < 2.5 inches (flange to flange head loss at peak flow through UV reactor)
- B. UV Design Criteria
 - 1. The equipment to be supplied and installed shall disinfect an effluent with characteristics as listed in Table below:

Annual Average Flow (AAF) Rate	0.47/ 326	MGD/GPM
Peak Hydraulic Flow (PHF) Rate (Peak Disinfection Flow Rate)	1.728/ 1,200	MGD/GPM
UV Transmittance	50.0	% UVT (Minimum)
Total Suspended Solids*	< 30.0	mg/l (Monthly Average)
BOD*	< 30.0	mg/l (Monthly Average)
Target Indicator Organism	E.Coli	
Influent Maximum	126,000.00	(CFU/100ml) E.Coli
Effluent Disinfection Limit	206.0	(CFU/100ml) E.Coli Monthly Avg GEOMEAN

UV Dose (manufacturer calculated)	30.0	Minimum UV dose of 40.0 mJ/cm ² . After applying Enaqua certified Lamp End of Lamp Life (EOLL) of .87, Fouling Factor of .89.
Plant Process	Advanced Aerated Lagoon with NitrOx Process	
Mean Particle Size*	30.0	Microns
Total Iron*	0.3	mg/l
Turbidity*	5	NTU
Process Redundancy	One UV reactor with two banks in series, with the system capable of disinfecting 50.0% of the peak flow with one UV bank out of service.	

*Note: Industry standard parameter used for UV Dose calculations.

1.4 PERFORMANCE REQUIREMENTS

- A. Effluent Standards to be Achieved
1. The UV reactor shall be designed to deliver minimum UV dose of 30.0 mJ/cm² at Peak Disinfection Flow, after application of Lamp End of Lamp Life (EOLL) of 87%, and Fouling Factor of 89% and shall produce an effluent as follows;
 - a. Monthly Geomean (CFU): < 206.0 CFU/100 ml E. Coli Monthly Average geometric mean
 2. Effluent standards based on influent characteristics in accordance with Section 1.3.
 3. Effluent indicator organism quantities based on a two single day grab samples and as a 30 Geometric Mean. Grab samples shall be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Ed.
- B. Operating Conditions:
1. Outdoor installations shall require a cover for protection against the elements. The cover of the UV unit shall be supplied by the Contractor.
 2. The UV system shall be designed to operate at a maximum pressure of less than 20 psi.
 3. The location and placement of the valves shall be as per the Drawings.

1.5 SUBMITTALS

- A. The Manufacturer shall furnish electronic submittals consisting of the following information:
1. Mechanical/ assembly drawings.
 2. Power/Control wiring single line diagrams.
 3. Manufacturer's catalog information consisting of descriptive literature, specifications and materials of construction for all components
- B. After successful startup, Manufacturer shall provide certification that the ultraviolet disinfection system is commissioned and is ready for service.
- C. Manufacturer shall furnish the OWNER with one (1) hard copy and electronic copies of maintenance data on all machinery and equipment furnished for the system. The manuals shall include the following:
1. Equipment operating and maintenance instructions
 2. Parts lists
 3. Assembly and disassembly instructions
 4. Equipment specifications and guaranteed performance data
 5. Recommendations for preventive maintenance
 6. Step-by-step operating and start-up procedures
 7. Lists of spare parts, tools, and supplies
 8. Wiring diagrams of all control circuits
 9. Software programming as updated after final acceptance
 10. Troubleshooting instructions

- D. Hydraulic calculations demonstrating compliance with the specified hydraulics characteristics.
- E. Experience documentation.
- F. Furnish the third-party bioassay validation testing report to verify the equipment manufacturer design UV requirements. The UV system shall deliver the target dosage based on equipment derating factors and confirm the factors utilized in the design are appropriate for the specific application.

1.6 GUARANTEE

- A. The manufacturer shall guarantee that the proposed UV disinfection system shall produce an effluent that meets or exceeds the requirements of this specification, listed in Section 1.3. The effluent quality exiting the UV system must be equal to or better than the specification requirements.
- B. The equipment furnished under this section shall be free of defects in material and workmanship, including damages that may be incurred during shipping for a period of one (1) year from start-up. All travel expenses, accommodations, etc. for a service visit due to a defect shall be included in the warranty.
- C. UV lamps shall be warranted for a minimum of 12,000 hours operating time under the conditions specified herein prorated after 9,000 hours. In the event of premature UV lamp failure, the UV system supplier shall offer the following:
 - 1. Lamp failure before 9,000 hours – send a replacement lamp free of charge
 - 2. Lamp failure after 9,000 hours – issue a credit proportional to the hours not used.
- D. Electronic ballasts are fully warranted for 5 years.
- E. AFP tubes shall be warranted for twenty years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design for UV disinfection system and components shall be equipment manufactured and supplied by Enaqua, Vista, CA. The Trojan System UV 3000Plus is considered an approved equal and shall include a 304SS channel and UV lifting module davit crane as manufactured by Trojan Technologies, Inc. No other manufacturers shall be accepted. The physical UV layout shown on the Drawings and the equipment specified herein are based upon the equipment manufactured by Enaqua UV system. If Trojan System is proposed, the Contractor is responsible for the revised layout, required equipment, updated piping, valves and appurtenances and revised outdoor building for weather protection.

2.2 DESIGN, CONSTRUCTION AND MATERIALS

- A. The Ultraviolet Disinfection (UV) system shall consist of the following components:
 - 1. Reactor Model No: C2t.06042
 - 2. Number of reactors: 1
 - 3. Each reactor shall consist of the following:
 - a. Number of Banks per Reactor 2
 - b. Number of AFP Tubes 24
 - c. Number of Lamp Racks per Bank 5
 - d. Number of Lamps per Lamp Rack 8
 - e. Number of Lamps per bank 40
 - f. Total number of lamps per reactor 80
 - g. Total number of ballasts per reactor 80
 - 4. The UV system shall include the following controls/monitoring:
 - a. Radar Level Sensor 1 (1 per UV reactor)
 - b. UV Intensity Monitor: 2 (1 per UV Bank)
 - c. ADRX: 2 (1 per UV Bank)
 - d. PIO 1

- e. EDC: 1 (1 per UV reactor)
- f. UV Control Panel (HMI Panel): 1
- g. Power Disconnect Panels: 2 (1 per UV bank)
- h. Air to Air HE assemblies 2 (1 per UV bank)
- 5. Spare parts consisting of the following:
 - a. Fully populated spare lamp rack 1
 - b. Additional Spare UV Lamps 6
 - c. Additional Spare UV ballasts 2
 - d. Operator Safety Kits: 2
 - e. Cleaning Kit: 2
- 6. Effluent level control mechanism shall consist of the following:
 - a. Rectangular contracted weir plate installed in effluent tank 1

B. General

- 1. All module welded metal components in contact with effluent shall be Type 304 stainless steel.
- 2. All wetted metal components shall be Type 304 stainless steel with the exception of the Lamp Rack Assembly, which shall be constructed of aluminum and be capable of sustaining intermittent pedestrian traffic on the lamp racks.
- 3. All wiring exposed to UV light within the UV reactor, or electrical ballast enclosure shall be Teflon™ coated.
- 4. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of lamp rack and not exposed to the effluent.
- 5. The effluent water shall be conveyed through the UV reactor via AFP tubes – there shall be no contact with effluent and quartz sleeves at any time during normal operation.
- 6. All wetted components in the UV reactor shall be: AFP, 304SS, PVC, ABS or other non-reactive, non-corrosive material.
- 7. The UV system (ballasts, lamps, and controls) shall be capable of 24 on/off cycles per 24-hour day for the full specified warranty life of the lamps and ballasts.

C. Lamp Array Configuration:

- 1. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow. The lamps shall be evenly spaced in horizontal and vertical rows with centerline spacings equal in both directions.
- 2. The single array pattern shall be continuous and symmetrical throughout reactor.
- 3. Systems with concentric array or uniform staggered array and having equivalent UV density shall have 30 percent additional lamps to compensate for the inefficiencies of these arrays as shown on Page 206, Fig. 7-33 of the US EPA Design Manual.
- 4. The UV reactor shall be designed to avoid any immersion of UV lamps in the Effluent.
- 5. The UV lamps shall be arranged around the outside of the AFP tubes in such a way that each AFP tube shall have no less than 6 lamps irradiating it at all times.

D. Inlet/Outlet Flow Distribution:

- 1. Each UV reactor shall have an inlet and outlet tank. Plant effluent piping shall connect to each of the tanks to convey effluent through the UV reactor.
- 2. Connection to inlet and outlet tanks of UV reactor:
- 3. Diameter: 12.00" Diameter (ASME/ANSI B16.5, CL 150 Flange)
- 4. Each UV reactor shall have a flow distribution sheet, so as to distribute wastewater efficiently through the AFP tubes.
- 5. The tanks and inlet flow distribution sheet shall be made of 304SS material. All material which comes in contact with the wastewater shall be non-corrosive.

E. Effluent Level Control Mechanism:

- 1. Each UV reactor shall have an effluent level control mechanism (a Rectangular contracted weir plate) installed in the effluent tank of the UV reactor, provided by manufacturer. The weir geometry shall be designed such that the weir will flood varying # of AFP tubes based

on flow thus achieving the required minimum submergence of the calculated # of AFP tubes and providing the minimum specified UV dose at varying flow conditions.

2. The effluent level control shall be a removable weir plate, and a weir frame installed in the effluent tank of the UV reactors. The weir plates and all mounting hardware shall be of 304 SS, to be supplied and installed by manufacturer.
- F. AFP840™ Tube Ultraviolet reactor:
1. Within the ultraviolet reactor, AFP UV transmitting tubes are arranged in a horizontal and vertical array. These AFP tubes are in a parallel mode and are attached at one end to the inlet flow distributor sheet and to the outlet flow distributor sheet with appropriate leak proof fittings. The AFP tubes shall be adequately supported.
 2. In between and around the AFP tubes, lamp rack assemblies shall be placed in such a fashion so as to provide uniform and adequate ultraviolet light intensity. The lamp racks slide in and out between and around a row of AFP tube array.
 3. Within the AFP UV reactor, all UV sensitive materials shall be protected from the UV light.
 4. The flow path through the AFP tubes shall achieve optimized plug flow regime. The flow of wastewater should be in sufficient turbulent mode; therefore, the Reynold's number in each UV reactor would be greater than 50,000 at peak flow. A turbulent flow shall be in such a way that it scours the inner walls of the AFP tube to help prevent scaling or fouling.
 5. The UV reactor shall be covered from five sides with either coated aluminum or stainless panels. The sixth side (top) shall have access door(s). The lamp racks shall be accessible through these doors.
 6. The air temperature inside the AFP UV reactor shall be maintained between 32 - 49 deg C or 90-120 deg. F by means of a heat exchanger. The control of the reactor temperature shall ensure optimum UV light emissions from the UV lamp.
 7. A temperature sensor shall be installed within the UV reactor for protection against heat build-up under no or low flow conditions.
- G. UV Reactor Thermal Control Mechanism:
1. Cooling within the UV reactor shall utilize a series of air to air heat exchangers. A series a cooling fans shall expel heat from the interior of the UV reactor to maintain the ideal temperature of the UV Lamps.
 2. The UV equipment manufacturer shall supply the heat exchangers and associated controls.
- H. UV Lamps: The UV lamps shall have the following characteristics:
1. A low pressure, high output (LPHO) non-amalgam mercury vapor lamp of the hot cathode type.
 2. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
 3. Each lamp will produce at least 90% emissions at the germicidal frequency of 253.7 (254nm) nanometers.
 4. The power consumption shall be a maximum of 138 input watts per lamp, total including ballasts losses shall not exceed 145 watts including ballast losses.
 5. The rated UV output at 253.7 nanometers (nm) shall be a nominal 57 UVC Watts at 100 hours of operation.
 6. The lamp shall have a minimum UV intensity of >400 microwatts/cm² at 1 meter.
 7. Each lamp shall have a rated life of 12,000 hours.
 8. Each lamp shall be single ended. Each lamp shall have a nominal arc length of 1400 millimeters.
 9. Each lamp has a minimum length of 1554 mm.
 10. Each lamp shall produce no measurable amount of ozone.
 11. Each lamp envelope is made of fused quartz and is capable of transmitting at 90% of UV light at 253.7 nm.
 12. Electrical connections shall be at one end of the lamp and have six (6) pins, dielectrically tested for 2,500 volts. Lamps that have 2-4 pins (instant start) may be considered. However

to be considered as an alternate, instant start lamp systems shall supply replacement spare lamps equal to 20% of the total number of lamps in the system.

13. Each UV lamp shall have a smart lamp Module (an integral unique lamp identification chip) embedded in the lamp pin connector that enables the lamp position in the UV reactor to be altered independent of a lamp holder. The smart lamp module shall be capable of measuring and storing at a minimum the following data for each UV lamp in a reactor:
 - a. Part and Serial number (unique identification) of each individual UV lamp
 - b. Total accrued run time hours
 - c. Lamp ON/OFF cycles
- I. UV Lamp Racks
1. The UV lamp racks shall be placed between rows of the AFP840™ tubes.
 2. The lamp racks shall typically slide in and out within a track that shall be attached to the main frame of the UV reactor.
 3. The use of cranes, hoists or other mechanical lifting devices shall not be required.
 4. The lamp rack assemblies shall be made from aluminum.
 5. Electrical mounting sockets shall be attached to one end of the lamp rack.
 6. The other end of the rack shall have slotted holes to slide lamps in and out during installation and removal of lamps.
 7. Quick power disconnects allow quick disconnect of the lamp rack assembly to the main power at the UV reactor chassis.
 8. Each lamp rack shall be equipped with its own on/off switch and fuse.
 9. Each lamp rack shall be equipped with an LED indicator to identify the operating condition of each lamp on the lamp rack.
 10. Lamp Racks shall be removable for service during UV operation without impacting Hydraulic flow and still maintaining plug flow regime in the reactor.
 11. Each lamp shall be controlled by an individual ballast. Systems that have one ballast controlling multiple lamps shall not be considered.
 12. There shall be no quartz sleeves, O rings, seals, glands or retainers required to be around the lamps when installed in the lamp racks.
- J. Electronic Ballasts:
1. The ballast used to energize the UV lamps shall be high frequency electronic ballasts. The ballasts shall be housed in the lamp rack assembly as an integral part of the lamp rack.
 2. The electronic ballasts shall be rated at 120-277 V +/- 10% without discernible change of characteristics.
 3. The electronics ballast shall have the following features:
 - a. Power factor greater than or equal to 0.95.
 - b. Electrical conversion efficiency greater than or equal to 90%.
 - c. Ballast shall have high frequency phase returns from the UV lamps.
 - d. The ballast operating frequency shall be between 40 and 150 K Hz.
 - e. The ballast shall have a thermal overload protector to protect against overheating when ballast skin temperature reaches 75 deg. C.
- K. Electrical:
1. The UV reactor shall be powered from its own incoming power supply.
 2. All cabling, conduit runs and wiring from the power supply to the UV reactor are shown on the Drawings.
 3. The Contractor shall be responsible for bringing main and control power to the UV reactor through a branch circuit protections device (disconnect) as shown on the drawings.
 4. Electrical power required shall consist of the following:
 - a. Main power to reactor(s): 480VAC, 3 phase (Y), 4 Wire (3 Ph + N) plus ground
 - b. Cooling power to reactor(s): 120VAC, 1 phase, 2 wire plus ground
 - c. Power to UV Control Panel: 120VAC, 1 phase, 2 wire plus ground
- L. Power Panel:

1. The power panel(s) for the UV system shall consist of a UL 508-A NEMA 4X rated electrical enclosure. The power panel shall house the following:
 - a. All contactors, disconnects, terminations and fuses required to power the appropriate bank.
 - b. Electrical safety lock-out.

2.3 CONTROL COMPONENTS

- A. Analog Input Output Modules (AIO)
 1. An AIO module shall be supplied in the UV control panel. AIO module provides for Precision and Isolated Analog Input and Output. The analog signals are in the form of a 4-20mA current loop. The Inputs can be signals from Flow and/or Level Sensors.
 2. Features of AIO modules:
 - a. 2 RJ 45 Ethernet ports for network integration with EDC module
 - b. Daisy Change up to 2 AIOs
 - c. 2 Precision Analog Inputs – 4~20 mA, Isolated
 - d. 1 Precision Analog Output – 4~20 mA, Isolated
 3. The UV control panel shall provide a 4-20 mA repeater signal for instantaneous flow to the plant PLC.
- B. Port Input Output Modules (PIO)
 1. One (1) PIO module per reactor shall be supplied in the UV control panel. PIO modules provide for one Analog Input (4-20 mA) and Switch Inputs and Relay Outputs. Switch Inputs may be remote start signals from a PLC or HOA (Hand-Off-Auto) switch. Relay Outputs can be programmed to provide an Alarm signal, System Operating and/or Cooling Control.
 2. Features of PIO modules:
 - a. 2 RJ 45 Ethernet ports for network integration with EDC module
 - b. Daisy Change up to 2 PIO's
 - c. One Simple Analog Inputs – 4~20mA
 - d. 4 Switch Inputs – Dry Contact
 - e. 4 Relay Outputs – Switch 120VAC @ 6A
 - f. 2 Temperature Probe Inputs
- C. Local Control and Monitor (ADRX)
 1. Each reactor bank shall be equipped with an Active Data Router Extended (ADRX) to control and monitor each bank of the reactor. The display for each bank shall be equipped with the following:
 - a. 20 Character, 4 row LCD display
 - b. Keypad
 - c. 2 Switch Inputs
 - d. 2 Output Relays:
 - 1) Status of unit ON/OFF
 - 2) General alarm (Low UV or Lamp out via powered relay)
 - e. Displays for:
 - 1) Individual lamp on indication
 - 2) Individual lamp hours
 - 3) UV Intensity
 2. Each UV reactor bank shall be equipped with three-way lamp control consisting of; HAND, OFF and AUTO.
 - a. In Hand: Shall provide local lamp control.
 - b. In Off: Shall power off the lamps in the reactor.
 - c. In Auto: Shall provide automatic lamp control from remote signal.
- D. Electronic Data Center (EDC)
 1. Each UV reactor shall be equipped with a 32 bit supervisory microcontroller called Electronic Data Center (EDC). The EDC shall collect all the data from individual UV lamps, UV and other sensors in the system and shall display it at the HMI and remotely to the plant

operation console. The Local display panel (HMI) shall show at a minimum the following data:

- a. UV Bank in Duty/Stand-By
 - b. On/Off status of lamps.
 - c. Error Status of lamps and sensors.
 - d. Lamp Hours
 - e. An advanced signal for lamp service or replacement.
 - f. Flow through UV system
 - g. Water Level in the inlet tank of the UV reactors
 - h. UV intensity per Bank.
 - i. The type and location of the alarm.
 - j. The frequency of alarms shall be counted and stored.
 - k. Alarms and historical operating data shall be stored in a removable storage device in comma delineated format.
2. Communication between each UV reactor and the EDC shall be via CAT5 Ethernet cable.
 3. Integration of alarms between the UV Control Panel and the EDC and the plant's PLC shall be via Modbus TCP. Communication between the UV Control Panel and the plant PLC shall be via CAT6 Ethernet cable.
 - a. All registers of the EDC shall be available to the plant's SCADA system PLC
- E. UV Control Panel (HMI Panel)
1. The HMI for Enaqua's EDC is installed and mounted in a UL 508-A NEMA 4X type 304 SS rated electrical enclosure to provide graphic interface for monitoring and control.
 2. The HMI interface shall be 19" NEMA 4X Touchscreen Industrial Display (Hope Industries Model HIS-ML19 (Rev. G)) with VIA Technologies Windows 10 PC (AMOS-3005-1Q12A2), and shall display all system operational data, system operational history and shall allow access via remote internet connection for troubleshooting and system upgrades.
 - a. The UV Control System enclosure shall house the following:
 - 1) 19-inch color touchscreen display
 - 2) Windows 10 Industrial PC
 - 3) Ethernet Switch, 8 port 10/100BaseT(X) (RJ45 connector. Weidmuller Model IE-SW-BL08-8TX
 - 4) Electronic Data Center (EDC) EDC GEN 2- Part # 62.010037
 - 5) PIO (Enaqua I/O Modules). Part # 062.01003600
 - 6) 24 V DC Power Supply. IDEC Slim Line Model PS5R-SB24
 - 7) Phoenix Contact QUINT 500 VA UPS MODEL # 2320270 with Battery MODEL # 2320319
- F. UV Intensity Monitor
1. The UV reactor shall have a minimum of two UV intensity sensors (one per bank) which responds to the germicidal portion of light generated. The sensor shall not degrade after prolonged exposure to the UV light or effluent.
 2. The sensor shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm. It shall have sensitivity at 254 nm of greater than 95%. Sensors whose sensitivity to other wavelengths amounts to more than 5% of the total sensitivity shall not be allowed.
- G. Radar Level Sensor
1. The inlet tank of each UV reactor shall include a radar level sensor and transmitter provided by Manufacturer of the non-contact UV disinfection equipment, which will monitor the water level in the inlet box and transmit a signal to the EDC for activation and de-activation of UV lamps based on the level in the influent tanks.
 2. The radar level sensor/transmitter shall conform to the following requirements:
 - a. Range: Rod & coaxial: 9.8' (3m)
 - b. Cable: 18' (5.5m)

- c. Accuracy: $\pm 3\text{mm}$
 - d. Dead band: Top: 4" (10cm), Bottom: 2" (5cm)
 - e. Repeatability: < 2mm
 - f. Resolution: < 2mm
 - g. Configuration: WebCal® PC Windows® USB 2.0
 - h. Supply voltage: 10-30 VDC
 - i. Max. consumption: < 50mA @ 24 VDC
 - j. Signal output: 4-20mA, 3-wire
 - k. Signal fail-safe: 4mA, 20mA, 21mA, 22mA or hold last
 - l. Dielectric: > 1.8
 - m. Process temp.: F: -40° to 302°, C: -40° to 150°
 - n. Ambient temp.: F: -40° to 185°, C: -40° to 85°
 - o. Pressure: -14.5 to 250 PSI (-1 to 17 bar)
 - p. Enclosure rating: NEMA 4
 - q. Encl. material: Aluminum
 - r. Feed through mat.: 316L SS & PEEK
 - s. Conduit entrance: (1) 1/2" NPT connector
 - t. Probe material: Rod: 316L SS
 - 1) Coaxial: 316L SS or galvanized
 - 2) Cable: 316 SS
 - u. Process mount: 3/4" NPT (3/4" G)
 - v. Classification: General purpose
 - w. Certification: cCSAus, NRTL
 - x. Compliance: CE, CRN, RoHS
3. The radar level sensor/transmitters shall be Flowline EchoWave® LG10-11 Guided Wave Radar Level Transmitter or approved equal.
 4. The radar level sensor/transmitter(s) shall be mounted atop a section of pipe passing through the removeable lid of the inlet tank and extending to within one inch (1") of the bottom of the inlet tank. The vertical pipe shall serve as a stilling basin for the radar level sensor transmitter and prevent false or no readings caused by water turbulence in the inlet tank.
- H. Remote Monitoring and Control
1. The UV reactor shall have the capability of providing basic remote monitoring/control via the plants main console (or other designated computer). The plant shall provide either an Internet IP address specific to the UV system, or allow access through its network and via secure website.
 2. Connection/integration to the main console shall be via MODBUS TCP.
- I. Alarms:
1. Minor alarms shall be provided by the EDC's PIO module (Discrete I/O Module) via dry contact, or via MODBUS TCP to the plant's PLC that maintenance attention is required. Alarms shall include:
 - a. Low UV Intensity shall be pre-set at the factory for 70% of the intensity after 100 hours. Alarm set point shall be field adjustable.
 - b. Single Lamp Out
 2. Major alarms shall be provided by the EDC's PIO module (Discrete I/O Module) via dry contact, or via MODBUS TCP to the plant's PLC to indicate an extreme alarm condition in which the disinfection performance may be jeopardized. Alarms shall include:
 - a. Low UV Intensity Alarm. This alarm shall be pre-set at the factory for 25% of the intensity after 100 hours' burn-in of the lamps. The alarm set point shall be field adjustable. A low intensity alarm shall not cause any bank to turn off.
 - b. Contiguous or multiple lamp failure
 - c. Bank 1 & Bank 2 Over Temperature Alarms.

- d. High Flow Alarm.
- J. UV Control Strategy
 1. At any given time, one UV bank shall be designated as LEAD, and one UV bank shall be designated as LAG.
 2. Level Pacing (UV Dose Pacing): The UV system shall employ a level pacing technique in which the lamps that are not required for maintaining the proper dosage are turned completely off in accordance with the level of the UV inlet channel, while ensuring minimum UV dose delivery at all times. Depending on the water level in the inlet channel, the turndown range (ratio of lamps in lamp rack to lamps used based on liquid level) shall be from as low as 33.0 % to 100.00 %. Determining water level shall be provided via an integral level sensor using a 4-20 mA signal terminated at the UV control panel.
 3. UV Bank alternation: The alternation of the UV reactor banks (lead and lag) shall be performed by the EDC ensure equalized operating hours for the two UV banks.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Equipment shall be installed by Contractor in accordance the manufacturer's recommendations, drawings and specifications to provide a complete installation.
- B. Installation Responsibilities of the Contractor
 1. Provide Manufacturer with at least two (2) week notice prior to any changes in the installation date previously agreed upon by the Owner and Manufacturer.
 2. Sufficient space for moving into place and placement of all equipment supplied by Manufacturer.
 3. Equipment anchoring and grouting including anchor bolts.
 4. All required permits.
 5. Structural work such as concrete pads, mezzanines for elevating equipment items, etc.
 6. Interconnecting electrical outside of the UV Skid limits.
 7. Connection and sealing of al flanges, fittings and connections to the adjacent plan processes.
 8. All flanges, reducers, elbows, valves and other plumbing appurtenances not specified within these specifications shall be by the Contractor.
 9. All electrical outside the skid limits including, transformers and disconnect switches. Equipment electrical supply shall be detailed on the shop drawings.
 10. Protecting the UV reactor from damage between the time of delivery and installation.
 11. Analytical testing.
 12. Equipment unloading, moving and rigging into position.
- C. Installation Responsibilities of Manufacturer
 1. Equipment packaging for transportation from Manufacturer Factory to the job site.
 2. All labor to complete the tasks listed as Manufacturer's responsibility shall be performed as straight time rates by employees of Manufacturer is a non-union company, or our designated subcontractors.
- D. Startup Responsibilities of the Contractor
 1. Provide Manufacturer with a two (2) week notice prior to any changes in the start-up date previously agreed upon.
 2. Availability of all required utilities.
 3. Availability of typical feed water quality and quantity.
- E. Joint Responsibility of Manufacturer and Contractor
 1. Final assembly of and loading of the UV lamps supplied by Manufacturer.
- F. Startup Responsibilities of Manufacturer
 1. Manufacturer's representative for the equipment specified herein shall be present at the jobsite for a minimum amount of workdays for services listed below. The following services shall be provided:

- a. Two workdays (8 hours each) for start-up, commissioning, maintenance training, maintenance assistance, classroom and on-site equipment operation instructions, troubleshooting, and other post-startup services.

3.2 ELECTRICAL CONNECTIONS AND CONTROLS

- A. Wiring and conduits for electrical power, controls, and instrumentation shall be provided by the Contractor.

END OF SECTION

SECTION 465332
LAGOON AERATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and technical specification sections, apply to this section.

1.2 SUMMARY

- A. The Owner has pre-selected Triplepoint Environmental through Municipal Equipment Company, Inc. to provide equipment within this specification. No other manufacturers will be accepted.
- B. The contractor shall furnish all labor, materials, tools, equipment to perform all work and services necessary for and incidental to the furnishing and installation of a complete Lagoon Aeration System, complete and ready for operation in accordance with the provisions of the contract documents.
- C. This Section includes the following:
 - 1. Individual Static Tube Coarse Bubble + Fine Bubble Air Diffusers
 - 2. Feeder Tubing
 - 3. Air Supply Blowers
 - 4. System Control Panel
- D. Related Sections include the following:
 - 1. Section 465333 – Lagoon Integrated Nitrification Reactor

1.3 DEFINITIONS AND REFERENCES

- A. Definitions:
 - 1. AOR: Actual oxygen requirements.
 - 2. SOR: Standard oxygen requirements.
 - 3. SCFM: Standard cubic feet per minute are understood to be air at 68°F, 14.7 PSIA and 36% relative humidity flowing at a rate of 1 cubic feet per minute.
 - 4. SWD: Side water depth is understood to be the overall dimension from the high point of the lagoon bottom or basin floor to the water surface.
- B. References: Following is a list of standards, which might be referenced in this Section:
 - 1. American Society of Civil Engineers (ASCE): Standard No. 002 “Measurement of Oxygen Transfer Efficiency in Clean Water”
 - 2. ASTM International (ASTM):
 - a. D1784 – Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC)
 - 1) Compounds
 - b. D1785 – Specification for Poly (Vinyl Chloride) (PVC)
 - 1) Plastic Pipe, Schedules 40, 80, and 120
 - c. D2666 – Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - d. D3350 – Specification for Polyethylene Plastic Pipe and Fittings Materials
 - e. F714 - Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

1.4 SYSTEM DESCRIPTION

- A. Static tube air diffuser system consists of a submerged aeration unit that combines mixing and aeration in one unit. Each unit shall consist of a coarse bubble static tube aerator surrounded by a series of fine bubble diffusers. Each unit shall be weighted with ballast and rest freely on the lagoon sludge layer or floor with all diffusers elevated above the sludge layer or floor.
- B. The static tube shall be designed to generate a flow through the base of the tube. This current shall draw sludge particles and other light organic solid particles from the bottom of the lagoon through the tube. Turbulence within the tube shall be created to maximize contact time and

number of individual collisions between the air bubbles, wastewater, and particulates. As the water column emerges from the top of the static tube and continues to rise, continued interaction between the air bubbles, wastewater, and suspended particulate will continue to influence the breakdown of organic solids. After these solids have risen with and spread radially from the water column, they will circulate back to the bottom where they will meet the slower rising air bubbles from the fine bubble diffusers, inducing additional organic and biological breakdown.

- C. Each aeration unit shall be connected to the air supply system by a flexible weighted PVC tube of sufficient length to allow removal of the aeration unit from above for cleaning, maintenance, repair, or replacement.
- D. The number and size of the aeration assemblies will be determined by their oxygen transfer efficiency, mixing capacity, and the area of influence.

1.5 PERFORMANCE REQUIREMENTS

- A. Design Parameters and Performance: Aeration system shall be installed in the lagoon cells #1, #2, and #3 of the size and comply with the design performance as required by the OWNER. The lagoon cells #1 and #2 sludge shall remain in the cells and the aeration system shall be installed on top of the sludge layer. Lagoon cell #3 will have the sludge cleaned out and the aerators shall be installed in the lagoon floor.
- B. The aeration system should be designed to provide enough oxygen to meet the following flow conditions:
- C. Pounds per day is calculated based on the Daily Average Flow.

LAGOON INFLUENT (CELL #1)		
DAF	0.470	MGD
PDF	1.152	MGD
PHF	1.728	MGD
	MG/L	LB/DAY
BOD	250	980
TSS	300	1176
TKN	30	117.6
NH3-N	15	58.8

LAGOON EFFLUENT (CELL #2)/MBBR FEED		
DAF	0.470	MGD
PDF	0.864	MGD
PHF	1.152	MGD
	MG/L	LB/DAY
BOD	30	118
TSS	30	118
TKN	21.2	83
NH3-N	21.2	83

- D. Structural Performance:
 - 1. All equipment, air distribution system, supports, anchors and fasteners shall be of adequate size and strength to withstand loads associated with starting, turbulence, debris,

thrusts from fluid movement, thermal expansion and contraction and other loads encountered under operating conditions.

2. System shall be designed for contraction/expansion over a temperature range of 120 degrees F without deforming any component.
- E. The lagoon cell aeration and nitrification system components shall collectively be designed to treat the plant raw wastewater influent concentrations as indicated in the Drawings Design Criteria Table and meet the permitted effluent requirements. Maximum influent concentrations for the nitrification system shall be based on plant raw wastewater influent concentrations to achieve these maximum influent concentrations for the nitrification system and shall be the responsibility of the supplier, Triplepoint Environmental

1.6 SUBMITTALS

- A. Product Data: Provide construction details, material descriptions, dimensions of individual components and profiles, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Provide plans, elevations, sections, details, and attachments to other work.
1. Provide dimensional layouts, materials, details of appurtenances, anchoring, installation, and operation instructions. Fabrication and installation shall be in accordance with such approved drawings.
 2. Specification cut sheets for all proposed equipment, including diffuser units and flexible self-weighted aeration tubing.
 3. Certified diffuser performance test data shall be submitted. It shall include air flow versus head loss data, and Standard Oxygen Transfer Tests conducted in clean water in accordance with the standards set forth by the ASCE Subcommittee on Oxygen Transfer Standards. Any tests must be completed in a minimum of 10' diameter tank; no single column tests will be accepted.
 4. SOTE calculations to verify the clean water oxygen transfer efficiency of the diffuser at both design and maximum airflow.
 5. Head loss Calculations for the complete aeration system from the top of the drop leg. Calculations shall include the total head loss across the membrane, balancing orifice, piping system and static head at both design and maximum airflow.
 6. Computational Fluid Dynamic modeling study proving the aeration system will provide the required mixing rate stated in the Performance Requirements Section.
- C. Information Submittals:
1. Special shipping, storage and protection, and handling instructions.
 2. Manufacturer's instructions for installation.
 3. Qualification Data: For manufacturer and manufacturer's representative.
 4. Equipment Warranty
 5. Operation and Maintenance Instructions
 6. Location of nearest stocking distributor of spare parts.
 7. Suggested spare parts list to maintain the equipment in service for a period of two years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current pricing information.
 8. Installation list demonstrating conformance to supplier qualifications as per 1.7 B.

1.7 QUALITY ASSURANCE

- A. Aeration equipment shall be provided by the following approved supplier: Triplepoint Environmental LLC or pre-approved equal (see below for approval qualifications).
- B. Supplier Qualifications:
1. All equipment should be the product of a supplier having at least five (5) North American installations with a lagoon aeration unit that combines static tube aeration with fine bubble diffusers in one portable unit (as per 1.4) each with a minimum of five (5) years satisfactory service.

- C. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation supervision of units required for this Project.
- D. Source Limitations: Equipment units of each type specified in this section shall be supplied by a single manufacturer. This does not require that all equipment be manufactured by a single manufacturer but does require that the manufacturer of the system shall be responsible for the complete system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS SCOPE OF SUPPLY

- A. The manufacturer shall supply all process equipment and design necessary to achieve the performance standards stated in section 1.5, this includes:
 - 1. Aeration units
 - 2. Air distribution piping arrangement and sizing from air supply header
 - a. All material beginning at the edge of the basin (water level) including air supply laterals, saddle connections, control valves, hose barb connection, hose clamps, flexible weighted tubing, and complete weighted aeration unit assemblies.
 - 3. All connections essential to proper installation, operation, and maintenance of aeration equipment.
 - 4. Shop drawings and process engineering design
- B. Other non-process related equipment shall be provided by the Contractor; items include but are not limited to:
 - 1. Air supply piping
 - a. Header pipes
 - b. Lateral riser pipes with BFV, details per the Contract Drawings

2.2 AERATION SYSTEM

- A. Design Responsibility:
 - 1. Equipment manufacturer shall be responsible for determining the size and number of aeration units, air distribution piping arrangement and sizing from the air supply header, and other equipment required to provide the air flow rates required for the biological treatment and to assure proper mixing within the lagoon or basin.
 - 2. Air Distribution System: Aeration System manufacturer shall provide an air distribution layout and the number of aeration assemblies required to:
 - a. Demonstrate uniform air delivery to all diffusers at design airflow in compliance with the air supply pressure requirement.
 - b. Demonstrate the oxygen transfer efficiency at standard conditions for the aeration assembly.
 - c. Demonstrate aeration assembly mixing capacity and the area of influence.
 - d. Demonstrate compliance with the air supply pressure requirement and provide baseline data for the increase in aeration assembly backpressure requirement.
- B. AERATION UNITS:
 - 1. SUMMARY
 - a. All Aeration Units shall be a combination of coarse bubble static tube diffusion and fine bubble diffusion on one portable platform.
 - b. All Aeration Units shall be self-weighted, containing their own ballast.
 - c. All Aeration Units shall rest unfastened, directly on the basin floor.
 - d. All Aeration Units shall be retrievable from the surface of the lagoon.
 - 2. STATIC TUBE:
 - a. The vertical static tube aerator shall be factory fabricated of polyethylene and/or PVC materials.
 - b. The static tube shall be mounted to rigid legs in such a way as to elevate the bottom of the tube 3" to 12" above lagoon floor or sludge layer, depending on lagoon and sludge depth.

- c. A coarse bubble diffuser shall be mounted within the static tube at an elevation of 6" to 12" above the lagoon floor or sludge layer.
 - d. The static tube shall extend 12" to 30" above the coarse bubble diffuser, depending on lagoon depth.
3. BASE:
- a. Base shall be securely fastened to the static tube and provide a ground contact footprint of at least 300 square inches.
 - b. Ballast material shall have a minimum specific gravity of 2.0. Means shall be provided of easily adding additional ballast to unit without removing unit from the water.
 - c. Overall submerged unit weight shall have a minimum specific gravity of 1.8 under maximum airflow conditions.
 - d. Manufacturer shall be responsible for ensuring compliance with minimum design densities.
4. FINE BUBBLE DIFFUSER:
- a. A series of fine bubble diffusers shall be mounted on the outside of the static tube. Diffuser size and quantity shall be based on the performance requirements of the aeration system.
 - b. Fine bubble diffusers shall be of EPDM or Silicone membrane type in tube style. No other fine bubble diffuser will be accepted.
 - c. Fine bubble diffusers shall be securely attached to unit at an elevation of 6" to 12" above the lagoon floor or sludge layer.
 - d. PVC or equivalent piping shall be used to supply air to each diffuser.
5. GENERAL AERATOR REQUIREMENTS:
- a. With the exception of integrated check-valves, no mechanical, moving parts shall be used.
 - b. Each diffuser (including coarse bubble) shall have an integrated check-valve capable of preventing backflow of water into air distribution system.
 - c. All hardware shall contain locking features to minimize likelihood of inadvertent disassembly during shipping, handling, installation, and operation.
 - d. All screwed plumbing fittings that do not utilize a gasket shall use appropriate Teflon type joint sealant or equivalent to minimize leakage and loosening of parts over time.
 - e. Airflow to fine bubble and coarse bubble diffusers shall be balanced by an integrated orifice plate system. Total ratio of fine bubble to coarse bubble airflow shall be maintained between 4 to 1 and 20 to 1, depending on the treatment system requirements.
 - f. A single 1" to 1-½" hose barb shall be integrated to aerator and used as an air inlet point. Flexible weighted tubing shall be attached to said hose barb by a stainless-steel hose clamp. This hose barb shall be integral with unit to reduce likelihood of breakage or failure should someone try to drag or lift unit by hose.
6. MATERIALS:
- a. All submerged hardware shall be of Type 304, 316 or better stainless steel.
 - b. All non-submerged hardware shall be of Type 304 or better stainless steel.
 - c. All removable fittings shall be of Type 304, 316 or better stainless steel.
 - d. All ballast shall be of non-corrosive and non-toxic material or shall be permanently sealed within or coated with such material.
 - e. All other parts shall be of stainless steel, PVC, HDPE, GPP, EPDM or equivalent, non-corrosive, non-toxic, and non-degradable materials suitable for complete immersion in a typical wastewater environment.
7. REMOVAL:
- a. Means for easily removing and replacing aeration units from above shall be provided including:
 - b. A floating marker buoy shall be permanently attached to each unit by a stainless-steel tether of proper length to float directly above the aeration unit.
 - c. Tether shall be a 3/8" MFP float line, capable of lifting at least ten times the weight (out of water) of the installed aeration unit.

C. FEEDER TUBING

1. Feeder tubing (flexible weighted tubing) used as the connection between the aeration unit and the header or lateral piping shall be low density, polyethylene or PVC tubing with self-contained ballast, color black, with 1 percent carbon black for ultra-violet stabilization. No tubing with external and/or intermittent ballast added will be accepted; the ballast must be integral to the tubing itself.
2. All polyethylene tubing shall conform to the requirements of ASTM D 1248.
3. Tubing length shall be of sufficient size to allow removal of the aeration unit from above for cleaning, maintenance, repair, or replacement.
4. Tubing inside diameter shall be 1.5" to minimize friction loss; smaller inside diameter tubing will not be accepted except for extremely low flow applications (≤ 10 scfm per unit).
5. Tubing shall be connected at both ends with Type 304 or 316 stainless steel hose clamps to stainless steel hose barbs.
 - a. In the case of systems designed with fixed, laterals that do not have the means for individually controlling airflow to each unit (such as a control valve mounted on the shore), a single, custom orifice plate shall be supplied by the manufacturer for each aerator position. This orifice plate shall be installed when the aeration unit is set in place at each lateral take-off point. The orifice plate shall be installed upstream of the flexible weighted tubing, between the take-off saddle and the hose barb.

D. AIR SUPPLY BLOWERS

1. Air supply blowers shall be provided to supply ambient air to the aerators.
2. The blower units shall be sufficiently sized to provide the air needed to the aerators in order to meet the performance requirements.
3. There shall be a minimum of two blower units, one for duty and one standby/backup.
4. Blower units will be tri-lobe positive displacement technology and complete with an inlet filter silencer, check valve, gate valve, pressure relief valve and pressure gauge. Blowers shall be Kaeser FB621C, 75 hp each and on VFDs.
5. The blowers will be located outdoors and shall be placed in a weatherproof enclosure and placed on a concrete pad.
6. The blower rotors shall be one-piece, ductile iron composition and balanced to the closest tolerances for smooth, efficient operation at all speeds and pressures.
7. Gears shall be spur-type, case hardened, precision ground timing to minimize vibration and mechanical noise and to ensure optimal timing and improved efficiency.
8. High efficiency TEFC/IP-55 motors shall be used to minimize energy consumption.
9. An 80 dBA or less free field guaranteed noise enclosure should be provided for each blower system. The noise enclosure shall be provided with minimum 1" foam and the foam shall comply with UL94-HF 1 for flammability.
10. Blowers shall be designed for the following:
 - a. Airflow Requirement per Blower: 1,630 scfm
 - b. Discharge Pressure: 5.15 psig
 - c. Minimum Horsepower: 75HP

E. SYSTEM CONTROL PANEL

1. The MANUFACTURER will supply a control panel to control the blowers.
2. The control panel will be mounted outside and shall be enclosed in an outdoor rated NEMA weatherproof enclosure
3. The panel shall be delivered completely assembled, pre-wired, tested and ready for installation.
4. The control panel shall have sufficiently sized motor starters for the blowers along with starters for the blower enclosure fans. The enclosure fans shall have a 15 min off delay after the blower is switched off to allow for enclosure cooling.
5. The control panel shall include a 7-day timer switch that will automatically switch the duty and standby blowers.

2.3 SOURCE QUALITY CONTROL

- A. Adequate testing and inspection of the factory assembled equipment shall be the responsibility of the manufacturer prior to shipment. Upon satisfactory completion of testing, the units will be disassembled into subcomponent assemblies for shipment and installation. At the manufacturer's option, the units may also be shipped to the site as complete units, providing said units can be installed as a complete assembly.
- B. Testing and Inspection Types
 - 1. General Appearance – All units for all order sizes shall be 100% visually inspected after general assembly for missing or damaged parts and finish.
 - 2. Connections – Plumbing and hardware connections shall be tested for tightness.
 - 3. Levelness – Fine bubble diffusers and/or arms shall be tested to ensure all aerators are horizontal, level, and on the same plane.
 - 4. Base – Base and/or assembled unit shall be weighed for sufficient ballast.
- C. Defects
 - 1. Major defects shall be considered any defect which would materially affect the intended life, use, or performance of the installed unit. These include, but are not limited to: missing parts, unglued PVC joints, severely damaged pipe fitting threads, fine bubble diffusers out of level by more than 3/16" between any 2 consecutive diffusers or 3/4" over any 2 diffusers, insufficiently weighted ballast, significant pressure loss (greater than 1 psi over 60 seconds).
 - 2. Minor defects shall be considered all other defects that would not materially affect the intended life, use, or performance of the installed unit. These include but are not limited to: scratches in the finish, bare patches in the paint, minor variation in fine bubble diffuser levelness, minor pressure loss (less than 1 psi over 60 seconds), etc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lagoon areas and conditions, with Installer present, for compliance with requirements for the installation of the aeration system and other conditions affecting performance of the Work. Examine aeration system components before installation. Reject components that are damaged. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. CONTRACTOR shall install and adjust equipment in accordance with the Drawings, approved shop drawings, and the manufacturer's instructions. Do not operate the equipment until the installation is approved by the manufacturer's representative.
- B. Prior to connecting the aeration units to the feeder tubes, CONTRACTOR shall clean all piping, headers, and accessories through which air is delivered, so that all dust, dirt, oil, grease, or other foreign material will be effectively removed from contact with the air being blown through the diffusers. This cleaning shall be done with clean water at a velocity of 2 to 3 feet per second.
- C. CONTRACTOR shall check installation prior to start-up for conformance to manufacturer's instructions. Adjust or modify equipment to ensure proper operation.

3.3 FIELD QUALITY CONTROL

- A. TESTS AND INSPECTIONS:
 - 1. General: After the installation of aeration equipment in the lagoons is complete and the installation is certified by the equipment manufacturer, field acceptance tests shall be conducted. The test procedures shall be generally as specified herein; specific written test procedures shall be submitted by the CONTRACTOR for review and approval by the ENGINEER. The field acceptance tests shall be conducted by the CONTRACTOR under the direct supervision of the equipment manufacturer.
 - 2. After the air distribution system is flushed, it shall be pressure tested by the CONTRACTOR to 20psi for one minute to ensure no leakage is present.

3. Level Test: The lagoons shall be full to the tops of the diffusers. The level of the diffusers shall then be checked to ensure that they are at the same elevation, within +/- 3 inches.
 4. Air Leakage: the aeration system shall be turned on and the header pipe shall be observed for leakage. All leaking joints shall be repaired or replaced.
- B. TEST RESULTS: If the equipment fails a field acceptance test, repairs, revisions or replacement of equipment shall be made as deemed necessary by the ENGINEER.
- C. Prepare test and inspection reports.

3.4 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: Present at Project site or classroom designated by OWNER, as required to provide installation assistance and inspection, functional and performance testing, facility startup, and post-startup training of OWNER's personnel:
- B. Services Provided:
1. Approve installation before operation.
 2. Furnish start up services.
 - a. Furnish test forms, and procedures for field testing.
 - b. Inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 3. Furnish training of OWNER'S personnel at such times requested by OWNER.
 4. Revisit job site within 14 calendar days of startup, if necessary, to correct any additional manufacturing defects to satisfaction of ENGINEER.

3.5 FACILITY STARTUP

- A. After initial startup under the supervision of a qualified representative of the manufacturer, a preliminary "running-in" period will be provided for the MANUFACTURER, per the Contract Documents, to make field tests and necessary adjustments.
- B. Contractor shall place each piece of equipment in the system in operation until the entire system is functioning. All components shall continue to operate without alarms or shut downs, except as intended, for five (5) consecutive days to be considered started up.
- C. Operator shall operate the equipment through the design performance range consistent with available flows. Adjust, balance, and calibrate and verify that the equipment, safety devices, controls, and process system operate within the design conditions. Each safety device shall be tested for proper setting and signal. Response shall be checked for each equipment item and alarm. Simulation signals may be used to check equipment and alarm responses.
- D. Prepare manufacturer's installation report and submit within 30 days after completion of field testing. Including the following information:
1. Field testing results.
 2. Descriptions of installation deficiencies not resolved to the manufacturer's satisfaction.
 3. Description of problems or potential problems.
 4. Names of the OWNER'S personnel who attended operations and maintenance training sessions.
 5. Record copy of materials used for training session including outlined summary of course.
 6. Manufacturer's Certificate of Installation and Certificate of Performance.
- E. At the end of the specified period of operation, the aeration system will be accepted if, in the opinion of the ENGINEER, the system has operated satisfactorily.

3.6 FIELD TESTING

- A. The Field Testing specified in this Section shall be conducted in addition to any testing procedures as required by the equipment Manufacturer and as specified in separate Sections herein.
- B. General: Contractor shall perform and furnish to Engineer and Owner a Certificate of Proper Installation (CPI), a Functional Acceptance Test (FAT), Performance Acceptance Test (PAT), and Reliability Acceptance Test (RAT), in the presence of the equipment manufacturer's qualified field service representative as specified.

- C. The following tests will be required:
1. Certificate of Proper Installation (CPI): Prior to system start-up, all equipment covered under this Specification shall be confirmed to have been installed in accordance with Manufacturer's instructions and ready for run testing. CPI shall be performed by Manufacturer's start-up representative/technician.
 2. Functional Acceptance Test (FAT): Prior to system startup, all equipment covered under this Specification will be inspected for proper alignment, proper connection, and proper function by means of a startup check. The FAT shall be performed in the presence of and with assistance from the equipment Manufacturer's start-up representative/technician.
 3. Performance Acceptance Test (PAT): After completing the Functional Acceptance Test, the equipment Manufacturer's start-up representative/technician shall conduct a Performance Acceptance Test, in the presence of the Contractor, in order to verify that the equipment item or system performs according to the requirements identified in Part 2 – MATERIALS of this Specification.
 4. Reliability Acceptance Test (RAT): Completion of the Reliability Acceptance Testing shall be required prior to placing the specified equipment into service and prior to the Owner assuming responsibility for said equipment. The RAT shall verify that the equipment item or system performs its intended function at the specified performance level for a period of four (4) consecutive 24- hour days without failure. "Failure" as used in this Paragraph shall be defined per the discretion of the Owner based upon the absence of equipment malfunctions and alarms/faults during the RAT testing period.
- D. Installation and Performance certifications shall be submitted per the requirements of Specification Section 013300.10.

3.7 WARRANTY

- A. Aerator Warranty: All equipment and workmanship shall be guaranteed to be free of defects in material and workmanship within the specified warranty period.
1. Warranty Period: One (1) year from date of Substantial Completion.
 2. Any such defects found within the warranty period shall be result in a repaired, replaced, or refunded unit by the manufacturer.

3.8 OPERATION AND MAINTENANCE MANUAL

- A. Contractor shall provide Owner with three (3) copies of an Operation and Maintenance Manual for proper operation and maintenance of the wastewater treatment plant, in accordance with Division 1. The manual shall include description of treatment process and equipment operation; shop drawings, field reports, operation and maintenance procedures, process control guidelines, equipment specifications, schedules, and spare parts information. A recommended list of spare parts shall be provided.

END OF SECTION

SECTION 465333

LAGOON INTERGRATED NITRIFICATION REACTOR

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and technical specification sections, apply to this section.

1.2 SUMMARY

- A. The Owner has pre-selected Triplepoint Environmental through Municipal Equipment Company, Inc. to provide equipment within this specification. No other manufacturers will be accepted.
- B. Contractor shall coordinate with Triplepoint Environmental to coordinate scope. Any items required by this specification that is not in Triplepoint Environmental's scope shall be provided by the Contractor. All coordination of submittals, startup activities, startup assistance, installation of equipment and materials, coordination of power and control wiring and conduits, coordination of piping, and related items shall be the responsibility of the Contractor.
- C. The contractor shall furnish all labor, materials, tools, equipment to perform all work and services necessary for and incidental to the furnishing and installation of a complete Lagoon Integrated Nitrification Reactor, complete and ready for operation in accordance with the provisions of the contract documents.
- D. This Section includes the following:
 - 1. All expertise, process design work, and equipment necessary to integrate an external Nitrification Reactor with a wastewater lagoon.
 - a. Ares 750 T aerators
 - b. High surface area media
 - c. Media retention sieves
 - d. Duckbill check valves
 - e. Air supply blowers
 - f. Fixed insulated covers
 - g. Immersion tank heaters and controls
 - h. Process integration control panel
- E. Related Sections include the following:
 - 1. Section 465332 Lagoon Aeration System

1.3 SUBMITTALS

- A. The following, at a minimum, shall be submitted for the various equipment items and systems included in these specifications:
 - 1. Shop and submittal drawings in AutoCAD format, including detailed dimensional drawings. Drawings shall show materials of construction, assembly, accessories, installation details/specifications and electrical requirements.
 - 2. A summary of biological process design calculations for the nitrification system.
 - 3. Special shipping, storage and protection, and handling instructions
 - 4. Manufacturers instructions for installation
 - 5. Manufacturer's product data for all aeration blowers, including blower curves and calculations showing how discharge conditions were determined for each blower.
 - 6. Control panel schematics, control panel and field wiring diagrams and manufacturer's catalog information for each panel component.
 - 7. Manufacturer's product data for immersion heater equipment, including wiring diagrams.
 - 8. O&M

1.4 QUALITY ASSURANCE

- A. The Drawings and Specifications are based on a post lagoon nitrification reactor, also known as NitrOx Process, designed by Triplepoint Environmental LLC, with offices located at 1010 Lake Street, Suite 503, Oak Park IL 60301.

- B. All necessary equipment, controls and engineering within the scope of supply stated in Section 2.1 that are needed to achieve the performance standards stated in section 1.5 below, shall be supplied by one manufacturer. The Owner has pre-selected the NitrOx Process equipment, provided by Triplepoint Environmental.
- C. Supplier Qualifications:
 - 1. All equipment should be the product of a supplier having at least ten (10) North American installations with a post-lagoon nitrification reactor.
 - 2. At least five (5) years of demonstrated operating experience with MBBRs.
- D. The manufacturer shall be regularly engaged in the design; manufacture, assembly and production of equipment of the type specified and shall have complete responsibility for the final design and furnishing of all process equipment components in the system within the manufacturers scope of supply.
- E. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation supervision of units required for this Project.
- F. Source Limitations: Equipment of each type specified in this section shall be supplied by a single manufacturer. This does not require that all equipemnt be manufactured by a single manufacturer but does not required that the manufacturer of the system shall be responsible for the complete system.
- G. The Nitrification Reactor must utilize self-cleaning random dump HDPE media. Rigid or stone media will not be accepted. The reactor must also be easily drained and aerators accessed for ease of inspection and/or maintenance.

1.5 NITRIFICATION SYSTEM PERFORMANCE REQUIREMENTS

- A. The treatment system shall be designed to treat the influent flow rates:
 - 1. Average Daily Flow to NitrOx = 470,000 GPD
 - 2. Peak Daily Flow Rate to NitrOx = 864,000 GPD
 - 3. Peak Hourly Flow Rate to NitrOx = 1,152,000 GPD
- B. The treatment system shall also be designed to hydraulically pass a peak hourly flow of 1,728,000 gpd.
- C. The nitrification system is designed to accept flow after the lagoons have pre-treated the influent BOD/TSS to levels described herein. The wastewater from the primary treatment lagoon cells will then be enter the nitrification reactors for the removal of ammonia. The effluent then flows into a final polishing cell prior to UV disinfection and discharge.
- D. The nitrification system shall be designed on the basis of the Moving Bed Biofilm Reactor process, utilizing the established treatment kinetics for sizing calculations the system.
- E. The lagoon cell aeration and nitrification system components shall collectively be designed to treat the plant raw wastewater influent concentrations as indicated in the Drawings Design Criteria Table and meet the following effluent requirements below. Maximum influent concentrations for the nitrification system shall be based on plant raw wastewater influent concentrations to achieve these maximum influent concentrations for the nitrification system and shall be the responsibility of the supplier, Triplepoint Environmental.
 - 1. Permitted Effluent Required Concentrations
 - a. BOD, 5-Day Summer/Winter 30 mg/L
 - b. Total Suspended Solids (TSS) 30mg/L
 - c. Ammonia (NH3) (January) 3.1 mg/L
 - d. Ammonia (NH3) (February) 2.7 mg/L
 - e. Ammonia (NH3) (March) 2.7 mg/L
 - f. Ammonia (NH3) (April) 2.3 mg/L
 - g. Ammonia (NH3) (May) 1.9 mg/L
 - h. Ammonia (NH3) (June) 1.5 mg/L
 - i. Ammonia (NH3) (July) 1.1 mg/L
 - j. Ammonia (NH3) (August) 1.3 mg/L

- k. Ammonia (NH₃) (September) 1.7 mg/L
- l. Ammonia (NH₃) (October) 2.6 mg/L
- m. Ammonia (NH₃) (November) 3.1 mg/L
- n. Ammonia (NH₃) (December) 2.7 mg/L
- o. Oil & Grease 10 mg/L
- p. pH (minimum) 6.5 SU
- q. Alkalinity Residual 50 mg/L

- F. The nitrification system will be designed on the assumption that the wastewater does not contain any threshold concentration of inorganic pollutants or other such materials, solutions, or product that are inhibitory to biological treatment processes.
- G. Influent wastewater going into the nitrification reactors shall not contain solids in excess of 1/2" in diameter.
- H. The reactor tanks shall be designed for no more than 20% media fill.

PART 2 PRODUCTS

2.1 MANUFACTURERS SCOPE OF SUPPLY

- A. The manufacturer shall supply all process equipment and design necessary to achieve the performance standards stated in Section 1.5 of this includes:
 - 1. Air supply blowers
 - 2. High surface area media
 - 3. Ares 750T aerators
 - 4. Heavy flex tubing
 - 5. Ball valves, fittings, and manifolds
 - 6. Media retention sieves
 - 7. Duckbill check valves
 - 8. Fixed insulated tank covers
 - 9. Immersion tank heaters
 - 10. System control panel
 - 11. Shop drawings and process engineering design

2.2 AERATORS

- A. Each nitrification reactor tank shall have Ares® 750T aerators designed to completely mix and aerate the contents of the basins.
- B. The aerators shall be designed such to provide enough oxygen and mixing necessary to accomplish the performance objectives.
- C. All aeration piping within the wastewater treatment plant shall be type 304 stainless steel pipe and fittings except as may be noted otherwise in other sections of the specifications or called for on the plans.
- D. The aerators shall be designed with sufficient distribution so that mixing prevents deposition of solids in any part of the basin, including near basin corners or incidental structural components. This will ensure no progressive buildup of solids exists or is such that process can be adversely affected.
- E. To ensure maximum retention, enhance spiral rotation and eliminate short-circuiting of raw sewage, the aerators shall be evenly spaced as shown on the Drawings.
- F. Aeration piping shall have an integrated purge line for purging of any accumulated water that may enter the system.
- G. Ensure that diffusers are of proven non-clog design with no moving parts. Equip each aerator with orifices to ensure adequate air distribution.
- H. Included in the scope of supply for the aerators are the following:
 - 1. The Manufacturer will supply twelve (12) Ares® 750T aerators in the tanks with twelve (12) guide rails and retrieval chains and all piping starting at the 4-inch by 2.5-inch reducer

tapping off the main air header pipe from the blowers as shown on the Drawings. Piping shall include a minimum of 300 feet of heavy flex tubing.

2. All other header piping connecting to the blowers external to the tanks shall be provided by the Contractor along with riser pipes, pipe supports at the top of the tanks and along the 4-inch header pipe.
- I. Contractor shall furnish supports of same material type as pipe; however, supports may be circular, rectangular, or rolled angle cross section with minimum wall or web thickness of 0.25inch.
 1. Ensure supports provide for cradle with minimum 1-inch wide bearing surface to support pipe for at least 90-degree arc.
 2. Provide minimum 1/2-inch diameter stainless steel expansion anchor supports to floor of basin.
 3. Ensure supports are adjustable +/- 2-inch vertically and +/- 1/2-inch laterally for alignment of piping.
 4. Design for expansion and contraction of entire piping system.
 5. Design temperature range shall 125 deg F.
 6. Design supports with a maximum spacing of 15 ft on center.

2.3 HIGH SURFACE AREA WAFER MEDIA

- A. High surface area wafer media shall be supplied to provide enough surface area for nitrifying bacteria to grow and achieve nitrification as per the performance standards.
- B. Media shall be manufactured of durable high-density polyethylene and be resistant to a wide range of aqueous solutions, acids, alkalis, oxidizing agents, oils, fats and alcohols.
- C. Media shall allow for a high concentration of microorganisms to thrive within the internally protected areas and significant void space to eliminate biomass plugging and allow for transfer of oxygen and nutrients to the biofilm. Each media piece shall be up to 1-inch in diameter and a minimum effective surface area of 1,800 m²/m³ for bacteria growth.
- D. The media shall have a specific gravity of 0.90 to 1.05 to allow it to float freely in the water column where the bacteria can gain access to food and oxygen.
- E. The media fill percentage shall be designed to allow for right density such that the aeration can sufficiently turbulate and allow for anti-clogging effect whereby biomass cannot build up on the pieces and hinder the process.

2.4 MEDIA RETENTION SIEVES

- A. Media retention sieves shall be installed as shown on the Drawings to prevent high surface area media from flowing out of each tank.
- B. The sieves will be 12-inch flange mounted and constructed of Type 304 Stainless Steel.
- C. The openings on the sieves shall be fine enough to prevent media migration and coarse enough to allow up to 0.563-inch diameter solids to enter from the lagoon.
- D. The sieves shall be designed to create a maximum head loss of 0.2-feet at peak hourly flowrate.
- E. Duckbill check valves Proco Products, Inc. Proflex Series 710/730 Light Weight shall be provided as shown on the Drawings to retain media in each tank. Maximum headloss of 0.39-feet at peak hourly flowrate.

2.5 AIR SUPPLY BLOWERS

- A. Air supply blowers shall be provided to supply ambient air to the aerators.
- B. The blower units shall be sufficiently sized to provide the air needed to the aerators in order to meet the performance requirements.
- C. There shall be two (2) tri-lobe positive displacement blower units for the NitrOx Tanks, one duty and one standby/backup. Blowers shall be Kaeser DB236C, 25 hp each and on VFDs.
- D. Blower units will be complete with an inlet filter silencer, check valve, gate valve, pressure relief valve and pressure gauge.

- E. The blowers will be located outdoors and shall include a weatherproof noise attenuating enclosure and placed on a concrete pad.
- F. The blower rotors shall be one-piece, ductile iron composition and balanced to the closest tolerances for smooth, efficient operation at all speeds and pressures.
- G. Gears shall be spur-type, case hardened, precision ground timing to minimize vibration and mechanical noise and to ensure optimal timing and improved efficiency.
- H. High efficiency TEFC/IP-55 motors shall be used to minimize energy consumption.
- I. An 80 dBA or less free field guaranteed noise enclosure should be provided for each blower system. The noise enclosure shall be provided with minimum 1" foam and the foam shall comply with UL94-HF 1 for flammability.

2.6 FIXED INSULATED COVERS

- A. A modular fixed insulated cover shall be provided for each tank in order to prevent heat loss of the wastewater in the winter months.
- B. The insulation shall be 2-4" thick and comprise of material designed for thermal insulation. The insulation foam shall be rated for R3 per inch and shall be encapsulated between two layers of 80mil HDPE or equivalent geomembrane material for maximum protection.
- C. Heat loss across the 2 cells shall not exceed 5% from influent to effluent.
- D. The panels shall be supported on the top of the tanks and be anchored to the concrete walls.
- E. The cover will be designed with two (2) panels thereby allowing for one panel to be folded on top of the other to provide access high points on each panel will allow rainwater to flow towards the drain holes and panel joints. A single membrane design will reduce trapped air and water within the panels.

2.7 IMMERSION TANK HEATERS

- A. Three (3) electric immersion heater shall be provided in order to maintain a minimum of 5 degrees centigrade water temperature in the reactor in the event water temperatures dip below that level in winter.
- B. The immersion heater shall be a wall-mounted unit consisting of hairpin bent tubular elements welded or brazed into a flange and provided with wiring boxes for electrical connection.
- C. The heater shall be made of stainless steel sheath elements and riser. It shall be an "over the side" type to allow for future removal should maintenance be necessary.
- D. The tank heater shall have a support system sufficient to stabilize the heater elements in the turbulent tank.
- E. There shall be a K-type thermocouple and thermowell assembly located a minimum of 3' distance from the heater elements. The thermocouple wire must placed in separate conduit needed for electrical wiring in order to avoid signal interference.

2.8 SYSTEM CONTROL PANEL

- A. The Manufacturer will supply a control panel to control the blowers and immersion tank heaters.
- B. The control panel will be mounted outside and shall be enclosed in an outdoor rated NEMA 4X weatherproof enclosure
- C. The panel shall be delivered completely assembled, pre-wired, tested and ready for installation.
- D. The control panel shall have sufficiently sized motor starters for the blowers along with starters for the blower enclosure fans. The enclosure fans shall have a 15 min off delay after the blower is switched off to allow for enclosure cooling.
- E. The control panel shall include a 7-day timer switch that will automatically switch the duty and standby blowers.
- F. The integrated temperature controller shall be able to accept a type-K thermocouple input and have a digital readout with buttons necessary to adjust the minimum temperature setting.

- G. The system control panel shall be compatible with a High Tide panel or equal communication/telemetry system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The nitrification system shall be constructed to the lines and grades as shown on the Drawings.
- B. Installation of the nitrification reactor equipment shall be in accordance with the manufacturer's specifications.
- C. Connect all electrical components in accordance with the requirements provided by manufacturer in submittals.
- D. Manufacturer shall provide the services of a field representative to advise on the nitrification system field installation. The services of the field representative shall include at least one (1) day, exclusive of travel time, and one (1) travel trip during the time that the equipment is being installed. The Contractor shall notify the manufacturer a minimum of ten (10) working days prior to the time that the field services are desired.

3.2 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall furnish all labor, materials, tools, equipment to perform all work and services necessary for and incidentals to the furnishing and installation of a complete Lagoon Integrated Nitrification Reactor, complete and ready for operation in accordance with the provisions of the contract documents.
- B. The Contractor is responsible for the construction of poured in place rebar reinforced concrete tanks as per the plans and concrete specifications. The manufacturer shall size them sufficiently to accomplish the performance requirements stated herein.
- C. The reactor tanks shall be fabricated of rebar reinforced concrete and be of sufficient thickness and strength to hold the necessary volume of wastewater as per the plans.
- D. Contractor is responsible for any hardware that is not explicitly stated as provided in this spec, including but not limited to bolts, gaskets, seals, anchors etc.
- E. Contractor is responsible ensuring screen wall connections are completely sealed so that no media will bypass screen openings.
- F. Contractor shall provide power necessary to operate the nitrification system.

3.3 START-UP AND TRAINING SERVICES

- A. The Contractor shall notify manufacturer when the installation of the nitrification equipment has been completed. A representative of the supplier shall inspect the installation prior to any media fill. Manufacturer shall advise the Contractor, Owner, and Engineer in writing of any corrections or adjustments that are required for the wastewater treatment plant equipment installation. After the wastewater treatment plant installation has been completed to the supplier's satisfaction, manufacturer shall furnish to the Contractor, Owner, and Engineer a letter of certification that all equipment is installed in accordance with its instructions and that the wastewater treatment plant is ready for operation.
- B. Upon receipt of a letter from the Contractor certifying that the wastewater treatment plant installation is ready for start-up, manufacturer shall provide the services of a field person. Time of trip shall be coordinated with Owner. The field person shall do a functional check of each item furnished by the manufacturer, and start-up of the process. During this time, the field representative will provide hoperation training for Owner's personnel, which shall include familiarization with the wastewater treatment plant process, its requirements, and review of the Operation and Maintenance manuals

3.4 WARRANTY

- A. The Contractor shall provide a one (1) year warranty to warranty the labor and installation of the nitrification equipment.

- B. The Contractor shall provide the services of a representative of the manufacturer to provide an inspection of the wastewater treatment plant eleven (11) months after substantial completion. The purpose of the inspection shall be to determine that the plant is properly operating and continuously meeting discharge permit requirements as outlined in these specifications. The cost of testing to determine that permit conditions are being met during inspection shall be the responsibility of the Contractor. The Contractor shall provide a written report to the Engineer and Owner certifying that the plant is operating properly and meeting permit requirements at the conclusion of this inspection and prior to the expiration of the one-year warranty period.

3.5 OPERATION AND MAINTENANCE MANUAL

- A. Contractor shall provide Owner with three (3) copies of an Operation and Maintenance Manual for proper operation and maintenance of the wastewater treatment plant. The manual shall include description of treatment process and equipment operation; shop drawings, field reports, operation and maintenance procedures, process control guidelines, equipment specifications, schedules, and spare parts information. A recommended list of spare parts shall be provided.

END OF SECTION

APPENDIX A

TRIPLEPOINT PRE-SELECTED EQUIPMENT



Aeration & NitrOx Basis of Design

Date: 01/04/2022

Project Name: Moberly Correctional Center, MO

Project Number: 2947

The Aeration Process

Biological Oxygen (BOD) Calculations

Removal of BOD (and CBOD) takes place naturally in an aerated lagoon. The Characteristic Equation for treatment efficiency of 5-Day Biological Oxygen Demand is given in Equations 1 through 3, at bottom of report. These calculations are used to size the lagoons. They are independent of the aeration calculations and assume that sufficient dissolved oxygen levels are maintained in the water. The equation is dependent on time and temperature. For lagoons operated in series, the equation is applied separately to each cell and the results are combined.

Aeration Requirement Calculations

Aeration calculations are more complicated than biological calculations as they depend on several factors. These include:

- Site conditions, such as treatment depth, elevation, and temperature.
- Design parameters, such as minimum dissolved oxygen (DO) level and oxygen supply rate.
- Actual Oxygen Requirement (AOR) which is based on the nutrient loading rates (these can include BOD/CBOD and TKN/NH₃-N and are based on the product of nutrient concentrations and the wastewater flow-rate).
- Type of aerator
- Oxygen transfer efficiency (OTE) of the aerator, which should be measured by an independent lab.
- Field condition adjustments (see Equation 2, below).
- Mixing requirements, such as complete or partial mix. The former is generally only required for activated sludge basins (ASB) or other high strength processes with short detention times.

Aerated Lagoons - Long Treatment Times

Aerated lagoons are typified by their comparatively large size and long treatment times (usually greater than 10 days). Influent concentrations are low to moderate (usually less than 300 mg/L of BOD). The bulk of the treatment takes place aerobically with additional anaerobic respiration taking place on the lagoon floor. Aerated lagoons do not generally have a mixed liquor suspended solids (MLSS) or return activated sludge (RAS) component. Partial mixing is required to prevent stratification and eliminate dead-zones; however, complete mix is not necessary.

Aerated lagoons are typically designed to operate at a minimum DO level of 2 mg/L. Oxygen is usually supplied at a rate of 1.5 times the BOD demand. If nitrification/denitrification takes place, the oxygen supply rate is designed for 4.6 times the nitrogenous oxygen demand (NBOD).

Activated Sludge Basins (ASB)

Activated sludge basins (ASB) and other related wastewater tanks and lagoons are characterized by short treatment times (usually from 1 to 5 days), high wastewater strengths, and an active biomass that must be maintained in suspension to prevent rapid sludge accumulation. A high strength (greater than 2,000 mg/L) return activated sludge (RAS) component is usually fed back into the basin from a downstream clarifier. Biological nutrient removal is much faster in these basins.

ASBs are typically designed to operate at a minimum DO level of 1 to 2 mg/L. Oxygen is supplied at a rate of 1.0 to 1.5 times the BOD demand. If nitrification/denitrification takes place, the oxygen supply rate is designed for 4.0 to 4.6 times the nitrogenous oxygen demand (NBOD). Aeration system is based on both oxygenation requirements and complete mix requirements, whichever is greater.

TRIPLEPOINT ENVIRONMENTAL Detailed Design Calculations: Aeration Moberly Correctional Center, MO

SUMMARY - General Design Parameters

v4.0	Design Scenario Name		Design W Sludge`
1	Influent Flowrate	MGD	0.470
2	Influent Concentration	mg/L	250.0
3	Effluent Conc. (Summer)	mg/L	2.2
4	Effluent Conc. (Winter)	mg/L	8.3
5	Actual Oxygen Supplied	lb/day	1561.3
6	Air included for nitrification?		No
7	Number of Aerators		45
8	Estimated Tubing Length	ft	500
9	Standard Airflow	SCFM	1629.85
10	Inlet Airflow	ICFM	1913.00
11	Design Pressure (w/cushion)	psig	5.15
12	Projected Brake Hp	bhp	37.20
13	Estimated Design Hp	hp	75.0

- $$FTE = \alpha (SOTE) \theta^{(T-20)} (\beta C^*_{\infty T} - DO) \div C^*_{\infty 20}$$

field transfer efficiency

Where,

 - α contaminant factor {contaminants, depth, bubble-size} (range: 0.40 – 0.70)
 - β TDS factor {total dissolved solids} (range: 0.90-1.00)
 - $\theta = 1.024$ temperature factor
 - DO target dissolved oxygen level (mg/L)
 - $C^*_{\infty T}$ saturation oxygen concentration at site – adjusted for water depth
 - $C^*_{\infty 20}$ sat. oxygen concentration at STP conditions – adjusted for water depth
 - T water temperature (Celsius)
- Airflow = AOR / (25.056 * FTE)
- $$E = 2.3 * k * t / (1 + 2.3 * k * t)$$

biological treatment efficiency

Where,

 - k = varies kinetic coefficient {related to temperature} (range: 0.06 to 0.12)
 - t = time treatment time in days

SUMMARY - Biological Treatment Calculations

	Item	Description	Units	Design W Sludge
	1	Number of Treatment Cells		2
	2	Flow Regime		Series
	3	Site Elevation - HWL	ft	865
Cell 1	4	Wastewater Flowrate	MGD	0.5
	5	Treatment Volume	M-Gal	11.7
	6	Treatment Time	days	24.9
	7	Treatment Type	-	Partial Mix
	8	Std Reaction Rate, k_{20}	days ⁻¹	0.28
Summer	9	Design Water Temp	°C	20
	10	Design Reaction Rate, k_T	days ⁻¹	0.122
	11	Biological Treatment Eff.	%	87.4%
	12	Influent BOD Loading	lb/day	979
	13	Influent BOD Concentration	mg/L	250.0
	14	BOD Removed	lb/day	856
	15	Effluent BOD Loading	lb/day	123
	16	Effluent BOD Concentration	mg/L	31.4
Winter	17	Design Water Temp	°C	0.5
	18	Biological Treatment Eff.	%	77.7%
	19	BOD Removed	lb/day	760.9
	20	Effluent BOD Concentration	mg/L	55.6
	N1	Influent NBOD Loading	lb/day	117
	N2	Influent NBOD Conc.	mg/L	30.0
	N3	Assumed NBOD Removed	lb/day	-
	N4	Effluent NBOD Loading*	lb/day	117
	N5	Assumed Eff. NBOD Conc.	mg/L	30
Cell 2	21	Wastewater Flowrate	MGD	0.5
	22	Treatment Volume	M-Gal	14.4
	23	Treatment Time	days	30.6
	24	Treatment Type	-	Partial Mix
	25	Std Reaction Rate, k_{20}	days ⁻¹	0.28
Summer	26	Design Water Temp	°C	20
	27	Design Reaction Rate, k_T	days ⁻¹	0.122
	28	Biological Treatment Eff.	%	89.5%
	29	Influent BOD Loading	lb/day	123
	30	Influent BOD Concentration	mg/L	31.4
	31	BOD Removed	lb/day	110
	32	Effluent BOD Loading	lb/day	13
	33	Effluent BOD Concentration	mg/L	3.3
Winter	34	Design Water Temp	°C	0.5
	35	Biological Treatment Eff.	%	81.1%
	36	BOD Removed	lb/day	176.6
	37	Effluent BOD Concentration	mg/L	10.5
	N6	Influent NBOD Loading	lb/day	117
	N7	Influent NBOD Conc.	mg/L	30.0
	N8	Assumed NBOD Removed	lb/day	-
	N9	Effluent NBOD Loading*	lb/day	117

	N10	Assumed Eff. NBOD Conc.	mg/L	30
Cell 3	38	Wastewater Flowrate	MGD	0.5
	39	Treatment Volume	M-Gal	0.9
	40	Treatment Time	days	1.8
	41	Treatment Type	-	Partial Mix
	42	Std Reaction Rate, k_{20}	days ⁻¹	0.28
Summer	43	Design Water Temp	°C	20
	44	Design Reaction Rate, k_T	days ⁻¹	0.122
	45	Biological Treatment Eff.	%	34.0%
	46	Influent BOD Loading	lb/day	12.9
	47	Influent BOD Concentration	mg/L	3.3
	48	BOD Removed	lb/day	4
	49	Effluent BOD Loading	lb/day	8.48
	50	Effluent BOD Concentration	mg/L	2.2
Winter	51	Design Water Temp	°C	0.5
	52	Biological Treatment Eff.	%	20.6%
	53	BOD Removed	lb/day	8.5
	54	Effluent BOD Concentration	mg/L	8.3
	N11	Influent NBOD Loading	lb/day	117
	N12	Influent NBOD Conc.	mg/L	30.0
	N13	Assumed NBOD Removed	lb/day	-
	N14	Effluent NBOD Loading*	lb/day	117
	N15	Assumed Eff. NBOD Conc.	mg/L	30

SUMMARY - Aeration Calculations

	Item	Description	Units	Design W Sludge	
	1	Site Elevation	ft	865	
	2	O ₂ Loading Factor (BOD ₅)	O ₂ /BOD	1.5	
	3	Alpha-value, α		0.50	
	4	Beta-value, β		0.95	
	5	Theta-value, θ		1.02	
Cell 1	6	Lagoon Side Water Depth	ft	5.90	
	7	Air Release Depth	ft	5.15	
	8	AOR - Total	lb/day	1284	
	9	SOTE/ft	%/ft	2.13%	
	10	SOTE	%	10.97%	
	11	Design DO Concentration	mg/L	2.0	
	12	FTE		3.75%	
	13	Air requirement	scfm	1368	
	14	Airflow per aeration unit	scfm	36.0	
	15	Aerator Type		750T	
	16	Number of aeration units	units	38	
		17	Water Pressure	psig	3.14
		18	Aerator Pressure Loss	psig	0.55
		19	Header/Feeder P Loss	psig	0.44
		20	Total Operating Pressure	psig	4.13
		21	Design Motor Pressure	psig	5.13
Cell 2	22	Lagoon Side Water Depth	ft	6.80	
	23	Air Release Depth	ft	6.05	
	24	AOR - Total	lb/day	265	
	25	SOTE/ft	%/ft	2.06%	

	26	SOTE	%	12.44%
	27	Design DO Concentration	mg/L	2.0
	28	FTE		4.27%
	29	Air requirement	scfm	248
	30	Airflow per aeration unit	scfm	41.3
	31	Aerator Type		750T
	32	Number of aeration units	units	6
	33	Water Pressure	psig	3.14
	34	Aerator Pressure Loss	psig	0.56
	35	Header/Feeder P Loss	psig	0.45
	36	Total Operating Pressure	psig	4.15
	37	Design Motor Pressure	psig	5.15
Cell 3	38	Lagoon Side Water Depth	ft	5.60
	39	Air Release Depth	ft	4.85
	N5	AOR - BOD	lb/day	13
	N6	AOR - NBOD	lb/day	0
	40	AOR - Total	lb/day	13
	41	SOTE/ft	%/ft	2.15%
	42	SOTE	%	10.44%
	43	Design DO Concentration	mg/L	2.0
	44	FTE		3.56%
	45	Air requirement	scfm	14
	46	Airflow per aeration unit	scfm	14.2
	47	Aerator Type		750T
	48	Number of aeration units	units	1
	49	Water Pressure	psig	3.14
	50	Aerator Pressure Loss	psig	0.55
	51	Header/Feeder P Loss	psig	0.44
	52	Total Operating Pressure	psig	4.12
	53	Design Motor Pressure	psig	5.12

The NitrOx™ Process

The patented NitrOx Process was developed based on the principle that nitrification will reliably occur when the proper conditions are created. For wastewater lagoon systems that receive primarily domestic waste, the critical conditions required for nitrification include:

1. **CBOD** of 20-30 mg/L
2. **Dissolved oxygen** of 4.6 lb/O₂ per pound of NH₃-N (Metcalf & Eddy)
3. **Sufficient Population of Nitrifying bacteria**
4. Given sufficient Nitrifying bacteria, a **water temperature of 4-5 °C**

NitrOx Process utilizes the existing lagoon infrastructure for 90% BOD removal, after which nitrifying bacteria begin to nitrify. The effluent from the lagoons then flows hydraulically or is pumped into a two-stage nitrification reactor. In colder climates where the winter water temperature drops below 4 °C, a thermal regulation heat exchanger is added in order to increase the water temperature; typically, only a few degrees during the coldest months of the year. In the two NitrOx reactor cells, there are millions of individual biofilm carriers that provide a habitat for nitrifying bacteria –ensuring that there are sufficient nitrifying bacteria even in the coldest water conditions. Each Nitrox reactor cell has aeration to provide the necessary oxygen, as well as to create a complete mix environment to keep the biofilm carriers in constant motion. The two cells are covered with floating insulated covers to mitigate heat loss and the media is kept in the tanks with stainless steel sieves. Finally, the effluent from the second NitrOx reactor is discharged into a final polishing/clarification lagoon prior to the ultimate discharge from the lagoon system.

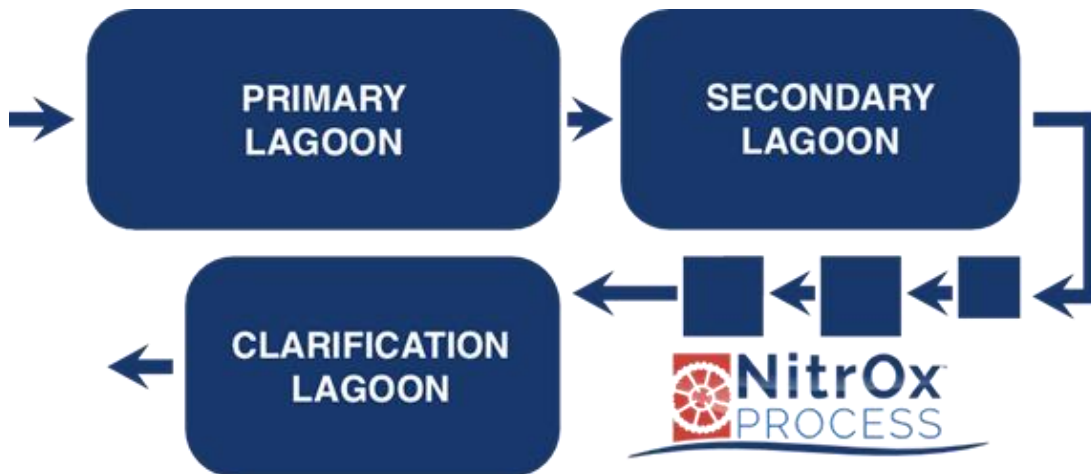


Figure 1: Basic flow process of the NitrOx Lagoon Ammonia Removal Process

TRIPLEPOINT ENVIRONMENTAL
Detailed Design Calculations: NitrOx
Moberly Correctional Center, MO

SUMMARY - Design Input Values

Plant Influent Characteristics		Units	Values
1	Annual Average Daily Flow	gpd	470,000
2	Maximum Monthly Average Daily Flow	gpd	470,000
3	Peak Daily Flow	gpd	1,152,000
4	Peak Hourly Flow	gpd	1,728,000
5	Influent BOD	mg/L	250
6	Influent BOD	lbs/day	980.0
7	Influent TSS	mg/L	300
8	Influent TSS	lbs/day	1,175.9
9	Influent NH3-N	mg/L	15.0
10	Influent NH3-N	lbs/day	58.8
11	Influent TKN	mg/L	30.0
12	Influent TKN	lbs/day	117.6
13	Influent pH		7 to 8
14	Water Temperature	deg-C	12
NitrOx Influent Characteristics		Units	Values
15	Annual Average Daily Flow	gpd	470,000
16	Maximum Monthly Average Daily Flow	gpd	470,000
17	Peak Daily Flow	gpd	864,000
18	Peak Hourly Flow	gpd	1,152,000
19	Influent BOD	mg/L	30
20	Influent TSS	mg/L	30
21	Influent NH3-N	mg/L	21.2
22	Influent TKN	mg/L	21.2
23	Design Influent TKN	mg/L	21.2
24	Influent pH		7
25	NitrOx Water Temperature	deg-C	5

SUMMARY - General Design Parameters

NitrOx Tank Sizing Summary		Units	Values
26	Number of Treatment Trains Proposed		1
27	Number of Tanks Per Train		2
28	Total Number of Tanks		2
29	Length of Each	ft	24.0
30	Width of Each	ft	16.0
31	Side Water Depth of Each	ft	12
32	Tank Height of Each	ft	16
33	Volume of Each	gallons	34,468
34	Volume Total	gallons	68,936
35	Hydraulic Retention Time at Max Month Flow	hours	3.5
36	Hydraulic Retention Time at Peak Hourly Flow	hours	1.4
40	Number of Ares Units per Tank		6
41	Total Number of Ares Units		12
NitrOx Air Requirement (Per Treatment Train)		Stage 1	Stage 2
42	AOR (lbs/day)	305	234
43	Assumed Diffuser Subm. at AWL (ft.)	11.25	11.25

44	Elevation (ft.)	865	865
45	Alpha	0.60	0.60
46	Beta	0.9	0.9
47	Target DO Residual (MBBR Process) (mg/L)	5.0	6.0
48	SOR (lbs/day)	1,249	1,251
49	Target Diffuser Efficiency/ft. Submergence	2.0	2.0
50	Airflow (scfm)	226	226

NitrOx Blower Requirement Summary		Units	Values
51	No. of Blowers		2
52	Airflow Requirement per Blower	scfm	452
53	Airflow per 1,000 scfm	scfm/1,000 cf	49
54	Water Pressure at Air Release Depth	psig	4.87
55	Piping and Diffuser Losses	psig	0.25
56	Cushion	psig	0.75
57	Maximum Design Discharge Pressure	psig	6.37
58	Assumed Overall Efficiency		0.62
59	Approximate BHP Requirement/Blower	bhp	20.0
60	Approximate BHP Requirement Total	bhp	20.0
61	Estimated Nameplate HP / Blower	hp	25
62	Blower Type		Tri-Lobe PD

SUMMARY - Calculated Output Values			
NitrOx Effluent Parameters		Units	Values
63	Effluent SCBOD	mg/L	7.5
64	Effluent SCBOD	lbs/day	29.4
65	Effluent NH3-N in Winter (Monthly Average)	mg/L	2.8
66	Effluent NH3-N in Winter (Monthly Average)	lbs/day	11.0
67	Effluent NH3-N in Summer (Monthly Average)	mg/L	1.3
68	Effluent NH3-N in Summer (Monthly Average)	lbs/day	5.1



Aeration & NitrOx Budgetary Quote

Date: 1-4-2022

Project Name: Moberly Correctional Center, MO

Project Number: 2947

QUOTE TO:

Drew Hess
 Municipal Equipment Company, Inc.
 Phone Number: (314) 290-2976
 Email: dhess@munequip.com

PREPARED BY:

Ben Shakman
 Triplepoint Environmental LLC
 Phone Number: (314) 873-7141
 Email: ben@lagoons.com

AERATION EQUIPMENT

Ares Aeration Equipment – DESIGN w/SLUDGE

- Designed to treat an average daily flow of 470,000 GPD
- Designed to supply 1561.3-lb of Oxygen Per Day.
- Capable of supplying air at 1629.85 SCFM at 5.15 PSI.
- **Total Cost: \$343,750.**

Standard Package	Quantity	Unit
750T Aerator	45	ea
1.5" Barbed Fittings: Stainless Steel	45	ea
1.5" Weighted Flexible Tubing	500	ft
1.5" Full Port Ball Valve & Fittings	45	ea
Estimated Duty Blower: Excelsior 75 HP	1	ea
Blower Starter Panel: NEMA 4X	1	ea
Orifice Plate: Air Balancing	45	ea
Estimated Redundant Blower: Excelsior 75 HP	1	ea
Spare Diffusers	10	ea

NOT Included: Optional Items

Triplepoint Installation Supervision..... \$2,000.00/day*
 Blower Startup & Training..... \$2,000.00
 Complete Amphibious Aeration Installation Allowance.....\$XX,XXX.00
 Shipping to Site.....To Be Determined

*Minimum (2) days.

NITRIFICATION EQUIPMENT

NitrOx Reactor System Equipment:

- Capable of heating and treating an average daily flow 470,000 GPD.
- Capable of handling an Influent NH3-N up to 21.2 mg/L & BOD of 30 mg/L.
- Capable of producing an Effluent NH3-N of 1.3 mg/L in Summer and 2.8 mg/L in Winter conditions.
- **Total Cost: \$438,300.**

Standard Package	Quantity	Unit
MBBR Media	2	set
Estimated Duty Blower: Excelsior 25 HP	1	ea
Media Retention Sieves: Custom Welded	2	ea
Ares Aeration Units	12	ea
Integrated Electric Heating Unit	3	ea
Control Panel: NEMA 4X	1	ea
Insulated Tank Cover	768	sf
Estimated Redundant Blower	1	ea
Heavy Flex Tubing	300	ft
Manifold	2	ea
Ball Valves & Fittings	12	ea
Guiderails & Retrieval Chain	12	ea

NOT Included: Optional Items

- Danfoss Variable Frequency Drives: NEMA 4X.....\$29,116.00
- DO Probe, Controller & Appurtenances.....\$13,989.29
- Triplepoint Startup & Training.....\$2,000.00/day*
- Blower Startup & Training.....\$2,000.00
- Blower Header System.....To Be Determined
- Shipping to Site.....To Be Determined
- Real Time Monitoring: DO/Temperature Probe.....To Be Determined

*Minimum (2) days.

TERMS & CONDITIONS

Scope of Supply

Triplepoint Environmental will supply all process expertise and equipment as part of this quote. The customer is responsible for the costs associated with the installation and infrastructure needed, including the concrete tanks, pumps (if required), operations building (as needed) and any influent/effluent/connecting piping that may be necessary.

Thermal Regulation

The NitrOx Reactor will achieve nitrification at temperatures water temperatures as low as 4 degrees Centigrade. If the influent water temperature for the reactor is likely to dip below this level in the winter months, a thermal regulation system is necessary to regulate the water temperature in order to guarantee year-round nitrification.

Payment Terms

The quote in this proposal remains valid for a period of 15 days. Fifty percent (50%) is due upon contract acceptance, forty (40%) is due upon offer to ship, and the final ten percent (10%) is due upon startup by Triplepoint's personnel.

Material Cost Escalation

If at any time the cost of materials quoted here significantly increases, through no fault of Triplepoint, the price shall be equitably adjusted by an amount reasonably necessary to cover any such significant increase in the costs of materials. As used herein, a significant cost increase shall mean any increase in cost of materials exceeding 5% experienced by Triplepoint either before or after a Purchase Order is issued. Such increase in material costs shall be documented through quotes, invoices, or receipts. Where the delivery of materials delayed, through no fault of the contractor, as a result of the shortage or unavailability of the materials, contractor shall not be liable for any additional costs or damages associated with such delay(s).

Currency & Taxes

All quotes are in United States Dollars. This price does not include local taxes and/or duties fees/taxes. Sales tax exception certificate must be submitted when applicable. All non-exempt taxes will be self-accessed payable by the customer to the local tax authority.

Design Limitations

The preliminary design(s) presented in this document were calculated with information provided at the time of proposal request. The design is only as good as the information provided. If incorrect or incomplete data was provided, assumptions have been made in order to develop the finished design. Prior to product installation, design properties and considerations must be reviewed and validated by the purchasing parties.

Delivery

All equipment will be delivered within a period of ten (10) to twenty-four (24) weeks. Lead time begins once items have been approved by owner or engineer of record. All packing and shipping costs are FOB ORIGINATION.

Installation Supervision

If included, a Triplepoint certified project manager will provide supervision of installation, inspection, testing, training and startup for a minimum of two (2) days during installation.

Force Majeure

Neither Party will be liable for any default or delay in performing an obligation under this Agreement when caused by strike, riot, war, terrorism, Act of God, generalized lack of availability of raw materials or energy, or other similar circumstances beyond our control.

Recommended Influent Screening

Due to the presence of sanitary wipes and/or other debris in influent collection systems, influent screening is highly recommended. Triplepoint has consistently found that aeration systems of all types collect rags, which ultimately prevent proper operation. Screening down to 1/4" min. is recommended.

Warranty

Triplepoint Environmental warrants your NitrOx and Aeration™ products to be free from defects in material and workmanship for a period of five (5) years from the date of substantial project completion for Municipal applications and a period of two (2) years from the date of substantial project completion for Industrial applications. If a defect is discovered in any of the constituent components covered by this warranty, Triplepoint will repair at our option using new or refurbished components for equal or improved quality. If a suitable repair is not possible, the product will be replaced. All defective parts, assemblies, and products become the property of Triplepoint Environmental. Any soft costs incurred during a warranty claim, including costs associated with removing, shipping and re-installing a warranted component, shall be the responsibility of the customer. Warranty is voided in the event issues are caused due to excessive existing sludge and/or ragging which inhibit proper operation.

Aeration Process Guarantee

Triplepoint Environmental guarantees your Aeration™ process for a period of five (5) years from the date of substantial project completion for Municipal applications. The guarantee assumes site conditions match design conditions and is voided in the event of excessive existing sludge and/or ragging which inhibit proper operation.

NitrOx Process Guarantee

Triplepoint Environmental guarantees your NitrOx™ process for a period of one (1) year from the date of substantial project completion. The guarantee assumes site conditions match design conditions and is voided in the event of excessive existing sludge and/or ragging which inhibit proper operation.

Limits of Liability

Triplepoint Environmental shall not be liable for any loss of profits, business, goodwill, interruption of business, nor for incidental or consequential merchantability or fitness of purpose, damages related to this quote.

Confidentiality Notice

The NitrOx and Aeration™ Processes are the subject of one or more confidential patents or patent applications filed in the United States Patent Office, and may be the subject of one or more confidential foreign patent applications, the customer and any other related parties contracted recognize the importance of maintaining the continued confidentiality of the design of the NitrOx and Aeration Processes. The customer and any other parties contracted all agree that they shall not sell, transfer or disclose any such confidential information relating to the design of the NitrOx and Aeration Processes to any other person, organization, or corporation without the express written authorization of Triplepoint Environmental LLC and pursuant to an enforceable agreement of confidentiality, except as required by law or as necessary in connection with the use, operation, maintenance, repair, or replacement of the system. Additionally, the customer and any other parties contracted all agree to preserve the confidentiality of this proposal and all materials attached and not to distribute or copy such materials for any other party's not previously authorized by Triplepoint.

APPENDIX B

GEOTECHNICAL REPORT



Geotechnical Engineering Report

**Wastewater Tanks
Moberly, Missouri**

October 22, 2021
Terracon Project No. 15215072

Prepared for:

Bartlett & West, Inc.
Jefferson City, Missouri

Prepared by:

Terracon Consultants, Inc.
St. Louis, Missouri

terracon.com

Terracon

Environmental



Facilities



Geotechnical



Materials



October 22, 2021

Bartlett & West, Inc.
1719 Southridge Drive, Suite 100
Jefferson City, Missouri 65109

Attn: Ms. Valerie Holland
P: (573) 659-6714
E: Valerie.holland@bartwest.com

Re: Geotechnical Engineering Report
Wastewater Tanks
US 63 Business
Moberly, Missouri
Terracon Project No. 15215072

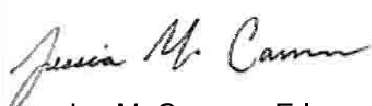
Dear Ms. Holland:


We have completed a Geotechnical Engineering evaluation for the referenced project. This study was performed in general accordance with Terracon Proposal No. P15215072 – Revision 1, dated September 22, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed tanks.

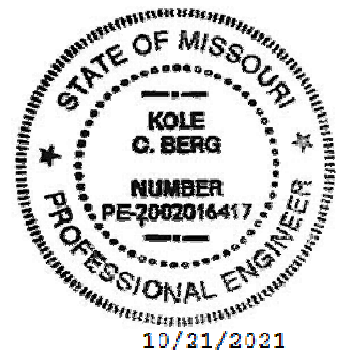
We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.


Jessica M. Cannon, E.I.
Staff Geotechnical Engineer


Kole C. Berg, P.E.
Senior Consultant
Missouri: 2002016417



REPORT TOPICS

INTRODUCTION.....	1
SITE CONDITIONS.....	1
PROJECT DESCRIPTION.....	2
GEOTECHNICAL CHARACTERIZATION.....	3
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LATERAL EARTH PRESSURES	11
GENERAL COMMENTS.....	14

ATTACHMENTS

FIGURES

EXPLORATION AND TESTING PROCEDURES

SITE LOCATION AND EXPLORATION PLANS

EXPLORATION RESULTS

SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Wastewater Tanks

US 63 Business

Moberly, Missouri

Terracon Project No. 15215072

October 22, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed wastewater tanks to be located along US 63 Business in Moberly, Missouri. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Seismic site class per IBC
- Lateral earth pressures


Maps showing the site and boring locations are included in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

The **General Comments** section provides an understanding of the report limitations.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located along US 63 Business in Moberly, Missouri. Latitude: 39.3626°N, Longitude: 92.4312°W See Site Location

Item	Description
Existing Improvements	
Current Ground Cover	Lightly-vegetated
Existing Topography	Based on Google Earth Pro™ , the site slopes downhill towards the south.
Geology	Based on the Geological Map provided by the United States Geologic Survey (USGS), the subject site is located over the Marmaton Group Formation. The Marmaton Group Formation consists of limestone and shale bedrock with smaller amounts of sandstone and coal.

PROJECT DESCRIPTION

Item	Description
Project Description	The project includes the construction of wastewater tanks in series, south of the existing lagoon. We understand 2 scenarios are under consideration. The first includes two tanks each 22.5 feet by 15 feet by 15 feet deep. The second includes one tank with the dimensions of 32 feet by 32 feet by 12 feet deep with the third boring will have a UV equipment pad that is approximately 20 feet by 6 feet. The top of the tanks is assumed to be 3 feet above grade.
Maximum Loads (estimated by Terracon)	<ul style="list-style-type: none"> ■ Walls: 3 klf ■ Floor: 1,200 psf
Grading/Slopes	Slopes are anticipated to be flatter than 3H:1V with a maximum height of 3 feet.
Below-Grade Structures	Based on the information provided, we anticipate the floors of the tanks will be at a maximum depth of about 15 feet below existing grades.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, and geologic setting. This characterization, termed GeoModel, forms the basis of our geotechnical analyses. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs and GeoModel can be found in the **Exploration Results** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	Existing Fill	Fat clay with trace amounts of sand
2	Lean and Fat Clay Soils	Lean clay (CL) with varying amounts of silt and sand; fat clay (CH) with varying amounts of sand
3	Sandy Lean Clay	Sandy lean clay (CL) with trace amounts of gravel
4	Sand	Silty sand (SM)

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**.

Groundwater was encountered in Boring B-2 at a depth of 33.5 feet while drilling and at the completion of drilling. Groundwater was not encountered in Borings B-1 and B-3. This does not necessarily mean these borings terminated above groundwater or the water level encountered in Boring B-2 is a stable groundwater level. Due to the low permeability of the clay soils encountered in the borings, a relatively long period of time may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be different from the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Existing Fill

Existing fill was encountered to a depth of about 6 feet in Boring B-3. The fill could extend deeper in areas not explored. No documentation or records regarding the placement of this fill were provided for our review.

Foundations for the new structures should not bear on or above the undocumented fill materials. The existing fill should be removed and replaced so that the foundations for the new structures bear on suitable native soils or on properly placed and compacted engineered fill extending to suitable native soils. Fill should be removed from below the proposed structure footprint and laterally at least 5 feet outside the perimeter.

Soft Subgrade

The near surface soils consist of clay which could become unstable when subjected to typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the wetter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

EARTHWORK

Earthwork will include clearing and grubbing, excavations, and fill placement.

Site Preparation

In existing vegetated areas of the site, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed structure areas. Organic soils removed during site preparation should not be used as fill beneath the proposed new structure areas.

We recommend that the exposed subgrade be thoroughly evaluated by the Geotechnical Engineer prior to placement of new fill. The soils on the site are sensitive to disturbance from construction equipment traffic, particularly during wet periods. Excessively wet or dry material should either be removed or be moisture conditioned and recompacted. The exposed subgrade should be proofrolled where possible to aid in locating loose or soft areas. Proofrolling can be performed with a loaded, tandem-axle dump truck. If unsuitable areas are observed during

construction, subgrade improvement will then be necessary to establish a suitable subgrade support condition. Potential subgrade stabilization techniques are discussed below.

- **Scarification and Recompaction** – It may be feasible to scarify, dry, and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades would likely not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.
- **Crushed Stone** – The use of crushed stone or gravel is the most common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 6 to 30 inches below finished subgrade elevation with this procedure. The use of high modulus geosynthetics (i.e., geotextile or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the geosynthetic, we recommend that all below-grade construction, such as utility line installation, be completed to avoid damaging the geosynthetic. Equipment should not be operated above the geosynthetic until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over the geosynthetic should meet the manufacturer's specifications, and generally should not exceed 1½ inches.
- **Chemical Stabilization** – Improvement of subgrades with portland cement, lime, lime kiln dust (Code L), or Class C fly ash could be considered for improving unstable soils. Chemical modification should be performed by a prequalified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the Geotechnical Engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, evaluating various stabilizing agents, the optimum amounts required, the presence of sulfates in the soil, and freeze-thaw durability of the subgrade. For estimating purposes, typical incorporation rates for chemical treatment (on a dry soil unit rate basis) are:
 - 3 to 5 percent for hydrated lime, by weight;
 - 5 to 7 percent for lime kiln dust (Code L), by weight; or
 - 4 to 6 percent for portland cement, by weight.

Fill Material Types

Compacted structural fill should meet the following material property requirements:

Fill Type ¹	USCS Classification	Acceptable Location for Placement
High Plasticity Material	CH (LL≥70 or PI≥40)	Deeper fill areas, including at least 3 feet below floor slabs and other lightly-loaded structures; at least 2 feet below shallow foundations; and at least 1 foot below pavement base rock
Moderate to High Plasticity Material ²	CH or CL, with 70>LL≥45 or 40>PI≥25	At least 2 feet below floor slabs and other lightly-loaded structures, at least 1 foot below pavement base rock
Granular Material ³	GM, GC, SM, or SC	All locations and elevations
Low Plasticity (LP) Material ⁴	CL (LL<45 & PI<25) or Granular Material ³	

1. Compacted structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation. On-site soils generally appear suitable for use as fill outside of the LP zone.
2. Delineation of moderate to high plasticity clays should be performed in the field by a qualified Geotechnical Engineer or their representative, and could require additional laboratory testing.
3. MODOT Type 5 crushed aggregate or an alternate approved gradation
4. Low plasticity cohesive soil or granular soil having low plasticity fines. Material should be approved by the Geotechnical Engineer.

Fill Compaction Requirements

A sample of each fill material type should be tested prior to being used on the site. Our professional opinions concerning suitability of fill materials are presented in the following table.

Item	Description
Fill Lift Thickness	9 inches or less in loose thickness for heavy compaction equipment 4 to 6 inches or less in loose thickness for light, hand-operated compaction equipment
Compaction Requirements ¹	At least 95 percent of the material's maximum standard Proctor dry density for cohesive soils or densely-graded granular materials, and at least 70 percent relative density for open-graded granular materials
Moisture Content – Cohesive Soil	-1 to +3 percent of the optimum moisture content value as determined by the standard Proctor test
Moisture Content – Granular Material	Workable moisture levels ²

Item	Description
1.	We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2.	Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site. Final surrounding grades should promote rapid surface drainage away from the tank. Accumulation of water adjacent to the tank could contribute to significant moisture increases in the subgrade soils and subsequent softening/settlement.

After construction of the tank(s) and other structures has been completed, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the tank(s) and other structures should also be periodically inspected and adjusted as necessary, as part of the facility's maintenance program.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content within the range recommended for structural fill. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Any water that collects over, or adjacent to, construction areas should be promptly removed. If the subgrade freezes, or becomes excessively wet or dry, or is disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted, prior to further construction. All of these processes should be observed by Terracon.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming any responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The Geotechnical Engineer should be retained during the construction phase of the project to observe earthwork and to perform tests and observations during subgrade preparation, proofrolling, placement and compaction of controlled compacted fills, backfilling of excavations into the completed subgrade, and just prior to construction of slabs.

TANK FOUNDATIONS AND FLOORS

Provided the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations. Foundations should not bear on or above the existing fill materials.

Ring Wall Foundation

Based on the conditions encountered at the borings, the tank wall footing is expected to bear on stiff to very stiff clay soils or engineered fill that has been placed and compacted as recommended in this report. If unsuitable soils are encountered, they should be overexcavated and replaced as recommended in the **Foundation Construction Considerations** section.

Description	Value
Maximum net allowable bearing pressure ¹	2,000 psf
Modulus of Subgrade Reaction ²	120 pounds per square inch per inch of deflection (psi/in or pci) for point loading conditions
Minimum embedment below finished grade for frost protection ³	3 feet
Minimum footing widths	Isolated footings: 30 inches Continuous footings: 16 inches
Estimated total settlement ⁴	on the order of 1 inch
Estimated differential settlement ⁴	1/2 to 2/3 of the total settlement over a horizontal distance of 50 feet

-
1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any soft soils or other unsuitable materials, if encountered, will be undercut and replaced with engineered fill.
 2. The recommended modulus value is based on a 12-inch square plate. The modulus value used in design should be adjusted based on the actual size of the floor slab according to the Naval Facilities Engineering Design Manual 7.2, Page 7.2-155, Table 4 equation: $K_b = K_v \left(\frac{b+1}{2b}\right)^2$ where K_v is the modulus value based on a 12-inch square plate, b is the width of the slab and K_b is the design modulus value.
 3. This embedment depth is recommended to provide frost protection and to reduce the effects of seasonal moisture variations in the foundation bearing soils.
 4. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill below the footings, and the quality of the earthwork operations and footing construction.
-

Tank Floor

Based on the subsurface conditions encountered at the boring locations, we expect the tank floor will be supported on medium stiff to stiff native clay soils or newly-placed engineered fill composed of granular materials. Based on the estimated tank floor maximum contact pressure of 1,200 psf, we estimate total settlement at the center of the tank will be on the order of 1½ inches. Differential settlement across the tank floor footprint will be on the order of one inch.

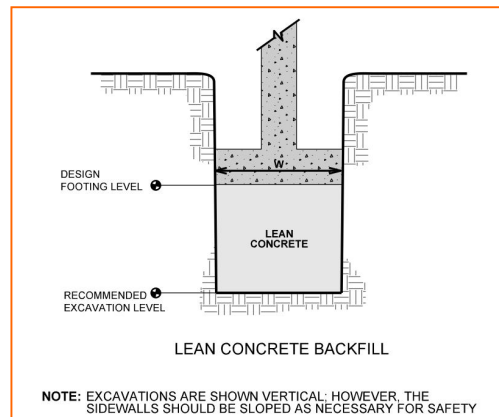
We understand the tank floor will be supported on a layer of free-draining granular material. We recommend free-draining materials consist of 6 inches (minimum) of open graded rock (ASTM C33 Size No. 57 aggregate or similar) that has been placed and compacted as recommended in this report.

Foundation Construction Considerations

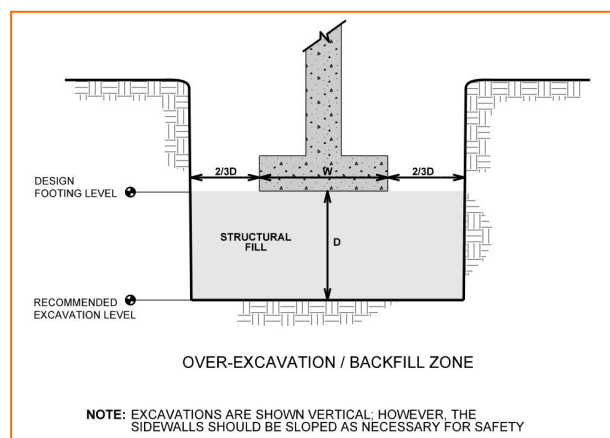
The footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed. Placement of a lean concrete mud-mat over the bearing soils should be considered if the excavations must remain open for an extended period of time.

Although groundwater was not encountered in the borings at depths expected to affect foundation excavations, it could still be encountered during foundation excavations or in other excavation activities. In addition, some surface and/or perched groundwater may enter foundation excavations during construction. It is anticipated that any water entering foundation excavations from these sources can be removed using sump pumps or gravity drainage. Additional dewatering efforts may be required if greater inflow occurs.

All footing bearing surfaces should be observed and tested by Terracon. If unsuitable conditions are encountered, footing excavations should be extended deeper to suitable bearing materials. Footings can bear directly on suitable soils at the lower level or on lean concrete backfill as shown in the following figure.



As an alternative, the footings could also bear on properly compacted structural backfill extending down to suitable soils. Overexcavation for compacted structural fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation as recommended in the **Earthwork** section.



Hydro-Testing Procedures

Hydro-testing should be performed under the observation of the Geotechnical Engineer to monitor soil deformation. The following procedure for hydro-testing of the tank foundations is recommended:

Survey Control: For monitoring settlements during hydro-testing, we suggest that a minimum of eight survey reference points be established at 45-degree intervals around the perimeter of the tank prior to filling the tank. These reference points should be referenced to a remote benchmark at least one tank diameter away from the tank.

Loading: The tank should be filled with water and observed in stages. The initial filling should be one-half of the capacity. Settlement monitoring of the above-mentioned reference points should be performed daily for three days. The observed settlement readings should be reviewed and assessed by the structural engineer and the geotechnical engineer. If the time-rate of settlement plot indicates an adequately decreasing rate, the tank can be filled to $\frac{3}{4}$ capacity and the settlement readings performed. Settlement readings should then be obtained again on the following day. If the settlements are consistent with those anticipated by the geotechnical and structural engineers, then the tank can be filled to full capacity. Settlement readings should again be taken after the tank has been full for a minimum of 24 hours.

Data Evaluation: The measured survey data should be reviewed by the structural engineer, tank manufacturer, and the geotechnical engineer. If authorized, we would be pleased to evaluate the settlement data obtained during hydro-testing of the completed tank, and to provide recommendations as to the duration of the hydro-test loads.

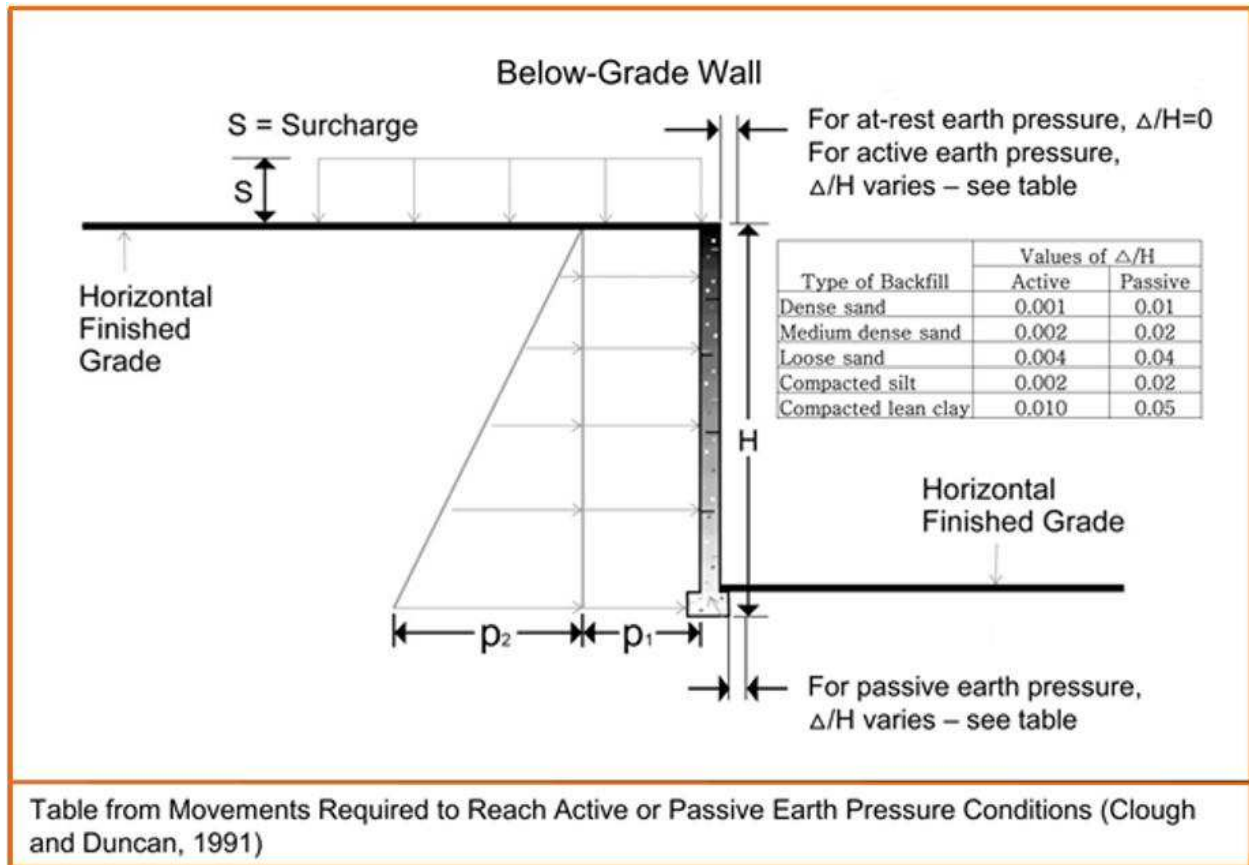
SEISMIC CONSIDERATIONS

Code	Site Class
2018 International Building Code (IBC)	D ¹
<p>1. The 2018 International Building Code (IBC) seismic site class definitions are based on average properties of the subsurface profile to a depth of 100 feet. The exploratory borings terminated within clay soils at depths of approximately 35 feet. Our opinion of site class is based on the subsurface data and our knowledge of local geological and geotechnical conditions.</p>	

LATERAL EARTH PRESSURES

Lateral Earth Pressure Design Parameters

Below grade walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls where wall movement is permitted. The at-rest condition considers no wall movement is permitted. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Lateral Earth Pressure Design Parameters					
Earth Pressure Condition ¹	Coefficient for Backfill Type	Minimum Φ Angle (degrees)	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (K_a)	Granular - 0.33	30	40	(0.33)S	(40)H
	Lean Clay - 0.39	25	50	(0.39)S	(50)H
At-Rest (K_o)	Granular - 0.50	30	60	(0.50)S	(60)H
	Lean Clay - 0.56	25	70	(0.56)S	(70)H
Passive (K_p)	Granular - 3.0	30	360	---	---
	Lean Clay - 2.5	25	300	---	---

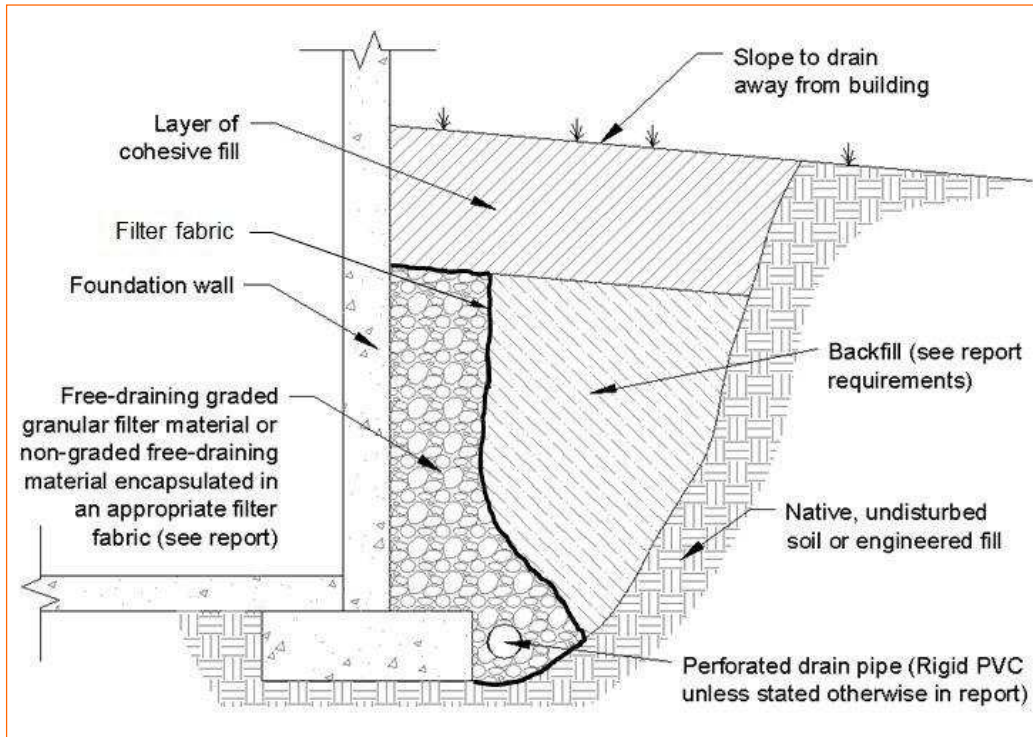
Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements as indicated in the above tables
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance as indicated in the above tables
- Uniform surcharge, where S is surcharge pressure
- Horizontal backfill, compacted at 95 to 98 percent of its standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

Subsurface Drainage for Below Grade Walls

To prevent hydrostatic pressure on below-grade walls, we recommend drains be installed at the foundation level. Each drain line should be sloped to provide positive gravity drainage and should be surrounded by free-draining granular material graded to prevent the intrusion of fines, or an alternative free-draining granular material encapsulated with suitable filter fabric. At least a 2-foot wide section of free-draining granular fill should be used for backfill above the drain line and adjacent to the wall. The free-draining granular fill should extend to within 2 feet of final grade and should be capped with compacted cohesive fill to minimize infiltration of surface water into the drain system.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils (i.e., fat clay is not acceptable backfill material). For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 degrees from vertical for the active and at-rest case and at least 60 degrees from vertical for the passive case. To calculate the resistance to sliding, a value of 0.30 should be used as the ultimate coefficient of friction between the footing and the underlying soil.



As an alternative to free-draining granular fill, a pre-fabricated drainage composite may be used. A pre-fabricated drainage composite is a plastic drainage core or mesh that is covered with filter fabric to resist soil intrusion and fastened to the wall prior to placing backfill.

If controlling hydrostatic pressure behind the wall as described above is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or pavement loading, which should be added. Heavy equipment should not operate within a horizontal distance closer than the exposed height of retaining walls to avoid lateral pressures greater than those provided.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations may occur between boring locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during construction. If variations appear, we can provide further

Geotechnical Engineering Report

Wastewater Tanks ■ Moberly, Missouri

October 22, 2021 ■ Terracon Project No. 15215072



evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation costs. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation costs. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, cost estimating, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

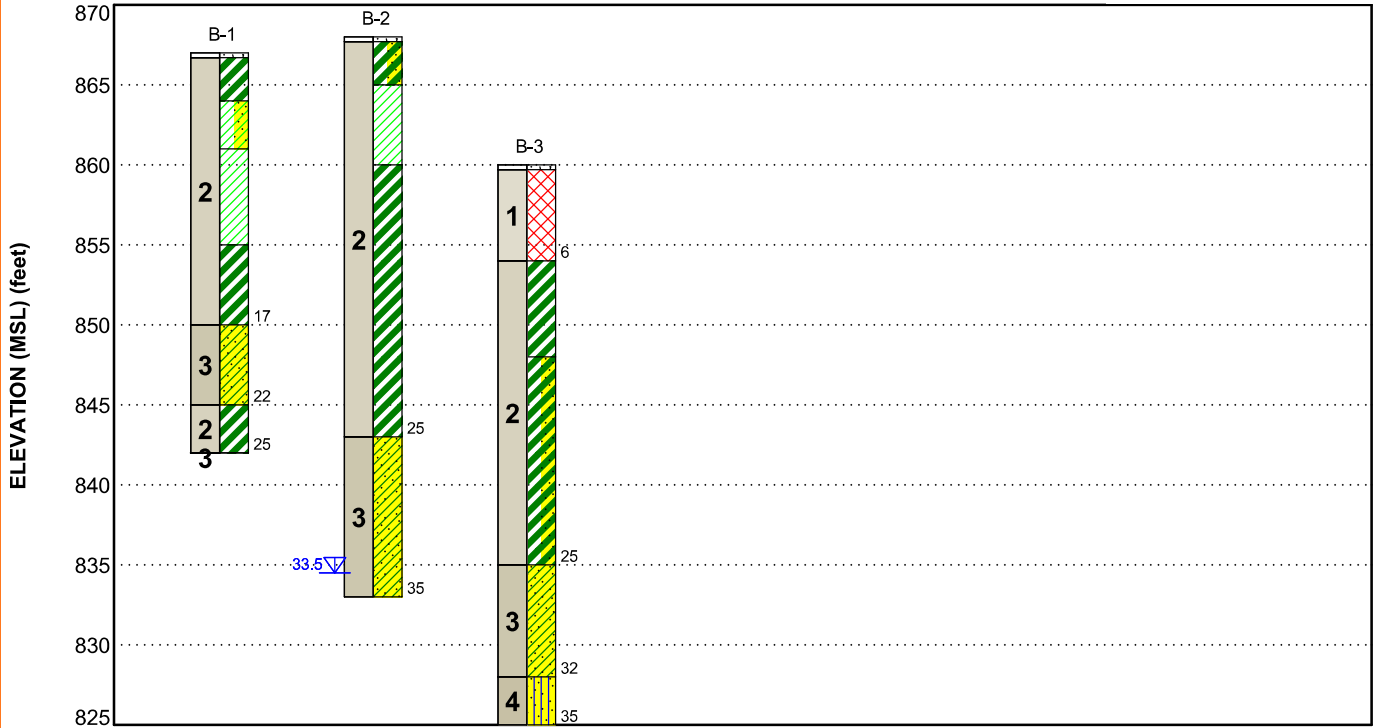
FIGURES

Contents:

GeoModel

GEOMODEL

Wastewater Tanks ■ Moberly, MO
Terracon Project No. 15215072



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Fat clay with trace amounts of sand
2	Lean and Fat Clay Soils	Lean clay (CL) with varying amounts of silt and sand; fat clay (CH) with varying amounts of sand
3	Sandy Lean Clay	Sandy lean clay (CL) with trace amounts of gravel
4	Sand	Silty sand (SM)

LEGEND

- Topsoil
- Lean Clay
- Fill
- Fat Clay
- Sandy Lean Clay
- Silty Sand
- Lean Clay with Sand
- Fat Clay with Sand

- First Water Observation
- Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
3	35	Tank areas

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 20 feet). Approximate elevations (rounded to the nearest foot) were obtained from Google Earth™. If more precise elevations and boring locations are desired, we recommend the borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using continuous flight, hollow-stem augers. Soil sampling was performed using thin-walled tube and split-barrel sampling procedures.

In the thin-walled tube sampling procedure, a seamless thin-walled steel tube with a sharpened beveled edge is pushed hydraulically into the cohesive or moderately cohesive soil at a selected depth at the base of the borehole. A relatively undisturbed sample of the soil is retained in the tube, and extracted in the laboratory for further testing.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch (outside diameter) split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound automatic hammer with a free fall of 30 inches, is the standard penetration resistance (SPT N-value). This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

Based on the material's texture and plasticity, we describe and classify soil samples in accordance with the Unified Soil Classification System. The project engineer reviewed the field

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Wastewater Tanks ■ Moberly, Missouri

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data and assigned various laboratory tests to better understand the engineering properties of the soil strata. The following tests were performed on selected samples.

- Water content
- Dry unit weight
- Atterberg limits
- Unconfined compressive strength

SITE LOCATION AND EXPLORATION PLANS

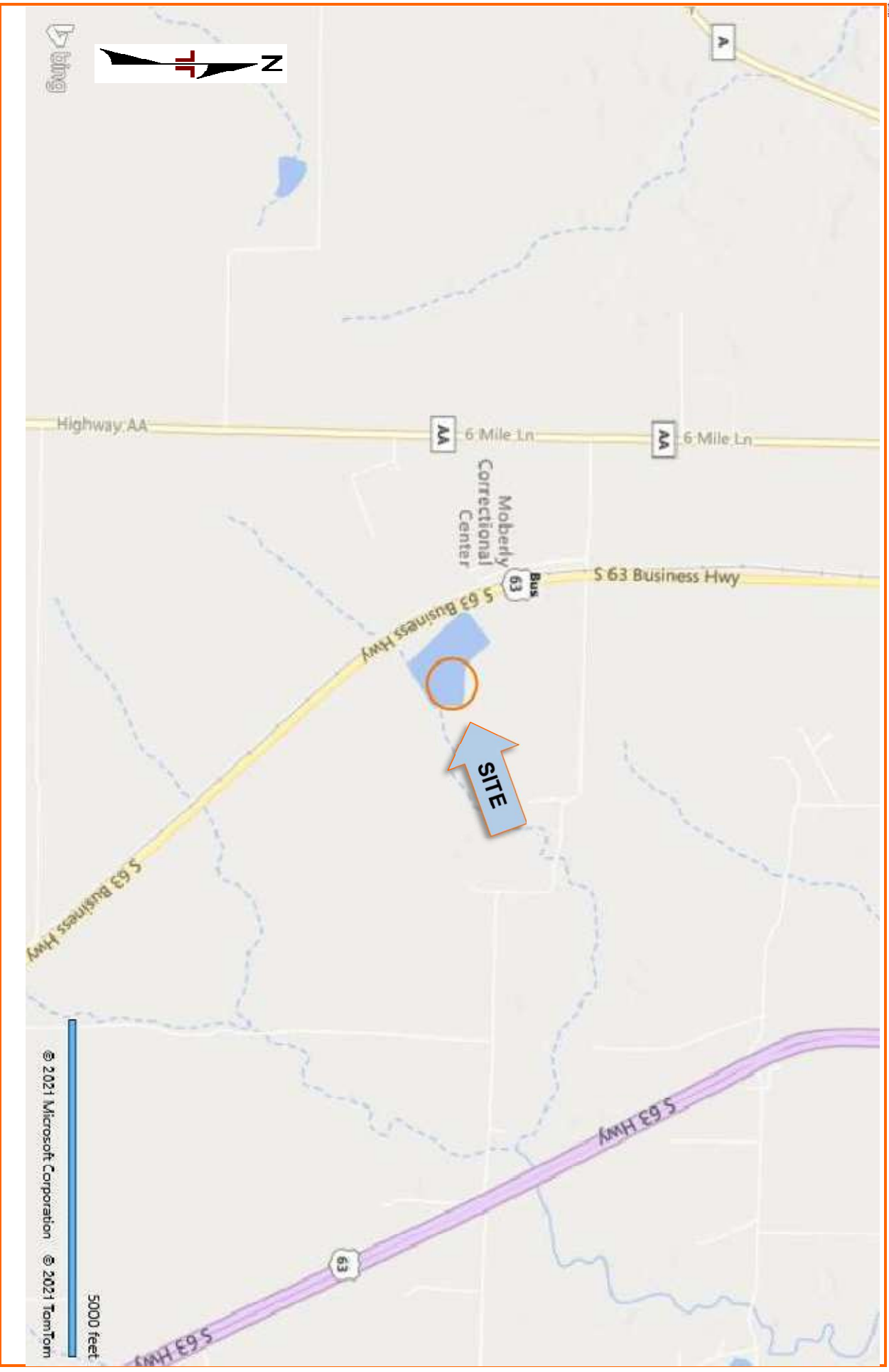
Contents:

Site Location Plan

Exploration Plan

SITE LOCATION

Wastewater Tanks ■ Moberly, Missouri
October 22, 2021 ■ Terracon Project No. 15215072



EXPLORATION PLAN

Wastewater Tanks ■ Moberly, Missouri
October 22, 2021 ■ Terracon Project No. 15215072

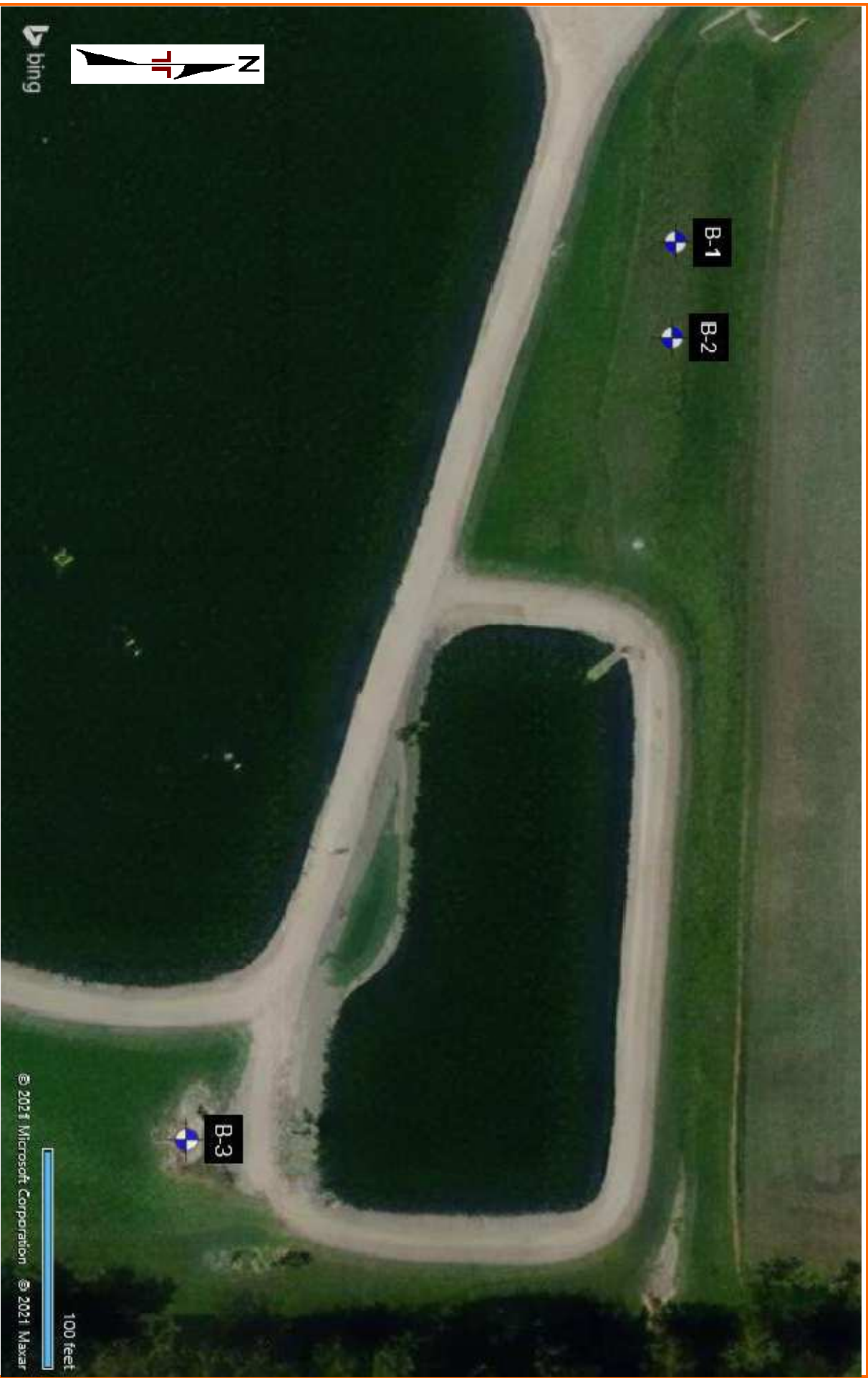


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-3)

BORING LOG NO. B-1

PROJECT: Wastewater Tanks

CLIENT: Bartlett & West, Inc.
Jefferson City, MO

SITE: US 63 Business
Moberly, MO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_15215072 WASTEWATER TANKS.GPJ TERRACON_DATATEMPLATE.GDT 10/18/21

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.3635° Longitude: -92.4326° Approximate Surface Elev.: 867 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LL-PL-PI
0.3	TOPSOIL , (approximately 3 inches)	866.5+/-										
3.0	FAT CLAY (CH) , trace sand, gray, very stiff	864+/-			6	10-8-8 N=16	1			19.2		
6.0	LEAN CLAY (CL) , with sand, brown and gray, stiff	861+/-			9	7-5-6 N=11	2			14.7		
12.0	LEAN CLAY (CL) , trace silt and sand, brown and gray, stiff	855+/-			12		3		4630	22.6	106	
17.0	FAT CLAY (CH) , trace sand, gray, medium stiff	850+/-			5	3-5-7 N=12	4	2500		11.3		
22.0	FAT CLAY (CH) , trace sand, gray, medium stiff	845+/-			18	3-3-4 N=7	5	2000		23.3		
25.0	SANDY LEAN CLAY (CL) , trace gravel, gray and brown, stiff	850+/-			18	4-6-9 N=15	6	3500		18.5		
25.0	FAT CLAY (CH) , gravelly, stiff	842+/-			18	4-5-7 N=12	7	4000		23.3		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

BORING LOG NO. B-1

PROJECT: Wastewater Tanks

**CLIENT: Bartlett & West, Inc.
Jefferson City, MO**

**SITE: US 63 Business
Moberly, MO**

GRAPHIC LOG	LOCATION See Exploration Plan	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
	Latitude: 39.3635° Longitude: -92.4326° Approximate Surface Elev.: 867 (Ft.) +/- DEPTH ELEVATION (Ft.)											LL-PL-PI
SANDY LEAN CLAY (CL), trace gravel, gray and brown, very stiff		30			18	6-8-12 N=20	8	5000		18.8		
LEAN CLAY (CL), with sand, gray, stiff		35			18	5-5-6 N=11	9	3500		22.4		
Boring Terminated at 35 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 15215072 WASTEWATER TANKS.GPJ TERRACON_DATATEMPLATE.GDT 10/18/21

BORING LOG NO. B-2

PROJECT: Wastewater Tanks

**CLIENT: Bartlett & West, Inc.
Jefferson City, MO**

**SITE: US 63 Business
Moberly, MO**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_15215072 WASTEWATER TANKS.GPJ TERRACON DATATEMPLATE.GDT 10/18/21

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.3635° Longitude: -92.4324° Approximate Surface Elev.: 868 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LL-PL-PI
DEPTH	ELEVATION (Ft.)											
0.3	FILL - TOPSOIL , (approximately 3 inches)	867.5+/-										
3.0	FAT CLAY (CH) , with sand, gray, very stiff			X	5	9-8-8 N=16	1			19.1		
8.0	LEAN CLAY (CL) , trace silt, brown and gray, medium stiff to stiff	865+/-			20		2		2290	20.3	150	
8.0				X	4	3-3-4 N=7	3			16.9		
8.0	FAT CLAY (CH) , trace sand, dark gray to light gray, stiff	860+/-		X	16	2-3-5 N=8	4	2000		24.1		86-16-70
15.0				X	18	3-3-5 N=8	5	2500		22.1		
20.0				X	18	3-3-5 N=8	6	3000		24.4		
25.0		843+/-		X	18	4-5-7 N=12	7	3500		22.9		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

- ▽ 33.5 feet while drilling
- ▽ 33.5 feet at completion of drilling



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

BORING LOG NO. B-2

PROJECT: Wastewater Tanks

**CLIENT: Bartlett & West, Inc.
Jefferson City, MO**

**SITE: US 63 Business
Moberly, MO**

GRAPHIC LOG	LOCATION See Exploration Plan	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
	DEPTH ELEVATION (Ft.)											LL-PL-PI
	Latitude: 39.3635° Longitude: -92.4324° Approximate Surface Elev.: 868 (Ft.) +/-											
35.0	SANDY LEAN CLAY (CL) , trace gravel, brown and gray, very stiff	30										
			X		18	7-8-11 N=19	8	4000		18.0		
			▽		18	24-9-17 N=26	9			20.1		
	Boring Terminated at 35 Feet	35										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

- ▽ 33.5 feet while drilling
- ▽ 33.5 feet at completion of drilling



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_15215072 WASTEWATER TANKS.GPJ TERRACON_DATATEMPLATE.GDT 10/18/21

BORING LOG NO. B-3

PROJECT: Wastewater Tanks

**CLIENT: Bartlett & West, Inc.
Jefferson City, MO**

**SITE: US 63 Business
Moberly, MO**

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.3628° Longitude: -92.4311° Approximate Surface Elev.: 860 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
												LL-PL-PI
0.3	TOPSOIL , (approximately 3 inches)	0.3										
6.0	FILL - FAT CLAY , trace sand, dark gray and brown dark gray and gray	6.0		X	9	4-4-4 N=8	1			20.9		
6.0	FAT CLAY (CH) , trace sand, gray, stiff soft	6.0		X	3	2-2-2 N=4	2			24.7		
12.0	FAT CLAY (CH) , with sand, dark gray, stiff	12.0		█	11		3		2280	25.9	101	74-13-61
12.0		12.0		X	17	2-1-2 N=3	4	1000		29.5		
15.0		15.0		X	18	3-4-6 N=10	5	3000		21.0		
20.0		20.0		X	18	3-4-8 N=12	6	3500		20.2		
25.0		25.0		X	18	4-6-10 N=16	7	4000		20.2		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 15215072 WASTEWATER TANKS.GPJ TERRACON_DATATEMPLATE.GDT 10/18/21

BORING LOG NO. B-3

PROJECT: Wastewater Tanks

**CLIENT: Bartlett & West, Inc.
Jefferson City, MO**

**SITE: US 63 Business
Moberly, MO**

GRAPHIC LOG	LOCATION See Exploration Plan	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	POCKET PENETROMETER (psf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
	Latitude: 39.3628° Longitude: -92.4311° Approximate Surface Elev.: 860 (Ft.) +/- DEPTH ELEVATION (Ft.)											LL-PL-PI
	SANDY LEAN CLAY (CL) , trace gravel, brown and gray, hard	30					8			11.9		
	SILTY SAND (SM) , fine grained, brown and gray, dense	35					9			18.7		
	Boring Terminated at 35 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow-stem augers

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations obtained from Google Earth Pro

WATER LEVEL OBSERVATIONS

Groundwater not encountered



Boring Started: 10-08-2021

Boring Completed: 10-08-2021

Drill Rig: DR721

Driller: JM

Project No.: 15215072

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_15215072 WASTEWATER TANKS.GPJ TERRACON_DATATEMPLATE.GDT 10/18/21

SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System







Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Wastewater Tanks ■ Moberly, MO

Terracon Project No. 15215072

SAMPLING	WATER LEVEL	FIELD TESTS
 Shelby Tube  Split Spoon	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See [Exploration and Testing Procedures](#) in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS		CONSISTENCY OF FINE-GRAINED SOILS		
(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 500	0 - 1
Loose	4 - 9	Soft	500 to 1,000	2 - 4
Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
		Hard	> 8,000	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification	
				Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: $Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
		$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Gravels with Fines: Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
		Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Clean Sands: $Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I
		Silts and Clays: Liquid limit 50 or more	Sands with Fines: Fines classify as ML or MH	SM	Silty sand ^{G, H, I}
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor		PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

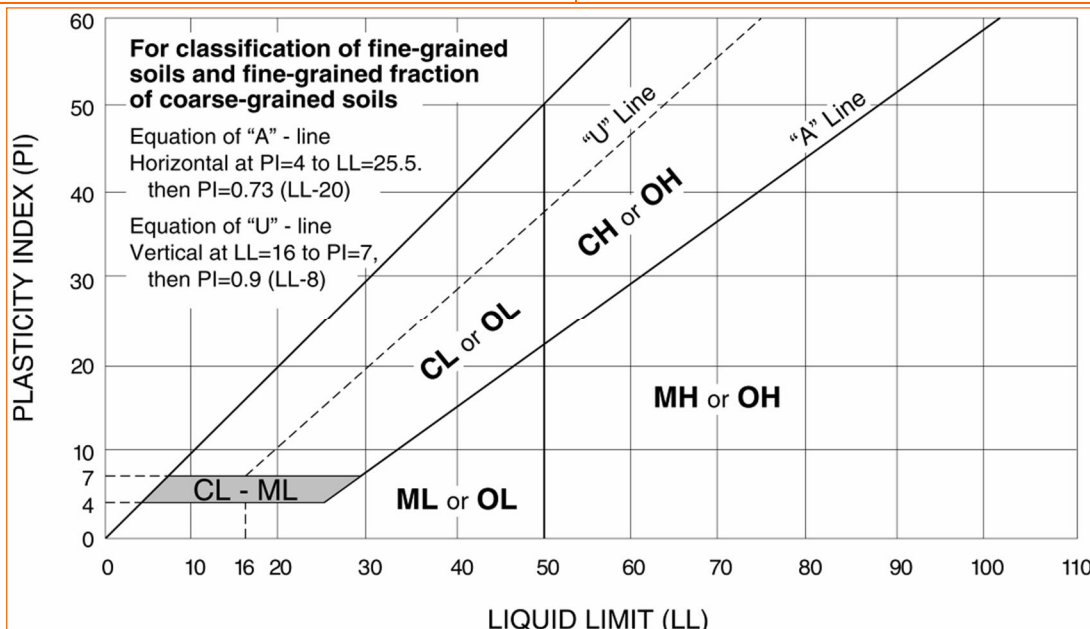
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

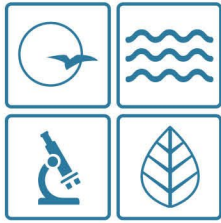
^P PI plots on or above "A" line.

^Q PI plots below "A" line.



APPENDIX C

DNR CONSTRUCTION PERMIT



MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Michael L. Parson
Governor

Dru Buntin
Director

June 6, 2022

Greg Wykes, Energy Management Coordinator
Missouri Department of Corrections
2729 Plaza Drive
Jefferson City, MO 65102

RE: Improvements – Moberly Correctional Center Wastewater Treatment Facility,
MO-0053937, Revised Construction Permit No. CP0002296, Randolph County

Dear Greg Wykes:

The Missouri Department of Natural Resources' Water Protection Program has reviewed the plans and specifications submitted by Valerie Holland, P.E., of Bartlet & West, Inc., for the Department of Corrections. Please find enclosed Construction Permit No. CP0002296, which was revised to document that sludge will be removed from cell #3 during the project in coordination with the Water Protection Program. Upon completing construction covered under this permit, submit a Statement of Work Completed form (<https://dnr.mo.gov/document-search/wastewater-construction-statement-work-completed-mo-780-2155>) to the Department in accordance with 10 CSR 20-6.010(5)(N) with a request to issue the operating permit.

This permit will terminate 24 months from the original date of issuance. In accordance with 10 CSR 20-6.010(5)(J), the Department of Natural Resources may grant an extension. If you believe that an extension is necessary, you must submit a request and a justification in writing for the extension at least 30 days prior to the permit expiration date. Expired construction permits require submittal of a new application and fee.

This construction permit does not supersede any requirements of the operating permit or enforcement actions. You must continue to submit any reports required in your existing operating permit, including reporting progress made in attaining compliance with final effluent limits for a schedule of compliance to the Northeast Regional Office. Nothing in this permit removes any obligations to comply with county or other local ordinances or restrictions.

If you have any questions concerning this matter, please contact Scott Adams, of the Water Protection Program by phone at 573-751-9122 or by email at scott.adams@dnr.mo.gov. You may also submit questions or comments in writing to the Department of Natural Resources, P.O. Box 176, Jefferson City, MO 65102.

Greg Wykes
Missouri Department of Corrections
Page 2

Thank you for your efforts to help ensure clean water in Missouri.

Sincerely,

WATER PROTECTION PROGRAM

A handwritten signature in black ink that reads "Cindy LePage". The signature is written in a cursive, flowing style.

Cindy LePage, P.E., Chief
Engineering Section

CL:sat

Enclosures

c: Valerie Holland, P.E., Bartlett & West, Inc.
David See, Moberly Correctional Center WWTF
Eric Hibdon, Office of Administration
Natalie Wigger, Enforcement Case Manager, Water Protection Program

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

Greg Wykes, Energy Management Coordinator
Missouri Department of Corrections
2729 Plaza Drive
Jefferson City, MO 65102

for the construction of (described facilities):

See attached.

Permit Conditions:

See attached.

Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources (Department).

As the Department of Natural Resources does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the Department of Natural Resources may inspect the work covered by this permit during construction. Issuance by the Department of Natural Resources of a permit to operate will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

May 24, 2022
Effective Date

June 6, 2022
Revised Date

May 23, 2024
Expiration Date

A handwritten signature in black ink that reads 'Chris Wieberg'.

Chris Wieberg, Director, Water Protection Program

CONSTRUCTION PERMIT

I. CONSTRUCTION DESCRIPTION

Replacing the existing surface aerators with submerged aerators, installing a NitrOx Moving Bed Bioreactor between cells 2 and 3, installing a UV disinfection system, and installing a magmeter-type flow meter. Additional stormwater deviation work and berm repair work will also be performed during this project. Sludge will be removed from cell #3 during this project in coordination with the Water Protection Program and in accordance with Standard Conditions Part III of Missouri State Operating Permit MO-0053937.

This project will also include general site work appropriate to the scope and purpose of the project and all necessary appurtenances to make a complete and usable wastewater treatment facility.

II. COST ANALYSIS FOR COMPLIANCE

The Department of Natural Resources is not required to complete a cost analysis for compliance, because the facility is not a combined or separate sanitary sewer system for a publically-owned treatment works.

III. CONSTRUCTION PERMIT CONDITIONS

The permittee is authorized to construct subject to the following conditions:

1. This construction permit does not authorize discharge.
2. All construction shall be consistent with plans and specifications signed and sealed by Valerie Holland, P.E., of Bartlet & West, Inc., and as described in this permit.
3. The Department of Natural Resources must be contacted in writing prior to making any changes to the plans and specifications that would directly or indirectly have an impact on the capacity, flow, system layout, or reliability of the proposed wastewater treatment facilities or any design parameter that is addressed by 10 CSR 20-8, in accordance with 10 CSR 20-8.110(11).
4. State and federal law does not permit bypassing of raw wastewater, therefore steps must be taken to ensure that raw wastewater does not discharge during construction. If a sanitary sewer overflow or bypass occurs, report the appropriate information to the Department of Natural Resources' Northeast Regional Office per 10 CSR 20-7.015(9)(G).
5. The wastewater facility structures, electrical equipment, and mechanical equipment shall be protected from physical damage by not less than the one hundred (100)-year flood elevation per 10 CSR 20-8.140(2)(B). The minimum distance between wastewater treatment facilities and all potable water sources shall be at least three hundred feet (300') per 10 CSR 20-8.140(2)(C)1.

6. In addition to the requirements for a construction permit, 10 CSR 20-6.200 requires land disturbance activities of 1 acre or more to obtain a Missouri state operating permit to discharge stormwater. The permit requires best management practices sufficient to control runoff and sedimentation to protect waters of the state. Land disturbance permits will only be obtained by means of the Department of Natural Resources' ePermitting system available online at <https://dnr.mo.gov/data-e-services/missouri-gateway-environmental-management-mogem>. See <https://dnr.mo.gov/data-e-services/water/electronic-permitting-epermitting> for more information.
7. A United States Army Corps of Engineers (USACE) Clean Water Act Section 404 Department of the Army permit and a Section 401 Water Quality Certification issued by the Department of Natural Resources may be required for the activities described in this permit. This permit is not valid until these requirements are satisfied or notification is provided that no Section 404 permit is required by the USACE. You must contact your local USACE district since they determine what waters are jurisdictional and which permitting requirements may apply. You may call the Department of Natural Resources' Water Protection Program, Operating Permits Section at 573-522-4502 for more information. See <https://dnr.mo.gov/water/business-industry-other-entities/permits-certification-engineering-fees/section-401-water-quality> for more information.
8. All construction must adhere to applicable 10 CSR 20-8 (Chapter 8) requirements listed below.
 - Flood protection shall apply to new construction and to existing facilities undergoing major modification. The wastewater facility structures, electrical equipment, and mechanical equipment shall be protected from physical damage by not less than the one hundred (100)-year flood elevation. 10 CSR 20-8.140(2)(B)
 - Unless another distance is determined by the Missouri Geological Survey or by the Department of Natural Resources' Public Drinking Water Branch, the minimum distance between wastewater treatment facilities and all potable water sources shall be at least three hundred feet (300'). 10 CSR 20-8.140(2)(C)1.
 - Facilities shall be readily accessible by authorized personnel from a public right-of-way at all times. 10 CSR 20-8.140(2)(D)
 - The outfall shall be so constructed and protected against the effects of flood water, ice, or other hazards as to reasonably ensure its structural stability and freedom from stoppage. 10 CSR 20-8.140(6)(A)
 - All sampling points shall be designed so that a representative and discrete twenty-four (24) hour automatic composite sample or grab sample of the effluent discharge can be obtained at a point after the final treatment process and before discharge to or mixing with the receiving waters. 10 CSR 20-8.140(6)(B)
 - All outfalls shall be posted with a permanent sign indicating the outfall number (i.e., Outfall #001). 10 CSR 20-8.140(6)(C)
 - All wastewater treatment facilities shall be provided with an alternate source of electric power or pumping capability to allow continuity of operation during power failures. 10 CSR 20-8.140(7)(A)1.

- Electrical systems and components in raw wastewater or in enclosed or partially enclosed spaces where hazardous concentrations of flammable gases or vapors that are normally present, shall comply with the NFPA 70 *National Electric Code (NEC)* (2017 Edition), as approved and published August 24, 2016, requirements for Class I, Division 1, Group D locations. 10 CSR 20-8.140(7)(B)
- An audiovisual alarm or a more advanced alert system, with a self-contained power supply, capable of monitoring the condition of equipment whose failure could result in a violation of the operating permit, shall be provided for all wastewater treatment facilities. 10 CSR 20-8.140(7)(C)
- No piping or other connections shall exist in any part of the wastewater treatment facility that might cause the contamination of a potable water supply. 10 CSR 20-8.140(7)(D)1.
- Where a separate non-potable water supply is to be provided, a break tank will not be necessary, but all system outlets shall be posted with a permanent sign indicating the water is not safe for drinking. 10 CSR 20-8.140(7)(D)4.
- A means of flow measurement shall be provided at all wastewater treatment facilities. 10 CSR 20-8.140(7)(E)
- Effluent twenty-four (24) hour composite automatic sampling equipment shall be provided at all mechanical wastewater treatment facilities and at other facilities where necessary under provisions of the operating permit. 10 CSR 20-8.140(7)(F)
- Adequate provisions shall be made to effectively protect facility personnel and visitors from hazards. The following shall be provided to fulfill the particular needs of each wastewater treatment facility:
 - Fencing. Enclose the facility site with a fence designed to discourage the entrance of unauthorized persons and animals; 10 CSR 20-8.140(8)(A)
 - Gratings over appropriate areas of treatment units where access for maintenance is necessary; 10 CSR 20-8.140(8)(B)
 - First aid equipment; 10 CSR 20-8.140(8)(C)
 - Posted “No Smoking” signs in hazardous areas; 10 CSR 20-8.140(8)(D)
 - Appropriate personal protective equipment (PPE); 10 CSR 20-8.140(8)(E)
 - Appropriately-placed warning signs for slippery areas, non-potable water fixtures (see subparagraph (7)(D)3.B. of this rule), low head clearance areas, open service manholes, hazardous chemical storage areas, flammable fuel storage areas, high noise areas, etc.; 10 CSR 20-8.140(8)(I)
 - Provisions for local lockout/tagout on stop motor controls and other devices; 10 CSR 20-8.140(8)(L)
 - Provisions for an arc flash hazard analysis and determination of the flash protection boundary distance and type of PPE to reduce exposure to major electrical hazards shall be in accordance with NFPA 70E *Standard for Electrical Safety in the Workplace* (2018 Edition), as approved and published August 21, 2017. 10 CSR 20-8.140(8)(M)
- Emergency Power. Disinfection processes, when used, shall be provided during all power outages. 10 CSR 20-8.190(2)(A); 10 CSR 20-8.140(7)(A)2.
- The UV dosage shall be based on the design peak hourly flow, maximum rate of pumpage, or peak batch flow. 10 CSR 20-8.190(5)(A)1.

- The UV system shall deliver the target dosage based on equipment derating factors and, if needed, have the UV equipment manufacturer verify that the scale up or scale down factor utilized in the design is appropriate for the specific application under consideration. 10 CSR 20-8.190(5)(A)3.
- The UV system shall deliver a minimum UV dosage of thirty thousand microwatt seconds per centimeters squared (30,000 $\mu\text{W}\cdot\text{s}/\text{cm}^2$, or 30 mJ/cm^2). 10 CSR 20-8.190(5)(A)4.
- Open channel UV systems. The combination of the total number of banks shall be capable of treating the design peak hourly flow, maximum rate of pumpage, or peak batch flow. 10 CSR 20-8.190(5)(B)1.
- The UV system must continuously monitor and display at the UV system control panel the following minimum conditions:
 - The relative intensity of each bank or closed vessel system; 10 CSR 20-8.190(5)(C)1.A.
 - The operational status and condition of each bank or closed vessel system; 10 CSR 20-8.190(5)(C)1.B.
 - The ON/OFF status of each lamp in the system; 10 CSR 20-8.190(5)(C)1.C. and
 - The total number of operating hours of each bank or each closed vessel system. 10 CSR 20-8.190(5)(C)1.D.
- The UV system shall include an alarm system. Alarm systems shall comply with 10 CSR 20-8.140(7)(C). 10 CSR 20-8.190(5)(C)2.
- Moving Bed Bioreactor (MBBR). A MBBR secondary treatment system shall provide upstream preliminary treatment units capable of—
 - Screening to reduce pass-through and suspended solids; 10 CSR 20-8.180(8)(A)
 - Grit removal; 10 CSR 20-8.180(8)(B) and
 - Oil and grease removal. 10 CSR 20-8.180(8)(C)
- Minimum freeboard shall be two feet (2'). 10 CSR 20-8.200(4)(A)3.
- Seep collars shall be provided on drainpipes where they pass through the lagoon seal. 10 CSR 20-8.200(4)(C)4.

Regarding the berm repair, as needed:

- Lagoon berms shall be constructed of relatively impervious material and compacted to at least ninety-five percent (95%) maximum dry density test method to form a stable structure. 10 CSR 20-8.200(4)(A)1.
- The minimum berm width shall be eight feet (8') to permit access of maintenance vehicles. 10 CSR 20-8.200(4)(A)2.
- The lagoon shall be sealed to ensure that seepage loss is as low as possible and has a design permeability not exceeding 1.0×10^{-7} cm/sec. 10 CSR 20-8.200(4)(C)1.

9. Upon completion of construction:

- A. The Department of Corrections will become the continuing authority for operation and maintenance of these facilities;
- B. Submit an electronic copy of the as-built plans if the project was not constructed in accordance with previously submitted plans and specifications; and
- C. Submit the enclosed form Statement of Work Completed to the Department of Natural Resources in accordance with 10 CSR 20-6.010(5)(N).

IV. REVIEW SUMMARY

1. CONSTRUCTION PURPOSE

The facility is in enforcement for failure to meet the November 2017 operating permit's schedule of compliance for *E. coli* and Ammonia as N. In addition, existing berm damage and stormwater diversion issues will be resolved.

2. FACILITY DESCRIPTION

The existing WWTF is a three-cell lagoon (cells 1 and 2 aerated), with a headworks (grinder with bypass screen followed by an influent lift station). The facility is in enforcement in part for failing to upgrade to meet the permit schedule of compliance. The December 2021 Abatement Order on Consent (AOC) requires proposed construction upgrades to be completed by September 30, 2023.

Proposed construction includes the addition of a NitrOx MBBR reactor and ultraviolet light (UV) disinfection system, as well as upgrading lagoon aeration. In addition, a new magmeter-type flow meter will be provided, electric service will be upgraded, a standby generator will be provided, stormwater routing will be improved near the headworks, and a leak in the southwestern berm of cell #2 will be repaired.

The Moberly Correctional Center WWTF is located at 5201 S Morley St, Moberly, in Randolph County, Missouri. The facility has a design average flow of 470,000 gpd and serves a hydraulic population equivalent of approximately 4,750 people.

3. COMPLIANCE PARAMETERS

The proposed project is required to meet final Ammonia as N effluent limits of 1.3 mg/L (Apr to Sep) and 2.8 mg/L (Oct to Mar) and an effluent limit of 206 colonies per 100 mL for *E. coli* as established in Operating Permit MO-0053937.

As the current operating permit (issued in November 2017) will expire prior to completion of construction, an operating permit renewal was drafted concurrent to this project. Ammonia limits were recalculated as part of the renewal, and "equivalent to secondary" limits for TSS and "lagoon" pH limits are no longer applicable. The limits following the completion of construction that will be applicable to the facility are as follows:

Parameter	Units	Monthly average limit
Biochemical Oxygen Demand ₅	mg/L	30
Total Suspended Solids	mg/L	30
<i>E. coli</i> bacteria	#/100mL	206
Ammonia as N (January)	mg/L	3.1
Ammonia as N (February)	mg/L	2.7
Ammonia as N (March)	mg/L	2.7
Ammonia as N (April)	mg/L	2.3
Ammonia as N (May)	mg/L	1.9
Ammonia as N (June)	mg/L	1.5

Ammonia as N (July)	mg/L	1.1
Ammonia as N (August)	mg/L	1.3
Ammonia as N (September)	mg/L	1.7
Ammonia as N (October)	mg/L	2.6
Ammonia as N (November)	mg/L	3.1
Ammonia as N (December)	mg/L	2.7
pH	SU	6.5-9.0
Oil & Grease	mg/L	10

4. **REVIEW of MAJOR TREATMENT DESIGN CRITERIA**

Existing major components that will remain in use include the following:

- Auger Monster (~1,000 gpm capacity) with a bypass channel containing a manual bar screen
- Influent Parshall flume with ultrasonic flow meter
- Influent lift station
- Lagoon cell 1 has a surface area of approximately 6.1 acres, with a depth approximately 7.5 ft from water surface elevation to bottom of lagoon cell, with a dry-weather detention time of at least 35 days at the design average flow rate of 470,000 gpd.
- Lagoon cell 2 has a surface area of approximately 7.0 acres, with a depth of approximately 7 ft from water surface elevation to bottom of lagoon cell, with a dry-weather detention time of at least 32 days at the design average flow rate of 470,000 gpd.
- Lagoon cell 3 has a surface area of just under an acre, with a water depth of at least 8 ft, and a dry-weather detention time of at least 3 days.

Construction will cover the following items:

- Components are designed for a Population Equivalent of 4,750 based on hydraulic loading to the system.
- Existing surface aerators in Lagoon cell 1 will be removed and replaced with 38 aerators in cell 1 and 6 aerators in cell 2 to maintain partial-mix conditions. Aeration will be by means of two tri-lobe positive displacement blowers (75 HP motors on VFDs) each capable of supplying at least 1616 scfm for both cells.
- Triplepoint Water Technologies, LLC NitrOx™ – The lagoon treated effluent will flow by gravity to the NitrOx™ system. The NitrOx™ system is capable of treating a design average flow of 470,000 gpd. The system is composed of two tanks with each approximately 24 ft (length) x 16 ft (width) x 18 ft (depth) with a sidewater depth of 12 ft. Total volume of the two tanks is 68,936 gallons. The average flow hydraulic retention time is 3.5 hours and the peak flow hydraulic retention time is 1.4 hours. A floating insulating cover shall be installed in each tank. An immersion tank heater will be installed to maintain a minimum wastewater temperature of 2.5°C. Each tank shall be filled approximately 16% with high surface area HDPE media (approximately 1,800 m²/m³). Aeration by means of dual 25 HP tri-lobe positive displacement blowers (duty and redundant, on VFD) capable of supplying 226 scfm in each tank. The effluent from the

- NitrOx™ will flow by gravity to Lagoon Cell No. 3 for polishing prior to disinfection and discharge. The system includes an alarm telemetry system.
- Disinfection – Disinfection is the process of removal, deactivation, or killing of pathogenic microorganisms.
 - Non-Contact Ultraviolet (UV) – A closed channel, gravity flow, low pressure high intensity UV disinfection system capable of treating a peak flow of 1,728,000 gpd (1,200 gpm) while delivering a minimum UV intensity of 30 mJ/cm² at an expected ultraviolet transmissivity of at least 50%. The single closed channel UV system consists of two banks in series with five modules per bank and eight lamps per module (a total of 80 lamps). Each bank is capable of disinfecting 50% of the design peak flow. The disinfected effluent will flow by gravity through flow measurement equipment and to Outfall No. 001. The proposed system is Enaqua C2T.06042 or approved equal. The tubes are fouling resistant AFP™ (Activated Fluoropolymer) material
 - Post Aeration –
 - To ensure sufficient oxygen, the polishing basin will have one medium or fine bubble submersible aerator capable of supplying 14.2 scfm. HRT at design average flow is ~89 hours; HRT at maximum hourly flow is ~36 hours.
 - Outfall – The outfall structure will be replaced (in the same location) with a new concrete structure and 1.0-ft thick rip-rap blanket for scour protection. The outfall consists of a discharge pipe. Effluent sampling will occur from the “washdown manhole”, just downstream of the UV system.
 - Emergency Power – A 400 kW standby diesel generator and automatic transfer switch will be provided to operate the treatment facility in event of power failure.
 - Flow Measurement – Installation of accurate flow measurement devices will give the treatment facility a means of improved data analysis.
 - Electromagnetic Meter – An effluent electromagnetic 12-inch flow meter shall measure the secondary treated and disinfected wastewater prior to discharge at Outfall No. 001.

5. OPERATING PERMIT

Operating permit MO-0053937 will require a modification to reflect the construction activities. The modified Moberly Correctional Center WWTF, MO-0053937, was successfully public noticed from April 1, 2022, to May 2, 2022, with no comments received. Submit the Statement of Work Completed to the Department of Natural Resources in accordance with 10 CSR 20-6.010(5)(N) and request the operating permit modification be issued.

The operating permit that is current at the time of drafting this renewal/modification was issued on November 1, 2017, and will expire on March 31, 2022. Since the operating permit is expected to expire prior to completion of construction, this draft permit will constitute both the five-year renewal and the modification due to construction upgrades.

This facility does not meet the requirements of the MOGD, issued on July 1, 2019, as the design average flow for the facility of 470,000 gpd (which is greater than the maximum allowed 50,000 gpd for the MOGD).

6. CONSTRUCTION PERMIT MODIFICATION

This construction permit is being modified upon the request of the facility owner to document that sludge will be removed from cell #3 concurrent with the construction project in coordination with the Water Protection Program's review and in accordance with Standard Conditions Part III of Missouri State Operating Permit MO-0053937.

V. NOTICE OF RIGHT TO APPEAL

If you were adversely affected by this decision, you may be entitled to an appeal before the Administrative Hearing Commission (AHC) pursuant to Section 621.250 RSMo. To appeal, you must file a petition with the AHC within 30 days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the AHC. Any appeal should be directed to:

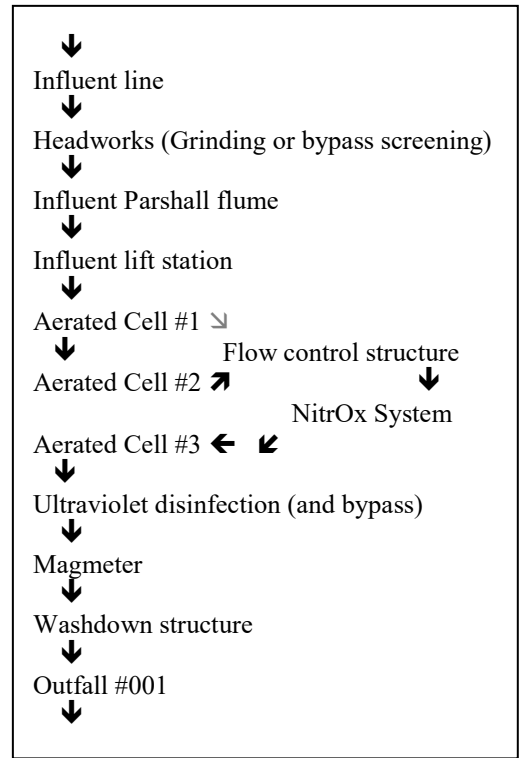
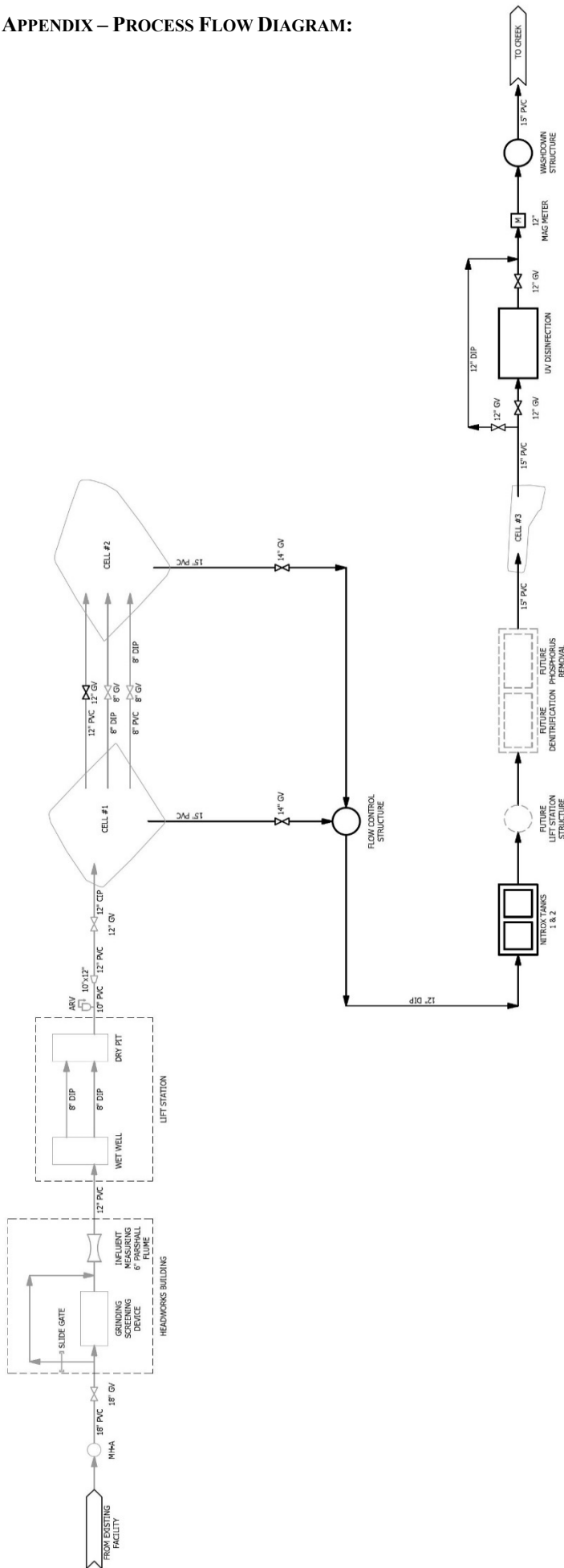
Administrative Hearing Commission
U.S. Post Office Building, Third Floor
131 West High Street, P.O. Box 1557
Jefferson City, MO 65102-1557
Phone: 573-751-2422
Fax: 573-751-5018
Website: <https://ahc.mo.gov>

Scott Adams, P.E.
Engineering Section
scott.adams@dnr.mo.gov

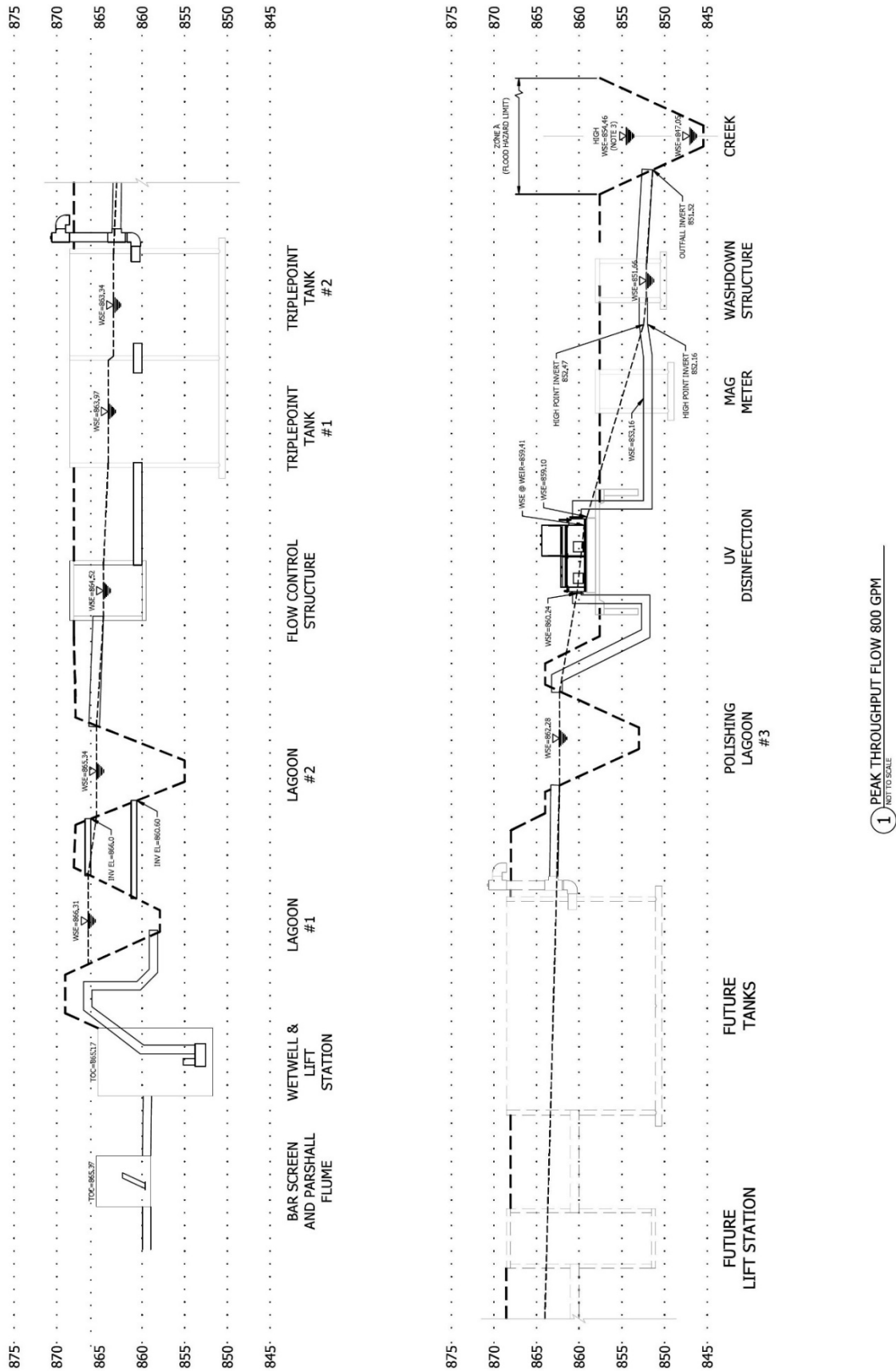
APPENDICES

- **Process Flow Diagram**
- **Facility Profile**

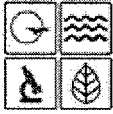
APPENDIX – PROCESS FLOW DIAGRAM:



APPENDIX – FACILITY PROFILE:



1 PEAK THROUGHPUT FLOW 800 GPM
NOT TO SCALE



MISSOURI DEPARTMENT OF NATURAL RESOURCES
 WATER PROTECTION PROGRAM
**APPLICATION FOR CONSTRUCTION PERMIT –
 WASTEWATER TREATMENT FACILITY**


FOR DEPARTMENT USE ONLY	
APP NO.	CP NO.
FEE RECEIVED	CHECK NO.
DATE RECEIVED	

APPLICATION OVERVIEW

The Application for Construction Permit – Wastewater Treatment Facility form has been developed in a modular format and consists of Part A and B. **All applicants must complete Part A.** Part B should be completed for applicants who currently land-apply wastewater or propose land application for wastewater treatment. **Please read the accompanying instructions before completing this form. Submittal of an incomplete application may result in the application being returned.**

PART A – BASIC INFORMATION

1.0 APPLICATION INFORMATION (Note – If any of the questions in this section are answered NO, this application may be considered incomplete and returned.)

- 1.1 Is this a Federal/State funded project? YES N/A Funding Agency: _____ Project #: _____
- 1.2 Has the Missouri Department of Natural Resources approved the proposed project's antidegradation review?
 YES Date of Approval: _____ N/A
- 1.3 Has the department approved the proposed project's facility plan*?
 YES Date of Approval: 10-19-2021 NO (If No, complete No. 1.4.)
- 1.4 [Complete only if answered No on No. 1.3.] Is a copy of the facility plan* for wastewater treatment facilities included with this application?
 YES NO Exempt because _____
- 1.5 Is a copy of the appropriate plans* and specifications* included with this application?
 YES Denote which form is submitted: Hard copy Electronic copy (See instructions.) NO
- 1.6 Is a summary of design* included with this application? YES NO
- 1.7 Has the appropriate operating permit application (A, B, or B2) been submitted to the department?
 YES Date of submittal: _____
 Enclosed is the appropriate operating permit application and fee submittal. Denote which form: A B B2
 N/A: However, In the event the department believes that my operating permit requires revision to permit limitation such as changing equivalent to secondary limits to secondary limits or adding total residual chlorine limits, please share a draft copy prior to public notice? YES NO
- 1.8 Is the facility currently under enforcement with the department or the Environmental Protection Agency? YES NO
- 1.9 Is the appropriate fee or JetPay confirmation included with this application? YES NO
 See Section 7.0 

* Must be affixed with a Missouri registered professional engineer's seal, signature and date.

2.0 PROJECT INFORMATION

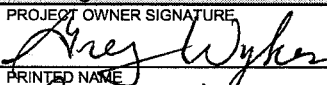
2.1 NAME OF PROJECT Department of Corrections Wastewater Treatment Facility Improvements	2.2 ESTIMATED PROJECT CONSTRUCTION COST \$ 2,950,000
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2.3 PROJECT DESCRIPTION
 This project improvements include the addition of aerators to Lagoon Cells #1, #2, and #3, Triplepoint Nitrox Tanks for ammonia treatment, UV for E. coli and an effluent flow meter.

2.4 SLUDGE HANDLING, USE AND DISPOSAL DESCRIPTION
 Sludge will be removed in Lagoon Cell #3 and disposed of in accordance with State and Federal laws. Sludge will be retained in the Lagoon Cell #1 and #2.

2.5 DESIGN INFORMATION
 A. Current population: _____; Design population: 4750
 B. Actual Flow: _____ gpd; Design Average Flow: 470,000 gpd;
 Actual Peak Daily Flow: _____ gpd; Design Maximum Daily Flow: 864,000 gpd; Design Wet Weather Event: 1,728,000 gpd

2.6 ADDITIONAL INFORMATION
 A. Is a topographic map attached? YES NO
 B. Is a process flow diagram attached? YES NO

3.0 WASTEWATER TREATMENT FACILITY				
NAME Moberly Correctional Center WWTF		TELEPHONE NUMBER WITH AREA CODE 573-526-6512		E-MAIL ADDRESS greg.wykes@doc.mo.gov
ADDRESS (PHYSICAL) 5201 South Morley Street		CITY Moberly	STATE MO	ZIP CODE 65270
COUNTY Randolph				
Wastewater Treatment Facility: Mo- 0053937 (Outfall 1 Of 1)				
3.1 Legal Description: SE ¼, NW ¼, NE ¼, Sec. 25, T 53N, R 14W (Use additional pages if construction of more than one outfall is proposed.)				
3.2 UTM Coordinates Easting (X): 549016 Northing (Y): 4357131 For Universal Transverse Mercator (UTM), Zone 15 North referenced to North American Datum 1983 (NAD83)				
3.3 Name of receiving streams: Tributary to Coon Creek				
4.0 PROJECT OWNER				
NAME Department of Corrections		TELEPHONE NUMBER WITH AREA CODE 573-526-6512		E-MAIL ADDRESS greg.wykes@doc.mo.gov
ADDRESS 2729 Plaza Drive		CITY Jefferson City	STATE MO	ZIP CODE 65102
5.0 CONTINUING AUTHORITY: A continuing authority is a company, business, entity or person(s) that will be operating the facility and/or ensuring compliance with the permit requirements.				
NAME		TELEPHONE NUMBER WITH AREA CODE		E-MAIL ADDRESS
ADDRESS		CITY	STATE	ZIP CODE
5.1 A letter from the continuing authority, if different than the owner, is included with this application. <input type="checkbox"/> YES <input type="checkbox"/> NO <input checked="" type="checkbox"/> N/A				
5.2 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A MISSOURI PUBLIC SERVICE COMMISSION REGULATED ENTITY.				
A. Is a copy of the certificate of convenience and necessity included with this application? <input type="checkbox"/> YES <input type="checkbox"/> NO				
5.3 COMPLETE THE FOLLOWING IF THE CONTINUING AUTHORITY IS A PROPERTY OWNERS ASSOCIATION.				
A. Is a copy of the as-filed restrictions and covenants included with this application? <input type="checkbox"/> YES <input type="checkbox"/> NO				
B. Is a copy of the as-filed warranty deed, quitclaim deed or other legal instrument which transfers ownership of the land for the wastewater treatment facility to the association included with this application? <input type="checkbox"/> YES <input type="checkbox"/> NO				
C. Is a copy of the as-filed legal instrument (typically the plat) that provides the association with valid easements for all sewers included with this application? <input type="checkbox"/> YES <input type="checkbox"/> NO				
D. Is a copy of the Missouri Secretary of State's nonprofit corporation certificate included with this application? <input type="checkbox"/> YES <input type="checkbox"/> NO				
6.0 ENGINEER				
ENGINEER NAME / COMPANY NAME Valerie Holland, P.E./Bartlett & West, Inc		TELEPHONE NUMBER WITH AREA CODE 573-659-6714		E-MAIL ADDRESS valerie.holland@bartwest.com
ADDRESS 1719 Southridge Drive, Suite 100		CITY Jefferson City	STATE MO	ZIP CODE 65109
7.0 APPLICATION FEE				
<input checked="" type="checkbox"/> CHECK NUMBER State of Missouri to transfer money. JETPAY CONFIRMATION NUMBER				
8.0 PROJECT OWNER: I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.				
PROJECT OWNER SIGNATURE 				
PRINTED NAME Greg Wykes			DATE 2-9-22	
TITLE OR CORPORATE POSITION Energy Management Coordinator		TELEPHONE NUMBER WITH AREA CODE 573-526-6512		E-MAIL ADDRESS greg.wykes@doc.mo.gov
Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES WATER PROTECTION PROGRAM P.O. BOX 176 JEFFERSON CITY, MO 65102-0176				
END OF PART A.				
REFER TO THE APPLICATION OVERVIEW TO DETERMINE WHETHER PART B NEEDS TO BE COMPLETE.				

APPENDIX D

LAND DISTURBANCE PERMIT

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI CLEAN WATER COMMISSION



MISSOURI STATE OPERATING PERMIT

General Operating Permit

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No MOR100038
Owner: OA-Facilities Mgmt, Design, and Construc
Address: 301 West High Street, Hst Rm 370
Jefferson City, MO 65101

Continuing Authority: OA Facilities Mgmt Design Construction
301 West High St.
Hst Rm 730
Jefferson City, MO 65102

Facility Name: Office of Administration
Facility Address: OA-FMDC, PO Box 809 301 W High street
JEFFERSON CITY, MO 65102

Legal Description: Land Grant 681, Cole County
UTM Coordinates: 571840.000/4270368.000
Receiving Stream: Various State Wide (U)
First Classified Stream - ID#: Missouri R. (P) 701.00
USGS# and Sub Watershed#: 10300102 - 1305

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein.

FACILITY DESCRIPTION All Outfalls SIC #1629

All Outfalls - Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading, filling and other activity that results in the destruction of the root zone and/or land disturbance activity that is reasonably certain to cause pollution of waters of the state)

This permit authorizes only wastewater, including storm water, discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System, it does not apply to other regulated areas. This permit may be appealed in accordance with RSMo Section 644.051.6 and 621.250, 10 CSR 20-6.020, and 10 CSR 20-1.020.

July 01, 2017

Issue Date

Edward B. Galbraith, Director
Division of Environmental Quality

June 22, 2022

Expiration Date

David J. Lamb, Acting Director
Water Protection Program

APPLICABILITY

1. This general permit authorizes the discharge of stormwater and certain non-stormwater discharges from land disturbance sites that disturb one or more acres or disturb less than one acre when part of a larger common plan of development or sale that will disturb a cumulative total of one or more acres over the life of the project. This general permit also authorizes the discharge of stormwater and certain non-stormwater discharges from smaller projects where the Missouri Department of Natural Resources (department) has exercised its discretion to require a permit [10 CSR 20-6.200(1)(B)].
2. This general permit is issued to a city, county, state or federal agency or other governmental jurisdiction for land disturbance projects performed by or under contract to the permittee.
3. A general stormwater control plan or stormwater pollution prevention plan (SWPPP) must be developed prior to issuance of this permit. These plans must include a narrative of the types and appropriate uses of Best Management Practices (BMPs) for erosion and sediment control and stormwater management. All water pollution controls on land disturbance sites shall conform to the storm water control program and/or SWPPP of the city, county or other governmental jurisdiction in which the land disturbance activity is occurring. The requirements of the stormwater control program and/or SWPPP must be at least as stringent as those described in this permit and 10 CSR 20-6.200.
4. A Missouri State Operating Permit must be issued before any site vegetation is removed or the site disturbed. Any site owner/operator subject to these requirements for stormwater discharges and who disturbs land prior to permit issuance from the department is in violation of both State regulations per 10 CSR 20-6.200(1)(A) and Federal regulations per 40 CFR 122.26. The legal owner of the property, right-of-way or the holder of an easement on the property, and operator on which the site is located are responsible for compliance with this permit.
5. This permit authorizes discharges from construction support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) provided that appropriate stormwater controls are designed, installed, maintained and provided:
 - a. The support activity is directly related to the construction site required to have permit coverage for stormwater discharges;
 - b. The support activity is not a commercial operation; and
 - c. The support activity does not continue to operate beyond the completion of the construction activity at the project it supports.The permittee is responsible for compliance with this permit for any construction support activities.
6. This permit authorizes non-stormwater discharges from the following activities provided that these discharges are addressed in the permittee's specific SWPPP required by this general permit:
 - a. Dewatering activities if there are no contaminants other than sediment present in the discharge, and the discharge is treated as specified in Requirements, Section 10.o. of this permit;
 - b. Flushing water hydrants and potable water lines;
 - c. Water only (i.e., without detergents or additives) rinsing of streets and buildings; and
 - d. Site watering to establish vegetation.
7. This general permit does not authorize the:
 - a. placement of fill materials in waters or floodplains
 - b. obstruction of stream flow,
 - c. redirection of stormwater across private property not owned or operated by the permittee, or

d. Changing the channel of a defined drainage course.

These actions may be regulated by other federal, state, or local entities, such as the U.S. Army Corps of Engineers or Federal Emergency Management Agency. This general permit addresses only the quality of the stormwater runoff and the minimization of off-site migration of sediments and other water contaminants.

8. This permit does not authorize land disturbance activity in jurisdictional waters of the United States, unless the permittee has obtained the required Clean Water Act Section 404 Department of the Army permit from the U.S. Army Corps of Engineers and its associated Section 401 Water Quality Certification from the department. Land disturbance activities may not begin in the affected waters of the United States until the required §404 permit and §401 water quality certification have been obtained.
9. This general permit prohibits any discharge of wastewater generated from air pollution control equipment or the containment of scrubber water in lined ponds to waters of the state.
10. This general permit prohibits any discharge of sewage or pollutants to waters of the state including but not limited to:
 - a. Any hazardous material, oil, lubricant, solid waste or other non-naturally occurring substance from the site, including fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance;
 - b. Soaps or solvents used in vehicle and equipment washing;
 - c. Hazardous substances or petroleum products from an on-site spill or handling and disposal practices;
 - d. Wash and/or rinse waters from concrete mixing equipment including ready mix concrete trucks, unless managed by an appropriate control. Any such pollutants must be adequately treated and addressed in the SWPPP, and cannot be discharged to waters of the state;
 - e. Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;
 - f. Domestic wastewaters, including gray waters; or
 - g. Industrial stormwater runoff.
11. The department reserves the right to revoke or deny coverage under this general permit to applicants for stormwater discharges from land disturbance activities at sites that have contaminated soils that will be disturbed by the land disturbance activity or where such materials are brought to the site to use as fill or borrow. A site-specific permit may be required to cover such activities.
12. If at any time the department determines that the quality of waters of the state may be better protected by requiring the owner/operator of the permitted site to apply for a site-specific or different general permit, the department may do so [10 CSR 20-6.010(13)(C)]. Examples of when this may occur:
 - a. The permittee is not in compliance with the conditions of this general permit;
 - b. The discharge no longer qualifies for this general permit due to changed site conditions and/or regulations; or
 - c. Information becomes available that indicates water quality standards have been or may be violated.The permittee will be notified in writing of the requirement to apply for a site-specific permit or a different general permit. When issued to the authorized permittee, the applicability of this general permit to the permittee is automatically terminated upon the effective date of the site-specific or different general permit.
13. Any owner/operator authorized by a general permit may request to be excluded from the coverage of the general permit and apply for a site-specific permit [10 CSR 20-6.010(13)(D)].

14. This operating permit does not affect, remove, or replace any requirement of the National Environmental Policy Act; the Endangered Species Act; the National Historic Preservation Act; the Comprehensive Environmental Response, Compensation and Liability Act; or the Resource Conservation and Recovery Act. Determination of applicability for the above mentioned acts is the responsibility of the permittee.
15. This permit does not supersede any requirement for obtaining project approval under an established local authority.
16. This permit is not transferable to other owners or operators.

EXEMPTIONS FROM PERMIT REQUIREMENTS

1. Facilities that discharge all stormwater runoff directly to a combined sewer system are exempt from stormwater permit requirements.
2. Land disturbance activity as described in 10 CSR 20-6.010(1)(B) and 10 CSR 20-6.200(1)(B).
3. Oil and gas related activities as listed in 40 CFR 122.26(a)(2)(ii).

REQUIREMENTS

1. Electronic Discharge Monitoring Report (eDMR) Submission System.
Per 40 CFR Part 127 National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule, reporting shall be submitted by the permittee via an electronic system to ensure timely, complete, accurate, and nationally-consistent set of data about the NPDES program. All general permit covered facilities under this master general permit shall comply with the department's requirements for electronic reporting.
 - a. Reporting Requirements.
 - (1) Application to participate in the department's eDMR system is required as part of the application for general permit coverage in order to constitute a complete permit application and may be accessed at dnr.mo.gov/env/wpp/edmr.htm.
 - (2) The permittee must electronically submit quarterly reports via the eDMR system.
 - b. Other actions. The following shall be submitted electronically after such a system has been made available by the department:
 - (1) General Permit Applications/Notices of Intent to discharge (NOIs);
 - (2) Notices of Termination (NOTs);
 - (3) No Exposure Certifications (NOEs); and
 - (4) Low Erosivity Waivers and Other Waivers from Stormwater Controls (LEWs).
 - c. Electronic Submissions. To access the eDMR system, use the following web link: <https://edmr.dnr.mo.gov/edmr/E2/Shared/Pages/Main/Login.aspx>.
 - d. Waivers from Electronic Reporting.
 - (1) The permittee must electronically submit reports unless a waiver is granted by the department in compliance with 40 CFR Part 127.
 - (2) The permittee may obtain a temporary or permanent electronic reporting waiver by first submitting an eDMR Waiver Request Form (Form 780-2692: <http://dnr.mo.gov/forms/780-2692-f.pdf>), by contacting the appropriate permitting office or emailing edmr@dnr.mo.gov. The department will either approve or deny this electronic reporting waiver request within 120 calendar days of receipt.
 - (3) Only permittees with an approved waiver request may submit reports on paper to the Department for the period that the approved electronic reporting waiver is effective.
2. Quarterly Reports: Permittees shall prepare a quarterly report with a list of active land disturbance sites including any off-site borrow or depositional areas associated with the construction project

and submit the following information electronically as an attachment to the eDMR system until such a time when the current or a new system is available to allow direct input of the data:

- a. The name of the project;
- b. The location of the project (including the county);
- c. The name of the primary receiving water(s) for each project;
- d. A description of the project;
- e. The number of acres disturbed;
- f. The percent of completion of the project;
- g. The projected date of completion.

The quarterly report(s) shall be maintained by the permittee and readily available for review by the department at the address provided on the application as well as submitted to the department quarterly via the department's eDMR system. When a permittee terminates permit coverage, the permittee shall submit with the request for termination, the final quarterly report for the current calendar quarter. The permittee shall submit quarterly reports according to Table A.

Table A Schedule for Quarterly Reporting	
Activity for the months of:	Report is due:
January, February, March (1st Quarter)	April 28
April, May, June (2nd Quarter)	July 28
July, August, September (3rd Quarter)	October 28
October, November, December (4th Quarter)	January 28

3. This permit is to ensure the design, installation and maintenance of effective erosion and sediment controls minimize the discharge of pollutants by:
 - a. Controlling stormwater volume and velocity within the site to minimize soil erosion;
 - b. Controlling stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion and scour in the immediate vicinity of discharge points;
 - c. Minimizing the amount of soil exposed during construction activity;
 - d. Minimizing the disturbance of steep slopes;
 - e. Addressing factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle size expected to be present on the site to minimize sediment discharges from the site;
 - f. Providing and maintaining natural buffers around surface waters as detailed in 10.f,
 - g. Directing stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration and filtering, unless infeasible; and
 - h. Minimizing soil compaction and, unless infeasible, preserve topsoil. Minimizing soil compaction or preserving topsoil is not required where the intended function of a specific area of the site dictates that it be compacted or the topsoil be disturbed or removed.
4. Installation of Best Management Practices (BMPs) necessary to prevent soil erosion at the project boundary must be complete prior to the start of all phases of construction.
5. Install sediment controls along any perimeter areas of the site..
 - a. Remove any sediment per the manufacturer's instructions or before it has accumulated to one-half of the above-ground height of any perimeter control.
 - b. For sites where perimeter controls are infeasible, other practices shall be implemented to minimize discharges to perimeter areas of the site.
6. BMPs shall be maintained and remain in effective operating condition during the entire duration of the project, with repairs made within the timeframe specified in the Requirements Section 9 of this permit, until final stabilization has been achieved.
7. Minimize sediment track-out from the site.
 - a. Restrict vehicle traffic to properly designed exit points such as an aggregate stone with an underlying geotextile or non-woven filter fabric.

- b. Use appropriate stabilization techniques at all points that exit onto paved roads.
 - c. Remove any sediment that has been tracked out within the same business day or by the end of the next business day if track-out occurs on a non-business day.
8. SWPPP Development and Implementation: The primary requirement of this permit is the development and implementation of a SWPPP which incorporates site-specific practices to best minimize the soil exposure, soil erosion, and the discharge of pollutants. The permittee shall fully implement the provisions of the SWPPP required under this part as a condition of this general permit throughout the term of the land disturbance project. **The SWPPP must be developed prior to issuance of the permit and must be updated with details specific to the land disturbance site prior to conducting any land disturbance activities at the site.** Either an electronic copy or a paper copy of the SWPPP must be accessible to anyone on-site at all times when land disturbance operations are in progress, or other operational activities that may affect the maintenance or integrity of the BMP structures and made available as specified under the Records Section of this permit.
9. The SWPPP must:
- a. List and describe all points of discharge to receiving water(s);
 - b. Incorporate required practices identified below;
 - c. Incorporate erosion control practices specific to site conditions;
 - d. Provide for maintenance and adherence to the plan;
 - e. Discuss whether or not additional authorizations, such as a Section 404 permit and associated Section 401 Water Quality Certification are required for the project; and
 - f. Name the person responsible for inspection, operation and maintenance of BMPs.

The purpose of the SWPPP is to ensure the design, implementation, management and maintenance of BMPs in order to prevent sediment and other pollutants in stormwater discharges associated with the land disturbance activities; compliance with the Missouri Water Quality Standards; and compliance with the terms and conditions of this general permit.

The following manuals are acceptable resources for the selection of appropriate BMPs. *Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites*, (Document number EPA 833-R-06-004) published by the United States Environmental Protection Agency (USEPA) in May 2007. This manual as well as other information, including examples of construction SWPPPs, is available at the USEPA internet site at <https://www.epa.gov/npdes/developing-stormwater-pollution-prevention-plan-swppp>; and the latest version of *Protecting Water Quality: A field guide to erosion, sediment and stormwater best management practices for development sites in Missouri*, published by the department is available on the department's internet site at <http://www.dnr.mo.gov/env/wpp/wpcp-guide.htm>.

The permittee is not limited to the use of these guidance manuals. Other guidance publications may be used to select appropriate BMPs. However, all BMPs should be described and justified in the SWPPP.

10. SWPPP Requirements: The following information and practices shall be provided for in the SWPPP:
- a. Nature of the Construction Activity: The SWPPP briefly must describe the nature of the construction activity, including:
 - (1) The function of the project (e.g., low density residential, shopping mall, highway, etc.);
 - (2) The intended sequence and timing of activities that disturb the soils at the site;
 - (3) Estimates of the total area expected to be disturbed by excavation, grading, or other construction activities including off-site borrow and fill areas; and
 - (4) A general map (e.g., United States Geological Survey quadrangle map, a portion of a city or county map, or other map) with enough detail to identify the location of the construction site and waters of the state within one mile of the site.

- b. Site Map: The SWPPP must contain a legible site map showing the site boundaries and points of discharge to receiving water(s) and identifying:
- (1) Direction(s) of stormwater flow and approximate slopes for all phases of construction activities;
 - (2) Areas of soil disturbance and areas that will not be disturbed (or a statement that all areas of the site will be disturbed unless otherwise noted);
 - (3) Location of permanent and temporary structural and non-structural BMPs identified in the SWPPP;
 - (4) Locations where stabilization practices are expected to occur;
 - (5) Locations of off-site material, waste, borrow or equipment storage areas;
 - (6) Locations of all waters of the state (including wetlands);
 - (7) Locations where stormwater discharges to a surface water; and
 - (8) Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.
- c. Site Description: In order to identify the site, the SWPPP shall include facility and points of discharge to receiving water(s) information. The SWPPP shall have sufficient information to be of practical use to contractors and site construction workers to guide the installation and maintenance of BMPs.
- d. Selection of Temporary and Permanent BMPs: The permittee shall select, install, use, operate and maintain appropriate BMPs for the permitted site and list them in the SWPPP.
- e. Preservation of trees and vegetation: The SWPPP shall require existing vegetation and trees to be preserved where practical.
- f. Surface Water Buffers: For surface waters of the state, defined as “all waters within the jurisdiction of this state, including all rivers, streams, lakes and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common, located on or adjacent to the site,” the permittee must comply with (1)-(3), except as noted in (4):
- (1) Provide and maintain a 50-foot undisturbed natural buffer;
 - (2) Provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by erosion and sediment controls that achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer; or
 - (3) If infeasible to provide and maintain an undisturbed natural buffer of any size, implement erosion and sediment controls to achieve the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.
 - (4) The permittee is not required to comply with (1), (2) or (3) above if one of the following exceptions apply and documentation is provided in the SWPPP:
 - (a) As authorized per Clean Water Act Section 404 Department of the Army permit and its associated Section 401 Water Quality Certification from the department.
 1. The angle of any crossing shall be as perpendicular as feasible to the water course or natural stream buffer to minimize adverse impacts.
 - (b) If there is no discharge of stormwater to waters of the state through the area between the disturbed portions of the site and waters of the state located within 50 feet of your site. This includes situations where you have implemented permanent control measures that will prevent such discharges, such as a berm or other barrier.
 - (c) Where no natural buffer exists due to preexisting development disturbances that occurred prior to the initiation of planning for the current development of the site.
 1. Where some natural buffer exists but portions of the area within 50 feet of the waters of the state are occupied by preexisting development disturbances, you are required to comply with (1), (2), or (3) above.
 - (d) For linear projects where site constraints make it infeasible to implement a buffer or equivalent provided you limit disturbances within 50 feet of any waters of the state and/or you provide supplemental erosion and sediment controls to treat stormwater

discharges from earth disturbances within 50 feet of the water of state.

- (e) For small residential lot construction as defined as 'a lot being developed for residential purposes that will disturb less than 1 acre of land, but is part a larger common plan of development or sale,' one has the option of complying with (1), (2) or (3) above or one of the following alternatives:
 - 1. Tiered-technology approach where:
 - a. A 50-foot or larger buffer is retained, no additional requirements are needed,
 - b. The buffer is greater than 30 feet but less than 50 feet wide, implement double perimeter controls spaced a minimum of at least 5 feet apart between land disturbance and water of the state, or
 - c. A less than or equal to 30-foot buffer is maintained, implement double perimeter controls between land disturbance and water of the state and stabilization activities completed with 7 calendar days of temporary or permanent cessation of land disturbance; or
 - 2. Sediment discharge risk based on the site's slope, location and soil type when combined with buffer width.

- g. Measuring Buffer Width: Where the permittee is retaining a buffer of any size, the buffer should be measured perpendicularly from any of the following points, whichever is further landward from the water:
 - (1) The ordinary high water mark of the water body, defined as the line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, and/or the presence of litter and debris; or
 - (2) The edge of the stream or river bank, bluff, or cliff, whichever is applicable.

- h. Description of BMPs: The SWPPP shall include a description of both structural and non-structural BMPs used one or more times at the site, providing the following general information for each:
 - (1) Physical description of the BMP;
 - (2) Site conditions that must be met for effective use of the BMP;
 - (3) BMP installation/construction procedures, including typical drawings; and
 - (4) Operation and maintenance procedures for the BMP.

- i. Specific Instance of BMPs: The SWPPP shall provide the following information for each specific instance where a BMP is to be installed:
 - (1) Whether the BMP is temporary or permanent;
 - (2) Where, in relation to other site features, the BMP is to be located;
 - (3) When the BMP will be installed in relation to each phase of the land disturbance procedures to complete the project; and
 - (4) Site conditions that must be met before removal of the BMP if the BMP is not a permanent BMP.

- j. Disturbed Areas: Slopes for disturbed areas must be defined in the SWPPP. A site map or maps defining the sloped areas for all phases of the project must be included in the SWPPP.
 - (1) For soil disturbing activities that have temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days:
 - (a) The permittee shall construct BMPs to establish interim stabilization; and
 - (b) Stabilization must be initiated immediately and completed within 14 calendar days.
 - (2) For soil disturbing activities that have been permanently ceased on any portion of the site, final stabilization of disturbed areas must be initiated immediately and completed within 14 calendar days.
 - (3) Allowances to the 14 day completion period for temporary and final stabilization may be made due to weather and equipment malfunctions. In drought-stricken areas where initiating vegetative stabilization measures immediately are infeasible, alternative stabilization measures must be employed. The use of allowances shall be documented in the SWPPP.

- (4) Interim stabilization shall consist of well-established and maintained BMPs that are reasonably certain to protect waters of the state from sediment pollution over an extended period of time. This may require adding more BMPs to an area than is normally used during daily operations. These BMPs may include a combination of sediment basins, check dams, sediment fences and mulch. The types of BMPs used must be suited to the area disturbed, taking into account the number of acres exposed and the steepness of the slopes. If the slope of the area is greater than 3:1 (three feet horizontal to one foot vertical) or if the slope is greater than 3% and greater than 150 feet in length, then the permittee shall establish interim stabilization within seven days of ceasing operations on that part of the site.
 - (5) In limited circumstances, stabilization may not be required if the intended function of a specific area of the site necessitates that it remain disturbed.
- k. Installation: The permittee shall ensure the BMPs are properly installed at the locations and relative times specified in the SWPPP.
- (1) Peripheral or border BMPs to control runoff from disturbed areas shall be installed or marked for preservation before general site clearing is started. Note that this requirement does not apply to earth disturbances related to initial site clearing and establishing entry, exit and access of the site, which may require that stormwater controls be installed immediately after the earth disturbance.
 - (2) For phased projects, BMPs shall be properly installed as necessary prior to construction activities.
 - (3) Stormwater discharges from disturbed areas which leave the site shall pass through an appropriate impediment to sediment movement such as a sedimentation basin, sediment traps and/or silt fences prior to leaving the land disturbance site.
 - (4) A drainage course change shall be clearly marked on a site map and described in the SWPPP.
 - (5) If vegetative stabilization measures are being implemented, stabilization is considered “installed” when all activities necessary to seed or plant the area are completed.
- l. Sedimentation Basins: The SWPPP shall include a sedimentation basin for each drainage area with ten or more acres disturbed at one time.
- (1) The sedimentation basin shall be sized to a local 2-year, 24-hour storm. A 2-year, 24-hour storm event shall be determined for the project location using the National Oceanic and Atmospheric Administration’s National Weather Service Atlas 14 which can be located at <http://hdsc.nws.noaa.gov/hdsc/pfds/>.
 - (2) Basins designed and initiated under the 2012 Area-Wide Land Disturbance General Permit MO-R100038 or prior authorizations shall comply with the requirements held in those authorizations. Any construction activities designed and initiated under this authorization shall comply with the local 2-year, 24-hour storm event by January 1, 2018.
 - (3) Accumulated sediment shall be removed from the basin when basin is 50% full.
 - (4) Utilize outlet structures that withdraw water from the surface when discharging from basins and impoundments unless infeasible.
 - (5) Discharges from the basin shall not cause scouring of the banks or bottom of the receiving stream.
 - (6) The SWPPP shall require the basin be maintained until final stabilization of the disturbed area served by the basin.
 - (7) The SWPPP shall require both temporary and permanent sedimentation basins to have a stabilized spillway to minimize the potential for erosion of the spillway or basin embankment.
 - (8) Where use of a sediment basin is infeasible, the SWPPP shall evaluate and specify other similarly effective BMPs to be employed to control erosion and sediment delivery. These similarly effective BMPs shall be selected from appropriate BMP guidance documents authorized by this permit. The BMPs must provide equivalent water quality protection to achieve compliance with this permit.

- m. Pollution Prevention Measures: The SWPPP shall include BMPs for pollution prevention measures. At minimum such measures must be designed, installed, implemented and maintained to:
- (1) Minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other wash waters. Wash waters must be treated in a sediment basin or alternative control that provides equivalent or better treatment prior to discharge;
 - (2) Minimize the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste, and other materials present on the site to precipitation and to stormwater. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in a discharge of pollutants, or where exposure of a specific material or product poses little risk or stormwater contamination (such as final products and material intended for outdoor use);
 - (3) Minimize the discharge of pollutants from spills and leaks and implement chemical spill and leak prevention and response procedures. Included but not limited to the installation of containment berms and use of drip pans at petroleum product and liquid storage tanks and containers; and
- n. Roadways: Where applicable, upon installation of or connection to roadways, all efforts should be made to prevent the deposition of earth and sediment onto roadways through the use of proper BMPs.
- (1) Stormwater inlets susceptible to receiving sediment from the permitted land disturbance site shall have curb inlet protection.
 - (2) Where stormwater will flow off the end of where a roadway terminates, a sediment catching BMP such as gravel berm or silt fence shall be provided.
 - (3) Curb inlets shall be cleaned weekly or following a precipitation event that generates a run-off.
- o. Dewatering: Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, are prohibited unless managed by appropriate controls. The SWPPP shall include a description of any anticipated dewatering methods.
- (1) The SWPPP shall call for specific BMPs designed to treat water pumped from trenches and excavations and in no case shall this water be pumped off-site without being treated by the specified BMPs.
11. Good housekeeping practices shall be maintained at all times to keep waste from entering waters of the state. Solid and hazardous waste management include providing trash containers and regular site cleanup for proper disposal of solid waste such as scrap building material, product/material shipping waste, and food containers and cups, and providing containers and proper disposal of waste paints, solvents and cleaning compounds. The provision of portable toilets for proper disposal of sanitary sewage and the storage of construction materials should be kept away from drainage courses and low areas.
12. All fueling facilities present shall at all times adhere to applicable federal and state regulations concerning underground storage, above ground storage and dispensers.
13. Hazardous substances that are transported, stored, or used for maintenance, cleaning, or repair shall be managed according to the provisions of the Missouri Hazardous Waste Laws and Regulations.
14. Containers: All paint, solvents, petroleum products, petroleum waste products and storage containers such as drums, cans, or cartons shall be stored according to BMPs. The materials exposed to precipitation shall be stored in watertight, structurally sound, closed containers. All containers shall be inspected for leaks or spillage during the inspection of BMPs.

15. Amending/Updating the SWPPP: The permittee shall amend and update the SWPPP as appropriate during the term of the land disturbance activity. The permittee shall amend the SWPPP at a minimum whenever the:
 - a. Design, operation, or maintenance of BMPs is changed;
 - b. Design of the construction project is changed that could significantly affect the quality of the stormwater discharges;
 - d. Department notifies the permittee in writing of deficiencies in the SWPPP;
 - e. SWPPP is determined to be ineffective in minimizing or controlling erosion and sedimentation (e.g., there is visual evidence of excessive site erosion or excessive sediment deposits in streams or lakes); and/or
 - f. Department determines violations of water quality standards may occur or have occurred.

16. An individual shall be designated by the permittee as the lead for environmental matters. The lead individual for environmental matters shall have a thorough and demonstrable knowledge of the site's SWPPP and sediment and erosion control practices in general. The lead individual for environmental matters or a designated inspector knowledgeable in erosion, sediment and stormwater control principles shall inspect all structures that function to prevent pollution of waters of the state

17. Site Inspections: The permittee (or a representative of the permittee) shall conduct regularly scheduled inspections.
 - a. These inspections shall be conducted by a qualified person, one who is responsible for environmental matters at the site, or a person trained by and directly supervised by the person responsible for environmental matters at the site.
 - b. Inspections are only required during the project's normal working hours.
 - c. For disturbed areas that have not been finally stabilized, all installed BMPs and other pollution control measures shall be inspected for proper installation, operation and maintenance.
 - d. Areas on-site that have been stabilized must be inspected at least once per month.
 - (1) For areas where disturbed portions have undergone temporary stabilization at the same time active construction continues on other areas, inspections shall occur at least once a month while stabilized and when re-disturbed shall follow either frequency outlined in subsection h. below.
 - (2) For areas where disturbed portions have undergone final stabilization at the same time active construction continues on other areas, inspection frequency may be cease on the finally stabilized areas according to the following:
 - (a) After the first monthly inspection, inspect once more within 24 hours of a storm event of 0.25 inches or greater.
 - (b) If there are no issues or evidence of stabilization problems, further inspections may cease.
 - (c) If unstable site conditions or sediment movement are observed, the site must be re-stabilized and monthly inspections shall occur until final stabilization is confirmed following a storm event of 0.25 inches or greater.
 - e. All stormwater outfalls shall be inspected for evidence of erosion or sediment deposition.
 - f. When practicable the receiving stream shall also be inspected for 50 feet downstream of the outfall.
 - g. Any structural or maintenance problems shall be noted in an inspection report and corrected as soon as possible but no more than seven calendar days after the inspection.
 - (1) If weather conditions prevent correction of BMPs within seven calendar days, the reasons for the delay must be documented (including pictures) and there must be a narrative explaining why the work cannot be accomplished within the seven day time period.
 - (2) The documentation must be filed with the regular inspection reports.
 - (3) The permittee shall correct the problem as soon as weather conditions allow.
 - h. All BMPs must be inspected in accordance to one of the two schedules listed below, and any

- changes to the frequency of inspections, including switching between the options listed below, must be documented in the SWPPP:
- (1) At least once every seven calendar days and within 48 hours after any storm event equal to or greater than a 2-year, 24-hour storm has ceased during a normal work day and within 72 hours if the event ceases during a non-work day such as a weekend or holiday; or
 - (2) Once every 14 calendar days and within 24 hours of the occurrence of a storm event of 0.25 inches or greater or the occurrence of runoff from snowmelt. To determine if a storm event of 0.25 inches or greater has occurred on-site, the permittee must either keep a properly maintained precipitation gauge on site, or obtain the storm event information from a weather station near the site.
 - (a) Inspections shall be conducted within 24 hours once a storm event has produced 0.25 inches within a 24 hour period, even if the storm event is still continuing.
 - (b) If the permittee has elected to inspect every 14 calendar days and there is a storm event at the site that continues for multiple days, and each day of the storm produces 0.25 inches or more of rain, the permittee is required to conduct an inspection within 24 hours of the first day of the storm and within 24 hours after the end of the storm.
18. The SWPPP must explain how the person responsible for erosion control will be notified when stormwater runoff occurs
19. Site Inspections Reports: A log of each inspection and copy of the inspection report shall be kept readily accessible and must be available upon request by the department. Electronic logs are acceptable as long as reports can be provided in a timely manner. If inspection reports are kept off-site, the SWPPP must indicate where they are stored. The inspection report shall be signed by the permittee or by the person performing the inspection if duly authorized to do so. The inspection report is to include the following minimum information:
- a. Inspector's name;
 - b. Date of inspection;
 - c. Observations relative to the effectiveness of the BMPs;
 - d. Actions taken or necessary to correct the observed problem; and
 - e. Listing of areas where land disturbance operations have permanently or temporarily stopped.
20. Notification to All Contractors: The permittee shall be responsible for notifying each contractor or entity (including utility crews and city employees or their agents) who will perform work at the site of the existence of the SWPPP and what action or precautions shall be taken while on-site to minimize the potential for erosion and the potential for damaging any BMP. The SWPPP shall contain a record of notification; for example, a list of contractors or entities given a copy of the SWPPP or education session sign-in sheet. The permittee is responsible for any damage a subcontractor may do to established BMPs and any subsequent water quality violation resulting from the damage.
21. Public Notification: The permittee shall post a copy of the public notification sign on page 15 of this permit at the main entrance to the site. The public notification sign must be visible from the public road that provides access to the site's main entrance. An alternate location is acceptable provided the public can see it and it is noted in the SWPPP. The public notification sign must remain posted at the site until the permit has been terminated.

OTHER DISCHARGES

A record of each reportable release of hazardous substance shall be retained with the SWPPP and made available to the department upon request. The department may also require the submittal of a written or electronic report detailing measures taken to clean up the spill within five (5) days of the spill. Such a report must include the type of material spilled, volume, date of spill, date clean-up was completed, clean-up method, and final disposal method.

SAMPLING REQUIREMENTS AND EFFLUENT LIMITATIONS

The department may require sampling and reporting as a result of illegal discharges, compliance issues, complaint investigations, or other such evidence of contamination from activities at the site. If such an action is needed, the department will specify in writing any sampling requirements, including such information as location, extent and parameters.

RECORDS

1. The permittee shall retain copies of this general permit, the SWPPP and all amendments for the site, results of any monitoring and analysis, and all site inspection records. The records shall be accessible during normal business hours. The records shall be retained for a period of at least three years from the date of the Letter of Termination.
2. The permittee shall provide a copy of the SWPPP to the department, USEPA, or any local agency or government representative if they request a copy in the performance of their official duties.
3. The permittee shall provide a copy of the SWPPP to those who are responsible for installation, operation, or maintenance of any BMP. The permittee, their representative, and/or the contractor(s) responsible for installation, operation and maintenance of the BMPs shall have a current copy of the SWPPP with them when on the project site.

LAND PURCHASE AND CHANGE OF OWNERSHIP

1. If the permittee sells any portion of the permitted site to a developer for commercial, industrial, or residential use, this land remains a part of the common sale and the new owner must obtain a permit prior to conducting any land disturbance activity. Therefore, the original permittee must amend the SWPPP to show that the property has been sold and therefore no longer under the original permit coverage.
2. Property of any size which is part of a larger common plan of development where the property has been stabilized and the original permit terminated will require application of a new land disturbance permit for any future land disturbance activity unless exempted per 10 CSR 20-6.010(1)(B), 10 CSR 20-6.200(1)(B), and 40 CFR 122.26(a)(2)(ii).
3. If the entire tract is sold to a single entity, then this permit shall be terminated when the new owner obtains a new land disturbance permit for the site.
4. If a portion of a larger common plan of development is sold to an individual for the purpose of building his or her own private residence, a permit is required if the portion of land sold is equal to or greater than one acre while no permit is required for less than one acre of land sold.

TERMINATION

This permit may be terminated when all projects are stabilized. The project is considered to be finally stabilized when perennial vegetation, pavement, buildings, or structures using permanent materials cover all areas that have been disturbed. With respect to areas that have been vegetated, vegetation cover shall be at least 70% over 100% of the site. In order to terminate the permit, the permittee shall notify the department by submitting *Form H- Request for Termination of a General Permit* (<http://dnr.mo.gov/forms/780-1409-f.pdf>).

DUTY TO REAPPLY

Unless terminated, the permittee shall submit an application for the renewal of this permit by submitting *Form E-Application for General Permit* (<http://dnr.mo.gov/forms/780-0795-f.pdf>) and

Form G – Application for Stormwater Permit Under the General Permit: Land Disturbance (<http://dnr.mo.gov/forms/780-1408-f.pdf>) no later than thirty (30) days prior to the permit's expiration date. If a facility submits a timely and complete application in accordance with 10 CSR 20-6.010(5)(B), (5)(C), and (10)(E)1, as well as § 644.051.10, RSMo 2015, if the department is unable, through no fault of the permittee, to issue a renewal prior to expiration of the previous permit, the terms and conditions of the expired permit are administratively continued and will remain fully effective and enforceable until such time when a permit action is taken. Failure to submit a renewal application for a facility that is still in operation is a violation of the Missouri Clean Water Law. As part of the complete application and as required by the federal NPDES eReporting rule, participation in the department's Electronic Discharge Monitoring Report Submission System (eDMR) will be required. Facilities already participating in eDMR need not re-apply upon renewal. More information can be found at: <http://dnr.mo.gov/env/wpp/edmr.htm>. Failure to apply for renewal of a permit may result in termination of this permit and enforcement action to compel compliance with this condition and the Missouri Clean Water Law. This permit may be applied for and issued electronically once made available by the director in accordance with Section 644.051.10, RSMo.

MODIFICATION, REVOCATION, AND REOPENING

1. The full implementation of this operating permit shall constitute compliance with all applicable federal and state statutes and regulations in accordance with §644.051.16, RSMo, and the CWA section 402(k); however, this permit may be reopened and modified, or alternatively revoked and reissued to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a) (2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:
 - a. contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
 - b. controls any pollutant not limited in the permit.
2. If this permit is reopened, modified or revoked pursuant to this Section, the permittee retains all rights under Chapter 536 and 644 Revised Statutes of Missouri upon the department's reissuance of the permit as well as all other forms of administrative, judicial, and equitable relief available under law.

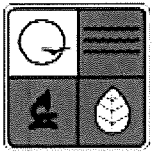
STANDARD CONDITIONS

These Standard Conditions incorporate permit conditions as required by 40 CFR 122.41 or other applicable state statutes or regulations. These minimum conditions apply unless superseded by requirements specified in the permit.

1. Other Information: Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the department, it shall promptly submit such facts or information.
2. Duty to Comply: The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Missouri Clean Water Law and Federal Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.
3. Duty to Provide Information: The permittee shall furnish to the department, within a reasonable time, any information which the department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the department upon request, copies of records required to be kept by this permit.

4. Inspection and Entry: The permittee shall allow the department, or an authorized representative (including an authorized contractor acting as a representative of the department), upon presentation of credentials and other documents as may be required by law, to:
 - a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;
 - b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
 - c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and
 - d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Federal Clean Water Act or Missouri Clean Water Law, any substances or parameters at any location.

5. Signatory Requirement:
 - a. All permit applications, reports required by the permit, or information requested by the department shall be signed and certified. (See 40 CFR 122.22 and 10 CSR 20-6.010)
 - b. The Federal Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or non-compliance shall, upon conviction, be punished by a fine of not more than \$10,000 per violation, or by imprisonment for not more than six (6) months per violation, or by both.
 - c. The Missouri Clean Water Law provides that any person who knowingly makes any false statement, representation or certification in any application, record, report, plan, or other document filed or required to be maintained pursuant to sections 644.006 to 644.141 shall, upon conviction, be punished by a fine of not more than ten thousand dollars, or by imprisonment for not more than six months, or by both.



Missouri
Department of
Natural Resources

STORMWATER DISCHARGES
FROM THIS LAND DISTURBANCE
SITE ARE AUTHORIZED BY THE
MISSOURI STATE OPERATING
PERMIT NUMBER:

ANYONE WITH QUESTIONS OR
CONCERNS ABOUT
STORMWATER DISCHARGES
FROM THIS SITE, PLEASE
CONTACT THE MISSOURI
DEPARTMENT OF NATURAL
RESOURCES AT

1-800-361-4827

Missouri Department of Natural Resources
Fact Sheet
MO-R100038

The Federal Water Pollution Control Act [Clean Water Act (CWA)] Section 402 of Public Law 92-500 (as amended) established the National Pollution Discharge Elimination System (NPDES) permit program. This program regulates the discharge of pollutants from point sources into the waters of the United States, and the release of stormwater from certain point sources. All such discharges are unlawful without a permit (Section 301 of the CWA). After a permit is obtained, a discharge not in compliance with all permit terms and conditions is unlawful. Missouri State Operating Permits (permit) are issued by the Missouri Department of Natural Resources (department) under an approved program, operated in accordance with federal and state laws (Federal CWA and Missouri Clean Water Law Section 644 as amended). Permits are issued for a period of five (5) years unless otherwise specified.

Per 40 CFR 124.56, 40 CFR124.8, and 10 CSR 20-6.020(1)(A)2., a Fact Sheet shall be prepared to give pertinent information regarding the applicable regulations, rationale for the development of effluent limitations and conditions, and the public participation process for the permit. A Fact Sheet is not an enforceable part of a permit.

This Fact Sheet is for a:

- Major
- Minor
- Industrial Facility
- Variance
- Master General Permit
- Permit with widespread public interest

Definitions

Common Promotional Plan: A plan undertaken by one (1) or more persons, to offer lots for sale or lease; where land is offered for sale by a person or group of persons acting in concert, and the land is contiguous or is known, designated or advertised as a common unit or by a common name or similar names, the land is presumed, without regard to the number of lots covered by each individual offering, as being offered for sale or lease as part of a common promotional plan.

Immediately: For the purposes of this permit, immediately should be defined as within 24 hours.

Infeasible: Infeasible means not technologically possible, or not economically practicable and achievable in light of best industry practices.

Larger Common Plan of Development or Sale: A contiguous area where multiple separate and distinct construction activities are occurring under one plan.

Non-structural Best Management Practice: Institutional, educational or pollution prevention practices designed to limit the amount of stormwater runoff or pollutants that are generated in the landscape. An example includes ordinance development.

Ordinary High Water Mark: The line on the shore established by fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation and/or the presence of litter and debris.

Peripheral: For the purposes of this permit, peripheral should be defined as the outermost boundary of the area that will be disturbed.

Permanently: For the purposes of this permit, permanently should be defined as any activity that has been

ceased without any intentions of future disturbance.

Structural Best Management Practice: Physical controls working individually or as a group, appropriate to the source, location, and area climate for the pollutant to be controlled. Examples include moving earth for sedimentation basin and planting vegetation.

Waters of the state: Section 644.016.1(27), RSMo defines waters of the state as, "All waters within the jurisdiction of this state, including all rivers, streams, lakes and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased or otherwise controlled by a single person or by two or more persons jointly or as tenants in common."

Part I – Facility Information

Facility Type: Industrial Stormwater
Facility Description: Construction or land disturbance activity (e.g., clearing, grubbing, excavating, grading, filling, and other activities that result in the destruction of the root zone and/or land disturbance activity that is reasonably certain to cause pollution to waters of the state).

This permit establishes a SWPPP requirement to minimize pollutants of concern from this type of facility or for all facilities covered under this permit. 10 CSR 20-6.200(6)(A)7. specifies that "general permits shall contain BMP requirements and/or monitoring and reporting requirements to keep the stormwater from becoming contaminated." Local conditions are not considered when developing conditions for a general permit. A facility may apply for a site-specific permit if they desire a review of local conditions.

While drafting this permit for renewal, the department hosted four public meetings on January 27, February 24, April 18, and May 19, 2016, which allowed stakeholders to voice concerns about conditions within the permit and submit comments during the period of initial involvement. These concerns were taken into consideration when drafting the permit.

Part II – Receiving Stream Information

APPLICABLE DESIGNATIONS OF WATERS OF THE STATE:

Per Missouri Effluent Regulations (10 CSR 20-7.015), the waters of the state are divided into seven (7) categories. This permit applies to facilities discharging to the following water body categories:

Please mark all appropriate designated waters of the state categories of the receiving stream.

- Missouri or Mississippi River [10 CSR 20-7.015(2)]
- Lakes or Reservoirs [10 CSR 20-7.015(3)]
- Losing Streams [10 CSR 20-7.015(4)]
- Metropolitan No-Discharge Streams [10 CSR 20-7.015(5)]
- Special Streams [10 CSR 20-7.015(6)]
- Subsurface Waters [10 CSR 20-7.015(7)]
- All Other Waters [10 CSR 20-7.015(8)]

Missouri Water Quality Standards (10 CSR 20-7.031) defines the Clean Water Commission water quality objectives in terms of "water uses to be maintained and the criteria to protect those uses." The receiving stream and/or 1st classified receiving stream's beneficial water uses shall be maintained in accordance with 10 CSR 20-7.031(4). The BMP requirement established by this permit are intended to be protective of all streams that fall within the categories of receiving water bodies indicated above. A general permit does not take into consideration site-specific conditions.

Part III – Applicability

Condition number 5 includes support activities. Those support activities are to become part of the land disturbance permitted area and included in the acreage calculations, whether the support activities are located adjacent to, on-site or off-site from the main land disturbance construction area. For example, if the main land disturbance site is 0.6 acres and the project needs fills that is gathered from a borrow site specific to this project which equals 0.5 acres, then the total acreage for this project is an acre or more and the conditions of this permit apply to both the main construction area and the borrow area.

Condition number 14 was expanded to include a more comprehensive list of state and federal requirements that must be taken into consideration.

If the proposed project encounters and will potentially affect a species of concern, please report it to the Missouri Department of Conservation and the United States Fish and Wildlife Service. For more information about requirements of the Endangered Species Act, please visit the following links:

1. To determine the potential for species of concern within or near a project, please visit the United States Fish and Wildlife Services' "Information, Planning and Conservation" website at <http://ecos.fws.gov/ipac/>.
2. If there are listed species in the county or township, check to see if critical habitat has been designated and if that area overlaps or is near the project area. Critical habitat designations and associated requirements may also be found at 50 CFR Parts 17 and 226. For additional information, use the map view tool at <http://criticalhabitat.fws.gov/crithab/> to find data specific to the state and county.

The Missouri Department of Conservation's internet site for the Natural Heritage Review may be very helpful and can be found at the following link, <https://naturalheritagereview.mdc.mo.gov/>.

Part IV – Exemptions

Condition Number 2 was added to cite all state exemptions from permitting requirements, combining several previous cited exemptions into one condition and reference. This includes an exemption for linear construction where the entire disturbance, including clearing of land to access the linear disturbance, is less than two feet in width.

Condition Number 3 was added to cite federal regulations that exclude land disturbance projects related to the installation or maintenance work for oil and gas related activities.

Part V – Rationale of Technology Based Limitations & Permit Conditions

303(d) LIST & TOTAL MAXIMUM DAILY LOAD (TMDL):

Section 303(d) of the Federal CWA requires that each state identify waters that are not meeting Water Quality Standards and for which adequate water pollution controls have not been required. Water Quality Standards protect such beneficial uses of water as whole body contact, maintaining fish and other aquatic life, and providing drinking water for people, livestock, and wildlife. The 303(d) list helps state and federal agencies keep track of waters that are impaired but not addressed by normal water pollution control programs.

ANTI-BACKSLIDING:

A provision in the Federal Regulations [CWA Section 303(d) (4); CWA Section 402(c); 40 CFR Part 122.44(I)] that requires a reissued permit to be as stringent as the previous permit with some exceptions.

- Applicable: Backsliding proposed in this permit conforms to the anti-backsliding provisions of Section 402(o) of the CWA and 40 CFR 122.44. The department has determined that technical mistakes were made in the previous permit [CWA 402(o)(2)(B)(ii)]. The Department has determined that technical mistakes or mistaken interpretations of law were made in issuing the

permit under section 402(a)(1)(b).

Settleable Solids: The Settleable Solids limitation was removed since has been determined to not be a statewide technology or water quality based limitation given a variability of soil type in the state. Increased technology based best management practices have been included and are a more appropriate technology based requirement.

Water Quality Standard Narrative Prohibitions. The previous permit contained language which referenced narrative compliance with the water quality standards found in 10 CSR 20-7.031. In order to comply with 40 CFR 122.44(d)(1), the permit writer has conducted reasonable potential determinations for each general and applicable specific criterion and established numeric effluent limitations where reasonable potential exists. While the removal of the previous permit language creates the appearance of backsliding, the permit writer has evaluated discharges associated with this general permit as to whether reasonable potential to cause excursions of specific or general criteria on a statewide level and found that no reasonable potential exists given the proper implementation of a Stormwater Pollution Prevention Plan and associated best management practices and that the requirements of this permit are equally protective as compared to the previous permit. Therefore, given this new information, and the fact that the previous permit special condition was not consistent with 40 CFR 122.44(d)(1), an error occurred in the establishment of the general criteria as a special condition of the previous permit.

ANTIDegradation:

Antidegradation policies ensure protection of water quality for a particular water body on a pollutant by pollutant basis to ensure Water Quality Standards are maintained to support beneficial uses such as fish and wildlife propagation and recreation on and in the water. This also includes special protection of waters designated as an Outstanding National Resource Water or Outstanding State Resource Water [10 CSR 20-7.031(3) (C)]. Antidegradation policies are adopted to minimize adverse effects on water. The department has determined that the best avenue forward for implementing the Antidegradation requirements into general permits is by requiring the appropriate development and maintenance of a SWPPP. The SWPPP must identify all Best Management Practices (BMPs) that are reasonable and effective, taking into account environmental impacts and costs. This analysis must document why no discharge or no exposure options are not feasible at the facility. This selection and documentation of appropriate control measures will then serve as the analysis of alternatives and fulfill the requirements of the Antidegradation Rule and Implementation Procedure 10 CSR 20-7.031(3) and 10 CSR 20-7.015(9)(A)5.

Any facility seeking coverage under this permit, which undergoes expansion or discharges a new pollutant of concern, must update their SWPPP and select new BMPs that are reasonable and cost effective. New facilities seeking coverage under this permit are required to develop a SWPPP that includes this analysis and documentation of appropriate BMPs. Renewal of coverage for a facility requires a review of the SWPPP to assure that the selected BMPs continue to be appropriate.

- Applicable:** The main pollutant of concern in this permit is sediment. Compliance with the technology-based limitations established in this permit for the protection of General Criteria, along with the evaluation and implementation of BMPs as documented in the SWPPP, meets the requirements of Missouri's Antidegradation Review [10 CSR 20-7.031(3), 10 CSR 20-7.031 Table A, and 10 CSR 20-7.015(9)(A)5].

STORMWATER POLLUTION PREVENTION PLAN (SWPPP):

In accordance with 40 CFR 122.44(3)(k) Best Management Practices (BMPs), BMPs are implemented to control or abate the discharge of pollutants when: (1) Authorized under Section 304(e) of the CWA for the control of toxic pollutants and hazardous substances from ancillary industrial activities; (2) Authorized under Section 402(p) of the CWA for the control of stormwater discharges; (3) Numeric effluent limitations are infeasible; or (4) The practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA.

In accordance with Developing Your Stormwater Pollution Prevention Plan, a Guide for Construction Sites (EPA 833-R-06-004; https://www3.epa.gov/npdes/pubs/sw_swppp_guide.pdf) published by the United States Environmental Protection Agency (EPA) in May 2007, BMPs are measures or practices used to reduce the amount of pollution entering waters of the state. BMPs may take the form of a process, activity, or physical structure. EPA developed resources and tools related to construction stormwater along with the BMPs to control and minimize stormwater (<https://www.epa.gov/npdes/stormwater-discharges-construction-activities>). Along with EPA's resources and tools, the International Stormwater BMP database (www.bmpdatabase.org/index.htm) may provide guidance on BMPs appropriate for specific industries.

Additionally in accordance with Stormwater Management, a SWPPP is a series of steps and activities to (1) identify sources of pollution or contamination, and (2) select and carry out actions which prevent or control the pollution of stormwater discharges.

- Applicable: A SWPPP shall be developed and implemented for each site and shall incorporate required practices identified by the department with jurisdiction, incorporate erosion control practices specific to site conditions, and provide for maintenance and adherence to the plan.

The new permit has been revised to allow permittees to store SWPPP documents electronically as long as they can be provided in an expedient manner.

Release of a hazardous substance must be reported to the department in accordance with 10 CSR 24-3.010. If the spill occurs outside of normal business hours, or if the permit holder cannot reach regional office staff for any reason, the permit holder is instructed to report the spill to the department's 24 hour Environmental Emergency Response hotline at (573) 634-2436 at the earliest practicable moment after discovery. Leaving a message on a department staff member voice-mail does not satisfy this reporting requirement.

WATER QUALITY STANDARDS:

Per 10 CSR 20-7.031(4), General Criteria shall be applicable to all waters of the state at all times, including mixing zones. Additionally, 40 CFR 122.44(d)(1) directs the department to include in each NPDES permit conditions to achieve water quality established under Section 303 of the CWA, including state narrative criteria for water quality.

SPECIFIC CRITERIA CONSIDERATIONS:

An evaluation of discharges associated with land disturbance activities has been conducted to determine if any pollutants discharged under this general permit would have reasonable potential to cause or contribute toward an excursion of specific water quality criterion. Pollutants discharged from land disturbance activities are not commonly associated with pollutants listed as specific criteria in the Missouri Water Quality Standards; therefore, reasonable potential to cause an excursion of a specific criterion does not exist.

GENERAL CRITERIA CONSIDERATIONS:

In accordance with 40 CFR 122.44(d)(1), effluent limitations shall be placed into the permit for those pollutants which have been determined to cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality. The rule further states that pollutants which have been determined to cause, have the reasonable potential to cause, or contribute to an excursion above a narrative criterion within an applicable State water quality standard, the permit shall contain a numeric effluent limitation to protect that narrative criterion. In order to comply with this regulation, the permit writer will complete reasonable potential determinations on whether the discharge will violate any of the general criteria listed in 10 CSR 20-7.031(4). These specific requirements are listed below followed by derivation and discussion [the lettering matches that of the rule itself, under 10 CSR 20-7.031(4)]. It should also be noted that Section 644.076.1, RSMo states that it shall be unlawful for any person to cause or permit any discharge of water contaminants from any water contaminant or point source located in Missouri that is in violation of sections 644.006 to 644.141 of the Missouri Clean Water Law or any

standard, rule or regulation promulgated by the commission.

- (a) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses. The SWPPP requires implementation of best management practices to store, prevent, or minimize stormwater and/or any related land disturbance activity discharges (namely sediment). If one follows their SWPPP and other permit conditions including timely inspections, no reasonable potential to cause an excursion of this narrative exists. Additionally, there had been no indication to the Department that a stream has had issues maintaining beneficial uses as a result of the controlled and managed stormwater discharges per the SWPPP. Therefore, based on the information reviewed during the drafting of this permit, no reasonable potential to cause or contribute to an excursion of this criterion exists.
- (b) Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses. Please see (a) above as justification is the same.
- (c) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses. Please see (a) above as justification is the same.
- (d) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life. This permit addresses discharges from land disturbance activities and it not expected to include an toxic pollutants. Best management practices are to be addressed in the SWPPP should any toxic pollutant of concern be on-site.
- (e) There shall be no significant human health hazard from incidental contact with the water. Please see (a) above as justification is the same.
- (f) There shall be no acute toxicity to livestock or wildlife watering. Please see (d) above as justification is the same.
- (g) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community. Please see (a) above as justification is the same.
- (h) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to section 260.200-260.247. Please see (a) above. Additionally, any solid wastes received or produced at this facility are wholly contained in appropriate storage facilities, are not discharged, and are disposed of offsite. Therefore, this discharge does not have reasonable potential to cause or contribute to an excursion of this criterion.

The settleable solids requirement was removed from this permit and was replaced with additional, more specific BMP requirements. The settleable solids limit was determined not to be protective of all waters across the state, therefore, it was removed. Examples of these BMPs include requirements to:

- Install and maintain perimeter controls along areas of the site that will receive pollutant discharges;
- Minimize sediment track-out from the site;
- Provide storage for runoff up to and including a 2-year, 24-hour storm event when designing sedimentation basins; and
- Direct stormwater to vegetated areas.

The minimum buffer width was increased from 25 feet to 50 feet. Studies have shown that a 50 foot vegetative buffer more adequately treats sediment from stormwater discharges. This appears to be standard in EPA's permit as well as in many other states. A literature review was conducted to assess the effectiveness of buffer widths in relation to sediment removal. In an early literature review on grass buffers in agricultural settings, Dosskey (2001) concluded that 40 -100% of sediment entering from cultivated fields was removed using buffer strips 0.5 to 20 meters. Liu *et al.* (2008) conducted an analysis of 85 estimates of sediment removal by vegetated buffers. They found that sediment removal efficiency (E_s , the percentage of inflowing sediment trapped within a buffer) increased with buffer width according to the relationship: $E_s = 13.4 \log_e(w) + 56.9$ in

which w (m) is buffer width. This equation predicts that E_s increases from 78% for a 5 meter wide buffer to 88% and 97% at widths of 10 meters and 20 meters, respectively. Yaun *et al.* (2009; 93 estimates) and Zhang *et al.* (2010; 81 estimates) garnered similar results to Liu *et al.*

In order to design controls that match the sediment removal efficiency of a 50-foot buffer, first the permittee must know what this efficiency is for the site. The sediment removal efficiencies of natural buffers vary according to a number of site-specific factors, including precipitation, soil type, land cover, slope length, width, steepness, and the types of sediment controls used to reduce the discharge of sediment prior to the buffer.

Sediment removal efficiencies are based on the U.S. Department of Agriculture's RUSLE2 (Revised Universal Soil Loss Equation 2) model for slope profiles using a 100-foot long exposed slopes.

Sediment removal is defined as the annual sediment delivered at the downstream end of the 50-foot natural buffer (tons/yr/acre) divided by the annual yield from cleared area (tons/yr/acre).

Sediment removal is in part a function of (1) a perimeter control (i.e., silt fence) located between the disturbed portion of the site and the upland edge of the natural buffer and (2) stormwater flows traveling through a 50-foot buffer of undisturbed natural vegetation.

Additional guidance may be found at https://www.epa.gov/sites/production/files/2017-02/documents/2017_cgp_final_appendix_g_-_buffer_reqs_508.pdf.

Inspection frequencies: Site inspection frequencies have been changed from the previous permit based upon guidance from the USEPA and from stakeholder discussions. These frequencies will allow flexibility but will still allow for frequent enough inspections to ensure that all BMPs are adequately functioning.

Part VI – Effluent Limitations Determination

In this general permit, Technology-Based Effluent Limitations are established through the SWPPP and BMP requirements. Effective BMPs may have to be designed on a site-specific basis. The implementation of monitoring provides a tool for each facility to evaluate the effectiveness of BMPs to ensure protection of water quality.

Part VII – Land Purchase and Change of Ownership

A “larger common plan of development or sale” is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. This term is used in conjunction with common promotional plan, as defined in §644, RSMo.

Any portion of a project that is sold to a developer is still considered part of a larger common plan of development or sale and will require a permit.

If a portion of a site is sold to an individual for the purpose of building his or her private residence:

- A permit is required if the portion of land sold is equal to or greater than one acre.
- A permit is not required if the portion of land sold is less than one acre.

Part VIII – Termination

The word ‘plant density’ was removed from the first paragraph since the department determined that percent of vegetative cover more accurately describes the vegetative requirements of this permit. This decision was made after discussion within the department and with stakeholders.

It is preferable that temporary BMPs such as sediment fence be removed prior to permit termination to

eliminate potential solid waste issues that may occur as a result of unnecessary and unmaintained BMPs.

Additional options for winter site stabilization as part of the vegetation requirement may exist, such as using a seeded erosion control blanket.

Part IX – Duty to Reapply

This section has been revised to reflect the current applicable statutes which require applicants to submit an application for coverage 30 days prior to expiration of this permit. Currently, a paper application is required; however, applicants are to submit an application for coverage electronically as soon as they are made available by the director. The department will announce the availability status of the new permit and the process to reapply at least 60 days prior to the expiration of the existing permit.

Part X – Standard Conditions

This section was revised to only include the standard conditions that specifically apply to this permit. All other conditions have been removed.

Part XI – Administrative Requirements

On the basis of preliminary staff review and applicable standards and regulations, the department, as administrative agent for the Missouri Clean Water Commission, proposes to issue a permit(s) subject to certain effluent limitations, schedules, and special conditions contained herein and within the permit. The proposed determinations are tentative pending public comment.

PUBLIC NOTICE:

The department shall give public notice that a draft permit has been prepared and its issuance is pending. Additionally, public notice will be issued if a public hearing is to be held because of a significant degree of interest or because of water quality concerns related to a draft permit. No public notice is required when a request for a permit modification or termination is denied; however, the requester and facility must be notified of the denial in writing.

The department must give public notice of a pending permit or of a new or reissued Missouri State Operating Permit. The public comment period is a length of time not less than thirty (30) days following the date of the public notice, during which interested persons may submit written comments about the proposed permit.

For persons wanting to submit comments regarding this proposed permit, please refer to the Public Notice page located at the front of this draft permit. The Public Notice page gives direction on how and where to submit appropriate comments.

- The Public Notice period seeking comments on this permit occurred from March 31 to May 1, 2017.

DATE OF FACT SHEET: 06/16/2017

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