ANNE ARUNDEL COUNTY, MARYLAND
DEPARTMENT OF PUBLIC WORKS

CAPE ST JOHN 1
SEWAGE PUMPING STATION RETROFIT

Project Number S791800
Contract Number S7918129

PROJECT MANUAL

Bureau of Engineering
July 2015
ANNE ARUNDEL COUNTY
CAFE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

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NOTICE TO CONTRACTORS
Bid No.: S7918129
Project No.: S791800

Sealed bids, addressed to Anne Arundel County, Bid No. S7918129, for Cape St. John 1 Sewage Pumping Station Retrofit for the Department of Public Works will be received until 1:30 P.M. local time, Tuesday, September 15th, 2015, at the Office of the Purchasing Agent, 3rd Floor, Heritage Office Complex, 2660 Riva Road, Annapolis, Maryland 21401, after which they will be publicly opened and read in the Patuxent Conference Room, located on the same floor.

The Work includes the following major items: Remove and replace two (2) sewage pumps and motors, two (2) suction valves, two (2) discharge valves, two (2) increasing check valves, existing drywell and wetwell improvements, and electrical requirements. The work also includes, but is not limited to, construction of a new 16,000 gallon emergency storage overflow vault, a surge valve/bypass connection vault and 10-inch force main improvements, four (4) new sanitary manholes and approximately 100 lineal feet of new sanitary sewer, providing temporary bypass pumping, new site fencing and paving, sediment & erosion control, painting, landscaping and site restoration.

To all contractors, Anne Arundel County Purchasing Office now has bid results for Capital Construction Projects as well as Notice to Contractors on the Web Page. Entering http://www.aacounty.org/CentServ/Purchasing/index.cfm can access it.

On or after Monday, August 10th, 2015, Plans and Specifications may be downloaded from the Anne Arundel County Purchasing website listed above. Plans will only be distributed via the web site.

This Contract will be constructed under the provisions of the Anne Arundel County Government January, 2001 "Standard Details and Specifications for Construction” and any subsequent revisions thereto.

The cost range for the Project is: $1,000,000 - $1,500,000.

EQUAL OPPORTUNITY

It is the policy of Anne Arundel County, Maryland, to ensure equal employment opportunity for all persons, and to ensure that minority and women-owned business enterprises have the maximum opportunity to participate in the performance of all county contracts for supplies and services.

NON-DISCRIMINATION IN EMPLOYMENT

THE CONTRACTOR OR ANY SUBCONTRACTOR MAY NOT DISCRIMINATE IN ITS EMPLOYMENT PRACTICES AGAINST ANY EMPLOYEE OR APPLICANT FOR EMPLOYMENT BECAUSE OF RACE, COLOR, RELIGION, SEX, NATIONAL ORIGIN, ANCESTRY, HANDICAP, AGE OR MARITAL STATUS.

On Tuesday, August 25th, 2015 at 1:00 pm, local time, a Pre-Bid conference will be held at the Department of Public Works, Heritage Office Complex, 2662 Riva Road, Annapolis, MD 21401. ALL VISITORS are asked to check in with the second floor receptionist for meeting location. The intent of this conference is to clarify the Plans and Specifications advertised and intended for bidding purposes. A site visit will be provided immediately after the conference. All potential bidders are requested to attend this conference. However, attendance is not a requirement of the Contract.

Questions regarding this Project should be directed to the Project Manager, Pierre Cayatte at 410-224-1275.

ANNE ARUNDEL COUNTY
William L. Schull, C.P.M., CPPB
Purchasing Agent
ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

INFORMATION TO BIDDERS

Sealed bids in duplicate, addressed to the Purchasing Agent, Anne Arundel County, Maryland, for construction of the Cape St. John 1 Sewage Pumping Station Retrofit as shown on drawings on file in the Office of the Department of Public Works, Heritage Office Complex, 2662 Riva Road, Annapolis, Maryland 21401 will be received in the Office of the Purchasing Agent, 3rd Floor, Heritage Office Complex, 2660 Riva Road, Annapolis, Maryland 21401, until September 15, 2015 at 1:30 p.m. Bids will be opened and read aloud in the Patuxent Room located on the same floor, immediately thereafter.

THE RIGHT IS HEREBY RESERVED TO REJECT ANY OR ALL BIDS AND TO WAIVE INFORMALITIES, AS THE INTERESTS OF THE COUNTY MAY REQUIRE.

All work to be performed under this Project shall be done under strict compliance with the Anne Arundel County Government January 2001 “Standard Details and Specifications for Construction” and any subsequent revisions thereto. Copies of Standard Specifications for Construction and Standard Details may be obtained by accessing the Anne Arundel County Department of Public Works website, http://www.aacounty.org/DPW/Engineering.cfm. The Standard Specifications and Details for Construction will only be available via the web site, and it shall be the duty of the Bidder to be familiar with these documents.

In addition, on May 18, 1990, the Commissioner of Labor and Industry adopted, through incorporation by reference to the Maryland Occupation Safety and Health Standards under COMAR 09.12.31 Maryland Occupational Safety and Health Act, amendments and revisions relating to Excavations as published in 54 Federal Register No. 209 (October 31, 1989) pages 45948-45991 and codified in Sub Part 29CFR 1926.650-1926.652 and Appendices A-F, together with certain amendments. The amendments are found at Maryland Register, Volume 17, issue 6 (Friday, March 23, 1990), pages 746-748. The Commissioner’s action is effective May 28, 1990. All holders of the Anne Arundel County Standard Specification and Details for Construction should familiarize themselves with these regulations and be guided accordingly.

Each bid must be enclosed in a sealed envelope marked “Proposal No. S7918129, Anne Arundel County, Maryland.” Bids made other than on the attached forms will not be considered. Changes in the phraseology of the bid, additions, or limiting provisions will render the bid irregular and may cause its rejection.

All bids shall include the following forms, each of which is to be submitted in duplicate:

1. Anti-collusion and non-bribery affidavit
2. Proposal form
(3) Bid Bond (Bonding Companies must be licensed to do business in the State of Maryland and have complied with the law and the regulations of the U.S. Department of the Treasury and be approved as A Certified Companies or A Certified Reinsurer Companies.)

(4) List of subcontractors and Equipment Suppliers; and

(5) Sales tax affidavit

Failure to complete and submit these forms shall render the proposal irregular and may be cause for rejection of the bid.

The Proposal form shall include the price, in figures, for each item of the proposed work and must be signed on behalf of the bidder. The bidder must examine the drawings, standard specifications, standard details and contract specifications carefully, and should make a personal examination of the location and nature of the proposed work. In case doubt shall arise as to the meaning or intent of anything shown on the drawings or comprised in the Standard Specifications, Standard Details and Contract Specifications, inquiry should be made of the project engineer, of the Department of Public Works before the bid is submitted. Submission of the bid shall indicate that the bidder thoroughly understands the drawings and the terms of the specifications. Bidders are especially directed to fill out the “total Price” column and total their bids, so that the results of the bidding, barring possible arithmetical errors, will be at once known. Any errors in computation will be corrected by the engineer when the bids are canvassed. The County reserves the right to accept alternatives in any order, to award on any bid item or combination of bid items. And to reject all bids if, in the sole determination of the County, it is advantageous to the County to do so. Any errors in computation or math will not invalidate the bid. In case of any discrepancy between the total figure and the correct total of the line items on the bid, the correct total of all line items shall govern and shall become the bid price.

Each bid must be accompanied by, and have sealed in the same envelope with the bid, a certified check or bid bond acceptable to the County for five percent (5%) of the amount of the bid, payable to Anne Arundel County, Maryland; and unless so accompanied, the bid will not be considered. The check or bid bond will be forfeited to the County as liquidated damages in case the contract, performance bond, and labor and materials bonds are not executed within ten (10) days after receiving the contract for execution.

The list of subcontractors and equipment suppliers to be submitted with the bid need only show certified small business, minority business and women business enterprises, which the bidder intends to use. In the event that the bidder cannot participate, the bidder shall include with the bid a notarized affidavit showing the evidence of the effort made to achieve this goal. Failure to submit the list of subcontractors and equipment suppliers delineating SBE, MBE, and WBE participation and/or the good faith documentation at the time the bid is submitted shall render the bid irregular and may be cause for rejection of the bid. The complete list of subcontractors and suppliers will be required from the apparent low bidder within (10) days of a request by the County.

The experience and equipment certification is to be submitted to the county by the apparent low bidder within ten (10) calendar days after request from the County.

Each bid must include a signed and notarized affidavit concerning sales and use tax. It is the bidder’s responsibility to contact the State of Maryland, Comptroller of the Treasury, Retail Sales Tax Division, to determine if any portion of the project is exempt from sales use tax.
THE APPARENT LOW BIDDER MAY NOT WITHDRAW ITS BID WITHIN NINETY (90) DAYS AFTER BID OPENING.

If the bidder, to whom an award is made, shall fail to execute the contract and bonds, the award may be annulled and the contract awarded to the second lowest responsible bidder, and such bidder shall fulfill every stipulation embraced herein, as if the bidder were the original party to whom the award was made; or the county may reject all of the bids, as its interests may require.

The County will hold the checks and/or bid bonds submitted by all bidders with their bids, until the execution and delivery of the contract and bonds whereupon they shall be returned.

As required by the Maryland Law, all foreign corporations doing business within the State of Maryland are required to be registered with the State Department of Assessments and Taxation as a condition precedent to the award of a contract.

If the contractor is a corporation, the contract shall be accompanied by a copy of the corporate resolution authorizing the officer of said corporation, whose name appears on the contract, to execute the contract. If a person other than an officer is designated, it must be stated under oath that the person is the agent of the corporation and is duly authorized to act for an in behalf of the corporation.

The Bidder must perform fifty-one percent (51%) of the work with his own forces.

Bidders are further reminded of State Finance and Procurement Article, Section 17-106 Annotated Code of Maryland, which provides:

Before a contractor receives a progress or final payment under a contract covered by payment security, the contractor shall certify, in writing that, in accordance with contractual agreements, suppliers, and subcontractors:

(1) Have been paid from the proceeds of previous progress payments; and

(2) Will be paid in a timely manner from the proceeds of the progress or final payment currently due.

The contractor shall make available, at anytime to the County, the contractor’s records for the purpose of auditing and/or verifying the contractor’s costs in connection with negotiated contracts, change order, or other amendments to the contract.
Executive Order 24

Pursuant to Executive Order 24, vendors are required to comply with all applicable laws and regulations relating to the employment of aliens. If a vendor fails to comply with applicable laws and regulations relating to employment of aliens, such failure shall constitute a material breach of the vendor’s contractual relationship with the County and shall be grounds for termination of the contractual relationship. By executing this Agreement, the Contractor certifies that it is aware of its obligations under Executive Order 24 and that it complies with all applicable laws and regulations relating to the employment of aliens. Contractor shall include this clause in all subcontracts, making subcontractors subject to these requirements.

Non-Discrimination Clauses:

Contractor shall comply with Executive Order 11246 entitled “Equal Employment Opportunity” as amended by Executive Order 11375, and as supplemented in U.S. Department of Labor Regulations 41 CFR Part 60.

The Contractor agrees not to discriminate in any manner against any employee or applicant for employment because of race, creed, color, or national origin; and, is obligated to include a similar requirement in all subcontracts, except subcontracts for standard commercial supplies or raw materials. In addition, the contractor and all subcontractors shall agree to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of the non-discrimination clause.

Where the Contractor willfully fails to comply with the non-discrimination provisions, the County may, where the Contract is still executory in part, compel continued performance of the Contract, but the County shall be liable only for the reasonable value of services performed and materials supplied from the date that the breach of contract was discovered, and any sums previously paid by the County under the Contract shall be set off against the sums to become due as the Contract is performed.

If any subcontractor willfully fails to comply with the non-discrimination provisions, the Contractor may void the subcontract and shall be liable only for the reasonable value of the services performed and materials supplied to the date of the voiding of the subcontract.

As to all contracts for materials, supplies, maintenance, services or other procurements except building construction services, the vendor agrees not to discriminate in any manner against any employee or applicant for employment because of race, creed, color, national origin, or sex. Any Contract with the County requiring subcontracts shall include similar requirements in each subcontract. The Contractor further agrees to comply with all applicable federal, state, and local laws and executive orders relating to equal employment opportunity.

Equal Opportunity Clause:

It is the policy of Anne Arundel County, Maryland, to ensure Equal Employment Opportunity for all persons, and to ensure that Minority and Women-Owned Business Enterprises have the maximum opportunity to participate in the performance of all County Contracts for supplies and services.
ANNE ARUNDEL COUNTY, MARYLAND

Solicitation Check List

PROPOSAL NO.: S7918129
Project No.: S791800

________________________________________________________________

THIS CHECKLIST IS PROVIDED FOR YOUR CONVENIENCE

_______ Bid Response/Proposal shall be delivered to the County Purchasing Department no later than the date and time shown in the Solicitation. Did you visit our website at (http://www.aacounty.org/CentServ/Purchasing/index.cfm) for any addenda, which may have been posted to our website or eMD Marketplace?

_______ Did an authorized company representative sign the Bid Response Form?

_______ Did an authorized company representative sign and notarize the Affidavit form(s)?

_______ Did you include the required signature authority documents, if required?

_______ If you are an entity (limited liability partnerships, corporations, limited partnerships, limited liability companies, limited liability limited partnerships, business trusts, real estate investment trust and trade name filings), is the legal name of your company listed with the State of Maryland Department of Assessments and Taxation and in good standing? You may check by going to www.sdat.org.

_______ If this Solicitation requires a Bid/Proposal bond, did you include one?

_______ Did you provide one original and one copy of your response?

_______ Is the outside of the submittal envelope marked with the Bid/Proposal Number, the title, the due date, your company name, and your company address?

MANDATORY REQUIREMENTS

The following item(s) are MANDATORY and shall be submitted, in fully executed format, with Bid Response/Proposal in order to be considered for an award. If the following item(s) are not submitted with the Bid Response/Proposal, the Bid/Response/Proposal shall be considered null and void, and therefore, will be rejected.

(A) Bid Bond or Certified Check (5%)
(B) County's Bid Response/Proposal Form
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

ANNE ARUNDEL COUNTY

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

AFFIDAVIT

On behalf of ________________________, I do solemnly declare and affirm, under penalty of perjury, that to the best of my knowledge, information, and belief:

1. Neither ________________________, nor any of its officers, directors, or partners, or any of its employees who are directly involved in obtaining or performing contracts with the State of Maryland, a unit of the State (as defined in ‘16-101 of the State Finance and Procurement Article), or a local governmental entity in the State, has:

   (a) been convicted of bribery, attempted bribery, or conspiracy to bribe, under the laws of any state or of the federal government;

   (b) been convicted under a State or federal law or statute of any offense enumerated in §16-203 of the State Finance and Procurement Article; or

   (c) been found civilly liable under a State or federal antitrust statute as provided in §16-203 of the State Finance and Procurement Article.

2. ________________________ shall not knowingly enter into a contract with a public body under which a person or business debarred or suspended under Title 16, Subtitle 3 of the State Finance and Procurement Article will provide, directly or indirectly, supplies, services, architectural services, construction related services, leases of real property, or construction.

3. Neither ________________________, nor any employee or representative of ________________________:

   (a) agreed, conspired, connived, or colluded to produce a deceptive show of competition in the preparation of the bid or offer being submitted; or

Revised 11/22/13
(b) has in any manner, directly or indirectly, entered into any agreement, participated in any collusion to fix the price of the bid or proposal of any bidder or offeror or any competitor, or otherwise taken any action in restraint of free competitive bidding in connection with the contract for which the bid or offer is submitted,

4. The Contractor/Bidder/Offeror:

(a) Is not currently identified on the list created by the Maryland State Board of Public works as a person engaging in investment activities in Iran as described in Section 17-702 of the Maryland State Finance and Procurement Article; and

(b) Is not currently engaging in investment activities in Iran as described in Section 17-702 of the Maryland State Finance and Procurement Article.

If the person is unable to make the certification, it will provide the County, under penalty of perjury, a detailed description of the Contractor/Bidder/Offeror’s investment activities in Iran.

Contractor/Bidder/Offeror: ______________________________

By: ______________________________

Printed Name: ______________________________

Printed Title: ______________________________

Date: ______________________________

Subscribed and sworn to before me, a Notary Public of the State of __________, County or City of__________________, this __________ day of _____________________________.

____________________________________
(Notary Public)

My Commission expires: ______________________________.
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

ANNE ARUNDEL COUNTY

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
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AFFIDAVIT CONCERNING SALES AND USE TAX
APPLICABLE TO THE CONSTRUCTION OF WATER AND WASTEWATER TREATMENT FACILITIES

I DO SOLEMNLY DECLARE AND AFFIRM, under the penalties of perjury, the following:

1. That I am aware of the following:
   a. Water and wastewater treatment facilities consist of both real and tangible personal property.
   b. As a general rule, all of the inter-connected machinery and equipment for processing and treating water or wastewater at a treatment facility is considered tangible personal property. This would include, for example, all of the tanks, pumps, pipes, valves, electrical systems, and chemical handling equipment.
   c. Buildings and the systems serving the buildings, such as HVAC systems, plumbing and electrical service, as well as roadways, pavements, and fencing at treatment facilities are improvements to the realty. Off-site pipes and pumping equipment which transport water or wastewater to or from a treatment facility are normally real property improvements.
   d. However, if significant processing occurs at a wastewater pumping station, the equipment will be considered tangible personal property.

2. That I am further aware of the following:
   a. That a contractor who furnishes materials and is responsible for their...
NOTE:  THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

installation as real property is responsible for paying sales and use tax on the purchase of materials so installed.

b.  That a contractor who furnishes and installs any machinery or equipment which remains tangible personal property may buy it tax-free by issuing a resale certificate to the vendor.

c.  That the resale of the tangible personal property included in a water or wastewater treatment facility to a local government unit is exempt.

3.  That in submitting a bid, the contractor has afforded Anne Arundel County, Maryland the benefit of any exemption.

4.  That the contractor will refund to Anne Arundel County, Maryland any refund of sales or use tax received by the contractor as a result of the County's exemption.

____________________________________
Signature

____________________________________
Name and Title of Signer

____________________________________
Company

____________________________________
Date

SUBSCRIBED TO AND SWORN TO BEFORE ME, A Notary Public of the State of ________________, County or City of__________________ this year and date first above written.

____________________________________
Notary Public

My Commission Expires:
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

PROPOSAL

TO ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

Made this ______ day of ______________________________,______,

by _______________________________________________________

________________________________________________________

Business Address:__________________________________________

We/I the undersigned Bidder declare that the only person, firm, or corporation, or persons, firms, or corporations, that has or have any interest in this Proposal, or in the Contracts proposed to be taken, is or are the undersigned; that this Proposal is made without any connection or collusion with any other person, firm, or corporation making a Proposal for the same work; the undersigned further certifies that they have received Drawings, Specifications, Addenda (if any), and copy of this Proposal and that they constitute all instruments for bidding this contract, and that the Specifications, form of contract and the Drawings, therein referred to, have been carefully examined and are understood; that as careful an examination has been made of the worksite as is necessary to become informed as to the character and extent of the work required; and that is proposed and agreed, if the Proposal is accepted, to Contract with Anne Arundel County, Maryland, in the form of contract hereto attached, to do the required work in the manner set forth in the Specifications and as shown by the Drawings.

If this Proposal shall be accepted by Anne Arundel County, Maryland and the undersigned shall refuse or neglect, within ten (10) days after receiving the Contract for execution, to execute the same and to give the stipulated Bond, then said County may, at its option, determine that the Bidder has abandoned the Contract, and thereupon the Proposal and the acceptance thereof shall be null and void, and the deposit accompanying the Proposal shall be forfeited and paid as liquidated damages to the County. The base bid, unit prices and alternatives on the attached and signed Proposal Form are to include and cover the furnishing of all necessary machinery, tools, apparatus and means for performing the work, and the doing of all the above mentioned work, in the manner set forth, described and shown in the Specifications and on the Contract Drawings within the prescribed number of consecutive calendar days after service of written notice from the Owner to proceed with the work.
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

The successful Bidder shall be required to submit a list containing all parties to which he intends to subcontract any portion of the work. The list shall contain the subcontractor's name, address, work to be sublet and business telephone number.

(NOTE: The Bidder or Bidders must sign here and the address of each must be given. In the case of firms, the firm name must be signed and subscribed to by at least one member. In the case of corporations, the corporate name must be signed by some authorized officer or agent thereof, who shall also subscribe his name and office. The seal of the corporation shall be affixed. Telephone number to be listed).

The names and addresses of all members of a firm or the names, addresses and titles of every officer of a corporation, or duly authorized agent, as the case may be, must be given here by the member of the firm or by the officer or agent of the corporation who signs the Proposal.

We/I will submit within ten (10) days of request by the county, the Experience and Equipment Certification specified and further understand and are/am aware that the work will be awarded to an approved organization which is properly constituted in experience, capital and equipment.

Prior to, or following, the award of this Contract, the Owner or Engineer may request that We/I supply him with whatever information is needed by him in order to become better familiarized with any of the subcontractors and/or equipment suppliers. It is further stipulated that no change in the names of those persons or organizations will be made unless written application is made with justification and prior approval is granted. It is further agreed that the apparent low bidder will submit within 10 days of a request by the county a detailed list of all subcontractors and equipment suppliers including anticipated dollar values.

We/I agree to accept as full compensation the unit prices stipulated for the contingent construction items that are incorporated into the work by direction of the Engineer in the field.
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

ANNE ARUNDEL COUNTY
DEPARTMENT OF PUBLIC WORKS
ANNAPOLIS, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

DATE: __________________

This is to certify that _______ has received Addendum No. _____ through ____ and this bid reflects the changes created by these addenda.

THE CONTRACTOR OR ANY SUBCONTRACTOR ON THIS WORK WILL BE REQUESTED TO COMPLY WITH EXECUTIVE ORDER 11246, ENTITLED "EQUAL EMPLOYMENT OPPORTUNITY" AS AMENDED BY EXECUTIVE ORDER 11375, AND AS SUPPLEMENTED IN U.S. DEPT. OF LABOR REGULATIONS (41 CFR PART 60).

Bidder's Names: ________________________________________________________________

Bidder's Signature: ____________________________________________________________

Bidder's Address: ______________________________________________________________

Telephone Number: ____________________________________________________________
### PART A- LUMP SUM BID ITEMS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit Size</th>
<th>Estimated Quantity</th>
<th>Unit Price Dols / Cts</th>
<th>Total Price Dols / Cts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mobilization/Demobilization</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Temporary Bypass Pumping, Including 24/7 Pump Watching</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Emergency Storage Tank, Sewage Grinder, Exhaust Blower, &amp; 12-inch DIP</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Skid Mounted Odor Control System</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Surge Relief/ Bypass Connection Vault &amp; Force Main Improvements</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Existing Wetwell Improvements</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Existing Drywell Improvements</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10-inch Sanitary Sewer and Manholes</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2-inch Water Service Line, Meter and Yard Hydrant</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Impress Current Cathodic Protection System</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Civil Site Work Demolition, Improvements, Landscaping &amp; Sediment and Erosion Control</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Electrical Work</td>
<td>LS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Part A Base Bid Items:** ____________________________________________
PART B – STANDARD CONTINGENCY UNIT PRICES

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit Size</th>
<th>Estimated Quantity</th>
<th>Unit Price Dols/Cents</th>
<th>Total Price Dols/Cents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reinforced Silt Fence.</td>
<td>LF</td>
<td>100</td>
<td>$6.50</td>
<td>$650.00</td>
</tr>
<tr>
<td>2</td>
<td>Temporary Seed &amp; Mulch.</td>
<td>SY</td>
<td>100</td>
<td>.70</td>
<td>$70.00</td>
</tr>
<tr>
<td>3</td>
<td>Earth Dike.</td>
<td>LF</td>
<td>52</td>
<td>2.25</td>
<td>$117.00</td>
</tr>
<tr>
<td>4</td>
<td>Excelsior Matting.</td>
<td>SY</td>
<td>30</td>
<td>2.00</td>
<td>$60.00</td>
</tr>
<tr>
<td>5</td>
<td>Stone #2 for Sediment Control on Filter Cloth, Including Removal After Completion of Construction.</td>
<td>CY</td>
<td>10</td>
<td>65.00</td>
<td>$650.00</td>
</tr>
<tr>
<td>6</td>
<td>Class 3 Excavation w/ Stone Refill/ Offsite Disposal of Unsuitable Material.</td>
<td>CY</td>
<td>10</td>
<td>90.00</td>
<td>$900.00</td>
</tr>
<tr>
<td>7</td>
<td>Select Backfill / Offsite Disposal of Unsuitable Material.</td>
<td>CY</td>
<td>10</td>
<td>65.00</td>
<td>$650.00</td>
</tr>
<tr>
<td>8</td>
<td>Borrow Backfill / Offsite Disposal of Unsuitable Material.</td>
<td>CY</td>
<td>5</td>
<td>50.00</td>
<td>$250.00</td>
</tr>
<tr>
<td>9</td>
<td>Calcium Chloride.</td>
<td>Ton</td>
<td>10</td>
<td>650.00</td>
<td>$6,500.00</td>
</tr>
<tr>
<td>10</td>
<td>Test Pit Excavation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Test Pit in County Road</td>
<td>CY</td>
<td>0</td>
<td>350.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>1) First CY</td>
<td>CY</td>
<td>0</td>
<td>250.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>2) Each Additional CY</td>
<td>CY</td>
<td>0</td>
<td>125.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>b) Test Pit Outside of Road (0-3 CY)</td>
<td>CY</td>
<td>0</td>
<td>200.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>c) Test Pit Outside of Road (&gt;3 CY)</td>
<td>CY</td>
<td>0</td>
<td>125.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>d) Test Pit (Includes Traffic Control) Non Destructive</td>
<td>EA</td>
<td>2</td>
<td>650.00</td>
<td>$1,300.00</td>
</tr>
<tr>
<td>11</td>
<td>Flowable Fill.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a) Test Pit in County Road</td>
<td>CY</td>
<td>0</td>
<td>350.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>1) First CY</td>
<td>CY</td>
<td>0</td>
<td>250.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>2) Each Additional CY</td>
<td>CY</td>
<td>0</td>
<td>125.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>b) Test Pit Outside of Road (0-3 CY)</td>
<td>CY</td>
<td>0</td>
<td>200.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>c) Test Pit Outside of Road (&gt;3 CY)</td>
<td>CY</td>
<td>0</td>
<td>125.00</td>
<td>$0.00</td>
</tr>
<tr>
<td></td>
<td>d) Test Pit (Includes Traffic Control) Non Destructive</td>
<td>EA</td>
<td>2</td>
<td>650.00</td>
<td>$1,300.00</td>
</tr>
<tr>
<td>12</td>
<td>Sheet and Shoring as Directed by the Engineer – Ordered Left in Place.</td>
<td>MBM</td>
<td>1</td>
<td>950.00</td>
<td>$950.00</td>
</tr>
<tr>
<td>13</td>
<td>Miscellaneous Concrete.</td>
<td>CY</td>
<td>3</td>
<td>325.00</td>
<td>$975.00</td>
</tr>
</tbody>
</table>

Total Part B Standard Contingent Items: $13,072
NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID

PART C – ADDITIONAL CONTINGENCY ITEMS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Size</th>
<th>Estimated Quantity</th>
<th>Unit Price Dols/Cents</th>
<th>Total Price Dols/Cents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wetwell Repair: Structural Crack Repair</td>
<td>LF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wetwell Repair: Actively Leaking Crack Repair</td>
<td>LF</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Wetwell Repair: Surface Spall Repair</td>
<td>CF</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Wet Well Repair: Formed Spall Repair</td>
<td>CF</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Contingent Bypass Pumping, Including 24/7 Pump Watching</td>
<td>Day</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Part C Additional Contingent Items: ___________________________________________

TOTAL BID (Sum of Part A, B & C): ________________________________________________ $  

BID PRICE MUST BE WRITTEN AND SHOWN IN NUMBERS, IN CASE OF DISCREPANCY THE WRITTEN AMOUNT WILL SUPERSEDE.

Total time for completion is 365 consecutive calendar days. Liquidated damages shall be $950 dollars per calendar day.

Basis of Award

The award of the Contract shall be in accordance with Section GP 3.0 of the Anne Arundel County Government January 2001 "Standard Details and Specifications for Construction” and any subsequent revisions thereto and based on the sum total of Parts A, B and C.

________________________________________
(Bidder)

By: _______________________________________
(Title)
In accordance with the County Code, Article 8-2-119, please list any affiliation with a County employee(s) or official(s) (Write "none" if there are no affiliations):
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
ANNE ARUNDEL COUNTY
CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

CONTRACT

THIS CONTRACT, made this ______ day of _____________ the year______, by and between ___________hereinafter called the CONTRACTOR, and ANNE ARUNDEL COUNTY, MARYLAND, a body corporate and politic of the State of Maryland, hereinafter called the COUNTY.

WHEREAS, the Contract for constructing (the project name)____________________________

shown on Drawings, marked Proposal __________, on file in the Office of the Department of Public Works, subject to all the conditions, covenants, stipulations, terms and provisions contained in the Special provisions, attached hereto, and the Anne Arundel County Government “Standard Details and Specifications for Construction” issued January 2001, and any revisions thereto, as adopted by the Department of Public Works, said Standard Specifications and Standard Details being in all respect made a part hereof by reference as full and with the same effect as if the same had been set forth in full herein, has recently been awarded to the Contractor by the County at and for the sum equal to the aggregate cost of the work, labor, materials and supplies done or furnished, at the prices and rates respectively named therefore in the proposal attached hereto.

AND WHEREAS, it was one of the conditions of said Award that a formal Contract should be executed by and between the contractor and the County evidencing the terms of said Award.

NOW THEREFORE, THIS CONTRACT WITNESSETH, that the Contractor does hereby covenant and agree with the County that he will well and faithfully construct said ________ ________________ in accordance with each and every one of the conditions, covenants, stipulations, terms and provisions contained in the above-mentioned Specifications, and as shown on said Drawings, at and for a sum equal to the aggregate cost of the work, labor, materials and supplies done and furnished at the prices and rates respectively named therefore in the Proposal attached hereto, that sum being $_____________________________(excluding change orders), and will well and faithfully comply with and perform each and every obligation imposed upon him by said Specifications, or the terms of said Award.

The Contractor further agrees that for each and every calendar day that the Contractor is in default in completing the work to be done under this Contract, the Contractor shall pay to the County the sum of __________________________ which sum is hereby agreed upon as liquidated damages as set forth in the Standard Specifications.

And the County does hereby covenant and agree with the Contractor that it will pay to the
Contractor, when due and payable under the terms of said Specifications and of said Award, the above mentioned sum; and it will well and faithfully comply with and perform each and every obligation imposed upon it by said Specifications or the terms of said Award.

And the Contractor and the County do hereby agree that this Contract constitutes a contract under seal and that they intend the twelve year statute of limitations period to apply, as set forth in Courts & Judicial proceedings Article, §5-102, Annotated Code of Maryland.

SERVICE OF PROCESS IN THE EVENT OF SUIT

The Contractor does hereby nominate and appoint ______________________________________
________________________________ who actually resides at ______________________________________
________________________________ in the State of Maryland who will accept service both before and after completion of the Contract and under no circumstances is the Contractor to have the right to withdraw or revoke the agency without the prior written permission of the County.

IN WITNESS WHEREOF, Said ______________________________________________
________________________________________________________________________
the Contractor, has hereunto set (his) (its) hand and affixed (his) (its) corporate seal, and the County has caused these presents to be signed and the County has caused its corporate seal to be hereunder affixed, duly attested by the Secretary of the County.

WITNESS:

________________________________ (SEAL)
Witness

________________________________ (SEAL)
Witness

________________________________
Contractor

________________________________
Contractor

ANNE ARUNDEL COUNTY, MARYLAND

WITNESS:

________________________________
Mark Hartzell, Chief Administrative Officer

Approved as to legal form and sufficiency:

Office of Law

Approved for sufficient funds, and encumbrance of same:

Controller
ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

CONTRACTOR'S PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That ________________________________,
as Principal, hereinafter called Principal, and ________________________________, as
Surety, hereinafter called Surety, are held and firmly bound unto the Anne Arundel County,
Maryland, a body corporate and politic of the State of Maryland, hereinafter called the County, in the
amount of ________________________________ Dollars ($_______)
(amount to be 100% of Contract Amount), for the payment whereof Principal and Surety bind
themselves, their heirs, executors, administrators, successors and assigns, jointly and severally,
firmly by these presents.

WHEREAS, the Principal has entered into a Written Contract dated __________
with the County for Project No.: ________________ Contract No.: ________________which contract is
by reference made a part hereof and hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such, that if the Principal
shall well, truly and properly perform and fulfill all the undertakings, covenants, terms, conditions
and agreements of said Contract and of all such alterations and modifications thereof as may
hereafter be made therein, in the manner and to the extent which said Contract provides for such
alterations and modifications, during the original term of said Contract and any extensions thereof
which may be granted by the County and agreed upon by the Principal; and if the Principal shall

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indemnify and save harmless the County from all loss, cost or damage arising out of a default hereunder or under said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety expressly waives any right to receive NOTICE of extensions of time, or alterations or modifications of the Contract, which are provided for and made pursuant to the terms of, said contract.

PROVIDED, HOWEVER, no right of action shall accrue on this bond to or for the use of any person, firm or corporation whatever other than the County named herein, or its successors in office.

Signed and sealed this __________ day of, ________________________, ________.

In the Presence of:

______________________________ (Contractor)

______________________________ (SEAL)

Signature of Principal/Corporate Officer

______________________________ (SEAL)

Title

______________________________

Surety

By: ____________________________ (SEAL)

______________________________

Bond No.
ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

CONTRACTOR'S LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS:
That ____________________________________________________________, as Principal, hereinafter called Principal, and ______________________________, as Surety, hereinafter called Surety, are held and firmly bound unto the Anne Arundel County, Maryland, a body corporate and politic of the State of Maryland, hereinafter called the County, for the use and benefit of Claimant, as herein below defined, in the amount of _______________________________ Dollars ($_________________________) (amount of bond to be 50% of Contract Amount), for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a Written Contract dated ______________ with the County for Project No.: ______________ Contract No.: ______________ which contract is by reference made a part hereof and hereinafter referred to as the Contract.

NOW, THEREFORE, the condition of this obligation is such, that if the principal shall promptly make payment to each and every Claimant, as hereinafter, defined, for all labor, materials, supplies and rental of equipment reasonably required and used or consumed in the performance of the Contract and of all such alterations and modifications of said Contract provides for such alterations and modifications, during the original term of said Contract and any extensions thereof
which may be granted by the County and agreed upon by the Principal, then this obligation shall be null and void; otherwise it shall be and remain in full force and effect.

The Surety expressly waives any right to receive notice of extensions of time, or alterations or modifications of the Contract, which are provided for and made pursuant to the terms of, said Contract.

PROVIDED, HOWEVER, anything in said Contract to the contrary notwithstanding, this bond is executed upon and subject to the express conditions and limitations of State Finance and Procurement Article, Section 17-108 and 17-109, Annotated Code of Maryland, as of the date of this contract wherein it is set forth in pertinent part as follows:

**Action on security.**

(a) *In general.* -- Subject to subsection (b) of this section, a supplier may sue on payment security if the supplier:

(1) Supplied labor or materials in the prosecution of work provided for in a contract subject to this subtitle; and

(2) Has not been paid in full for the labor or materials within 90 days after the day that the person last supplied labor or materials for which the claim is made.

(b) *Payment owed by subcontractor.* —

(1) A supplier who has a direct contractual relationship with a subcontractor or sub-subcontractor of a contractor who has provided payment security but no contractual relationship with the contractor may sue on the security if the supplier gives written notice to the contractor within 90 days after the labor or materials for which the claim is made were last supplied in prosecution of work covered by the security.

(2) A notice under this subsection:

(i) Shall state with substantial accuracy the amount claimed and the person to whom the labor or material was supplied; and

(ii) Shall be sent by certified mail to the contractor at the contractor's residence or a place where the contractor has an office or does business.
Venue; limitations; costs.

(a) Venue. -- An action on a payment bond required by this subtitle shall be filed in the appropriate court of the county where:

(1) The contract was executed and performed; or

(2) The contractor has its principal place of business.

(b) Limitations period. -- An action on a payment bond required by this subtitle shall be filed within 1 year after the public body finally accepts the work performed under the contract.

Signed and sealed this _____________ day of __________________________.______.

In the Presence of:

___________________________________________
(Contractor)

_____________________________________________(SEAL)
Signature of Principal/Corporate Officer

_____________________________________________(SEAL)
Title

______________________________________________
Surety

By: ___________________________________________

______________________________________________
Bond No.
ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

CORPORATE RESOLUTION

RESOLVED, that _________________________________________ be, and it is hereby authorized to do business and enter into contracts and agreements with Anne Arundel County, Maryland,

RESOLVED, that ______________________ and ______________________ who are respectfully the ______________________ and ______________________, or its duly authorized agent(s) of the ______________________ are authorized to file and sign contracts on behalf of the said Corporation.

AND IT IS FURTHER RESOLVED, that the authority to said officer(s) or agent(s) conferred by this Resolution shall remain open and good until revoked by a formal action of the Board of Directors of the Corporation and due notice of such revocation delivered to the Anne Arundel County, Maryland in writing under the signature of the Secretary or Assistant Secretary of this Corporation, and this authority shall apply to any present or future incumbent of the aforesaid office.

I HEREBY CERTIFY that the above is a true copy of the Resolution of the Board of Directors of ______________________, passed at a meeting of said Board duly called and held on the day of _____________,______, at which meeting a quorum of said Board of Directors was present and voted.

__________________________________________
Secretary

SEAL
ANNE ARUNDEL COUNTY, MARYLAND

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800


BID BOND

KNOW ALL MEN BY THESE PRESENT, that we

___________________________________________________________ hereinafter called the "Principal" and

Company Name

___________________________________________________________

Surety

as Surety ("Surety"), are held and firmly bound unto Anne Arundel County, Maryland, hereinafter called the "Owner" in the penal sum of ________________________ Dollars ($______) lawful money of the United States, for the payment of which sum well and truly make, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying bid dated ________________________ for the ________________________, Anne Arundel County, Maryland.

(Name of Project)

NOW THEREFORE, if the Principal shall not withdraw said bid within the period specified therein after the opening of the same, or, if no period is specified, within ninety (90) days after said opening; and within ten (10) days after the prescribed forms are presented to him for signature, enter into a written contract with the Owner, in accordance with the bid as accepted and give Bond with good and sufficient surety or sureties, as may be required for the faithful performance and proper fulfillment of such contract; or in the event of the withdrawal of said bid within the period specified or the failure to enter into such contract and give such bond within the time specified if the principal shall pay the Owner the difference between the amount specified in said bid and the amount for which the Owner may procure the required work or supplies, or both, if the latter amount be in excess of the former, then the above obligation shall be void, and of no effect, otherwise to remain in full force and effect.
*NOTE: THIS FORM MUST BE SUBMITTED IN DUPLICATE WITH THE BID AND MUST BE ACCOMPANIED BY A VALID POWER OF ATTORNEY.

IN WITNESS WHEREOF, the above bonded parties have executed this instrument under their several seals this day of , the name and corporate seal of each corporate party being hereto affixed, and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

In the Presence of:

______________________________________  
(Contractor)

______________________________________  
WITNESS:

______________________________________  
Signature of Principal/Corporate Officer

______________________________________  
(SEAL)

______________________________________  
Title

______________________________________  
Surety

By:______________________________________

______________________________________  
Bond No.
ANNE ARUNDEL COUNTY
CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

EXPERIENCE AND EQUIPMENT CERTIFICATION

I. General

a. Legal Title, Address and Phone Number of Organization

____________________________________________________________________
______________________________
____________________________________________________________________
____________________________________________________________________

b. Maryland Representative's Name, Title and Address.

____________________________________________________________________
______________________________
____________________________________________________________________
____________________________________________________________________

C. (Check one) Corporation _____ Co-Partnership____ Individual _____

II. Experience

a. Indicate type of contracting undertaken by your organization and years experience.

General _____ Sub _____ Type ________________________________

Years          Years            Years

Type ________________________________

Years

Type ________________________________

Years
b. State construction experience of principal members of your organization.

**Construction Experience**

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE (As Pres., Mgr, etc.)</th>
<th>CONSTRUCTION EXPERIENCE YEARS</th>
<th>TYPE OF WORK (Sewer, Hwy, Bridges, Paving, etc.)</th>
<th>IN WHAT CAPACITY (Supt, Foreman)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
</tbody>
</table>


c. Give any special qualifications of firm members
(Registered Engineer, Surveyors, etc.)

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

d. List Principal projects completed by your organization.

<table>
<thead>
<tr>
<th>Description</th>
<th>Gen. or Sub (If sub, what type of work)</th>
<th>Your Contract Amount</th>
<th>Year</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>


e. Have you ever failed to complete any work awarded to you? 
If so, where and why?
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

B6-2
NOTE: THIS FORM TO BE SUBMITTED BY APPARENT LOW BIDDER WITHIN TEN DAYS OF REQUEST BY THE COUNTY

f. Has your firm been assessed liquidated damages within the last three years? If so, explain circumstances. *(Attach separate sheet)*

III. Financial Capability

The following financial data shall be provided upon request of the County. If the Bidder is a subsidiary of another firm, then the information requested should be provided for both the Bidder and the parent organization, as it may be applicable to the Bid.

a. The Bidder's most recent Form 10-K, as filed with the U.S. Securities and Exchange Commission (*"SEC"*) and all Form 100’s since the last 10-K,

b. All Bidders not filing a Form 10K with the SEC should submit the following information:

1. Federal Tax Returns for the last three (3) years;

2. Audited financial statements for the past three (3) fiscal years to include, at a minimum, income statement, balance sheet, and statement of changes in financial position;

3. Copies of quarterly financial reports since the last audited statement;

4. Any material changes in the mode of conducting business, bankruptcy proceedings, and mergers or acquisitions for the past three years, as well as any disclosure of any potential mergers or acquisitions; and

5. Any and all lawsuits filed against the Bidder since January 1, 1988 and a statement as to the outcome or current status of each such lawsuit.

d. A full and complete description of the legal and financial relationships among all entities which will be bound by the terms and conditions of the Contract including any entities which will guarantee the obligations of, or provide financial support to, any such parties.

IV. Bidder Certification
NOTE: THIS FORM TO BE SUBMITTED BY APPARENT LOW BIDDER WITHIN TEN DAYS OF REQUEST BY THE COUNTY

The above statements are certified to be true and accurate and we have the equipment, labor, supervision and financial capacity to perform this Contract, either with our organization, or with subcontractors.

Dated at ___________________________ this ______ day of ___________________________.____.

By: ____________________________________

________________________

>Title of Person Signing

________________________

(Name of Organization)

State of ___________________________

County of ___________________________

________________________

(Name of Person Swearing)

Being duly sworn states that he/she

is ___________________________ of ___________________________

(Office) (Name of Organization)

and that the answers to the foregoing questions and all statements therein contained are true and correct.

Sworn to before me this ___________________________ day of ___________________________.____.

_________________________________

Notary Public

My Commission Expires
ANNE ARUNDEL COUNTY

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

LIST OF SUBCONTRACTORS AND EQUIPMENT SUPPLIERS

<table>
<thead>
<tr>
<th>Subcontractor's Type of Work or Supplier's Type of Equipment</th>
<th>Name</th>
<th>Address</th>
<th>Percent of Total Contract</th>
<th>MBE SBE or WBE</th>
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PART II

SPECIAL PROVISIONS
SECTION 01010

GENERAL REQUIREMENTS

01010.01 GENERAL

A. Description

1. The work to be done under this contract consists of the furnishing of all labor, equipment and material and other facilities and items necessary and proper to construct, complete in place “Cape St. John 1 Sewage Pumping Station Retrofit” for Anne Arundel County, Department of Public Works, as shown on the Drawings and as specified, including all necessary appendices. The work also includes construction of a new emergency storage tank and a new surge valve/bypass connection vault.

2. The plans and specifications are intended to cover a complete project and it shall be thoroughly understood that failure to mention specifically any work, which would naturally be required to complete the project, shall not relieve the Contractor of his responsibility to perform such work.

B. Scope Of Work

1. It is the intent of this Contract that the proposed project, as shown on the Drawings, shall be constructed complete in place including all appurtenances and be completely tested. It will be the Contractor's responsibility to verify in the field by test pitting, prior to start of construction, existing utilities in the vicinity of the proposed improvements where shown on the Contract Drawings.

2. The Contractor shall be held solely responsible for all necessary coordination between the various County, State or Federal agencies, utility companies, his sub-contractors, and the Engineer for the duration of this Contract.

C. Supplemental Specifications

1. The Standard Specifications and Standard Details for this project are Anne Arundel County Department of Public Works Standard Specifications and Details for Construction dated January 2001, and subsequent addenda or revisions thereto, except as modified herein.

2. References to the General Provisions shall refer to the General Provision Sections of the Anne Arundel County Standard Specifications for Construction.

3. By submitting a proposal, the bidder verifies that he shall not present claims relating to
failure to comply with the Standard Specification Sections GP-2.03 - INTERPRETATION OF QUANTITIES IN BID SCHEDULE and GP-2.04- SITE INVESTIGATION.

D. Bidders Inspection of the Work Site:

1. As specified in the GENERAL PROVISIONS, bidders shall be provided with a tour led by the County to visit the site of the proposed work, to inspect and familiarize them with the extent of the work. The time & duration of tour to take place, will be scheduled during the project Pre-Bid Meeting, and performed soon thereafter.

E. Standards

Whenever in these contract documents references are made to ASHRAE, AWWA, ASTM, NEC, ANSI, AIEE, AASHTO, and/or any other standards and/or requirements, it shall be understood that the latest standards and/or requirements of the American Society of Heating, Refrigeration and Air Conditioning Engineers, American Water Works Association, American Society for Testing Materials, National Electric Code, American National Standards Institute, Incorporated, American Institute of Electrical Engineers, American Association of State Highway Officials etc. are intended and shall apply, except to the extent that said standards and/or requirements may be in conflict with applicable laws, ordinances, etc.

F. Contract Time

The work shall be commenced at the time stated in a written notice to the Contractor to proceed and the work shall be completed within 365 consecutive calendar days, including weekends and holidays. The Contract time stated herein shall include the time needed by the Contractor for the preparation and approval of shop drawings and the procurement and assembly of equipment and materials as well as the actual construction work.

G. Limits of Work

The Contractor shall confine his operations to within the limit of disturbance as shown on contract drawings. The Contractor may not utilize other County or the adjacent property outside the limit of disturbance without prior approval of the owner.

H. Hours Of Work

The Contractor’s working hours shall be limited to 7:00 am to 3:00 pm Monday through Friday. No weekend or holiday work will be allowed. The Contractor shall obtain prior written approval from the Owner to conduct work outside of these hours.
I. Progress Schedule

1. The Contractor shall submit to the Engineer for review and acceptance, a construction progress schedule for completing the project. The progress schedule shall be submitted prior to, or at the pre-construction meeting. No work shall be undertaken on the Contract until the progress schedule has been reviewed and accepted by the Engineer.

2. The progress schedule shall be complete, realistic and thoroughly detailed, and as a minimum requirement, shall incorporate the use of a critical path method chart, or a bar chart, graphs and drawings or schematics which indicate the sequence of construction and the estimated starting and completion dates of the various stages of the work, delivery dates for specific items of material and equipment, number of crews to be utilized, a preliminary schedule of values of the work and all other pertinent information that may be requested by the Engineer.

3. The progress schedules shall be completely updated by the Contractor each month making adjustments for work that is ahead or behind schedule, as the case may be, and resubmitted to the Engineer for review. Should the construction fall behind the schedule the Contractor shall provide the Engineer with a detailed written explanation as to why and at what anticipated date each phase of the work will return to the original schedule. If the Contractor fails to provide updated schedules and explanations or if in the opinion of the Engineer the updated schedules and explanations are unrealistic or inadequate, monthly invoices shall not be processed until complete and adequate information is received by the Engineer. The Contractor or his representative shall attend monthly progress meetings.

J. Schedule of Values

1. The Contractor shall break down the lump sum bid item and submit a schedule of values of all work including quantities and unit prices, aggregating to the overall bid price for “Cape St. John 1 Sewage Pumping Station Retrofit”. The schedule of values shall be submitted prior to, or at the pre-construction meeting.

2. This schedule shall be satisfactory in form and substance to the Engineer and shall subdivide the work into component parts in sufficient detail to serve as the basis for progress payments during construction. As a minimum, the schedule of values shall subdivide the work into “furnish” and “install” from each material and equipment item organized by specification section or work area. Include with each line item a direct proportional amount of the Contractor’s overhead and profit.

3. No progress payments will be made until a schedule of values has been approved by the Engineer. Upon approval of the schedule of values by the Engineer, it shall be
incorporated into form of application for payment furnished by the Engineer.

K. Record Drawings

During the progress of the job, the Contractor shall keep a careful record at the job site of all changes and corrections to the information shown on the Drawings. The Contractor shall enter such changes and corrections on one set of Contract Drawings immediately. The Record Documents shall indicate, in addition to all interior changes and corrections, the actual location referenced from two permanently fixed surface structures of all subsurface utilities installed or uncovered by him. Upon completion of the work and prior to conditional acceptance, the Contractor shall submit to the County one set of clean white prints of Record

L. Electric Power for Construction

The Contractor shall supply all electric power required for construction.

M. Use of County Water

All water for construction activities shall be provided by the Contractor at his expense. Water may be purchased from the County. Contact the Department of Utilities – Meter Section for requirements. Water required for various tests will be supplied from the County’s water distribution system during low system demands as determined by the Engineer. The Contractor shall provide and install all temporary tanks, piping, and valves necessary to transport the water to the various desired parts of the project. The use of water shall be confined to proper use without waste. No water shall be used from the public system without prior approval of the Owner. All methods of use shall be in accordance with Anne Arundel County Plumbing Code, regarding preventing of contamination, etc. The Owner reserves the right to order the Contractor to stop all work and immediately correct all violations, should the Contractor violate the requirements of the Anne Arundel County Plumbing Code.

N. Temporary Sanitary Facilities

The Contractor, from the commencement of the job, shall provide sufficient sanitary toilet room facilities for the use of all personnel on the job. These are to be kept in sanitary condition and at the completion of the job shall be cleaned out and removed. Sanitary facilities shall conform to Department of Health State and local requirements, or other agencies having jurisdiction.

O. Guarantee

The Contractor hereby guarantees all of the work performed under this Contract for a period of one year after the date of Conditional Acceptance, as specified in the GENERAL PROVISIONS Section GP 5.12.1. Other applicable conditions of guarantee are as outlined in
the GENERAL PROVISIONS.

P. Equipment and Products Specified

1. If, inadvertently, in any of the detailed sections of the specifications the term “or approved equal” is used, it shall be understood to mean “or equal”.

2. Equipment and products specified by name of manufacturer, brand, trade name or catalog number (or if applicable the equal thereof) shall be furnished under the contract. If a specified material or piece of equipment does not indicate that an equal may be submitted, then no substitutions by the Contractor shall be permitted.

3. Unless designated as a sole source procurement, when any item of material or equipment is specified by proprietary name, trade name, or name of manufacturer, with or without the addition of such expressions as “or equal”, and “approved equal”, it shall be understood that the article named or the equal thereof is intended subject to the approval of the Engineer as to the quality thereof.

Q. Manufacturer’s Certificate

1. The Contractor shall provide the Engineer with manufacturer’s certificates for all items of equipment and products listed in the various Sections of these Specifications stating that the equipment and products have been installed under either the continuous or periodic supervision of the manufacturer’s field representative, that they have been adjusted and initially operated in the presence of the manufacture’s field representative, and that they are operating in accordance with the specified requirements, to the manufacturer’s satisfaction. A copy of all manufacturers’ certificates shall be bound in each Operation and Maintenance Manual.

2. A certificate submitted for equipment, a product, or component of a product, shall indicate test results providing that the equipment, product, or component of a product, meet the requirements of the Contract Documents. An affidavit consisting of a sworn statement by an official of the company manufacturing the equipment or product indicating that the information on the certificate is true and accurate shall accompany the certificate.

3. A statement originating from the Contractor, or any of this subcontractor’s, suppliers, or any other agent, which merely indicates that, a particular item of equipment, product, or component of a product meeting the requirements of the Contract Document shall not be considered a certificate. Any such submittal made in this manner will not be approved and the corresponding equipment, product, or component of a product, shall not be finally accepted.
R. Shop Drawings And Submittals

1. Shop Drawings shall be submitted in accordance with the GENERAL PROVISIONS Section GP 5.04.

2. The Contractor shall submit twelve (12) copies of shop drawings as required for adequate distribution to subcontractors, vendor’s consultants and Owner.

3. Within thirty (30) days after Notice to Proceed, and prior to the submission of any shop drawings for those items, the Contractor shall submit for the approval of the Engineer an “Equipment List” identifying the manufacturer and model number he intends to use.

4. The Contractor shall submit ten (10) copies of Plans of Operations as required for review and approval by the Owner. Plans of Operation shall be treated as Working Drawings as defined in the GENERAL PROVISIONS.

S. Operation And Maintenance Manuals

All Operation and Maintenance Manuals shall be submitted as specified in the GENERAL PROVISIONS Section GP 5.04.8.

1. The contractor shall submit two (2) hard copies and five (5) electronic copies.

T. Sub-Surface Data & Borings

1. If the Contractor, in preparing or submitting his bid relies on sub-surface information shown in the Contract Documents, he does so at his own risk. The Contractor must verify the information given to his own satisfaction and shall be fully responsible for determining in the field the exact location of all such underground structures and utilities by means of test pits or other approved methods, and protecting them from damage, whether such structures and utilities are or are not shown on the Drawings.

2. Soil borings for sub-surface investigations were performed on the project site. See Appendix A for the Geotechnical Exploration Report.

3. It is the Contractor’s option, at his own expense, to make sub-surface investigations, as he may deem necessary to determine his bid price for performance of the work within the terms of the Contract. The Contractor is required to obtain all necessary permits related to these activities.

U. Pre-Construction Conference

Before starting the work, a conference will be held to review the Progress Schedule, to establish procedure for handling shop drawings and other submissions and for processing
applications for payment. Among those present at the Conference will be, the Owner, Engineer, the Contractor’s Project Manager and his superintendent.

V. Construction Coordination Requirements

1. The Contractor shall notify Department of Public Works, not less than ten (10) working days prior to the beginning of construction. Contractor shall provide a name and phone number of a person to contact in the event of any emergency where the Contractor is performing work.

W. Control of Work

1. Control of Work shall be as defined in GP-5 of the GENERAL PROVISIONS.

2. Conditional acceptance shall be as defined in GENERAL PROVISION 5.12.1.

3. Final acceptance shall be as defined in GENERAL PROVISION 5.12.2.

X. Site Security

Contractor shall not be granted free access to the site or equipment. The Engineer shall maintain in their possession all keys for station access gates, doors and panels. The Engineer shall open and lock all items as required at the beginning and end of each Contractor workday.

The Contractor shall be responsible for overall site security for the duration of the project. The Contractor shall provide temporary fencing as required for maintaining suitable site security while the existing fence is being removed and replaced with new fence. The Contractor shall continue to provide site security until the new fence has been accepted by the County.

Y. Site Access for County

The Contractor shall maintain clear access for the County to the control building, the generator and the fuel tank for the duration of the work for their daily operations.

Generator testing is performed by County on a weekly basis.

If an emergency situation occurs, the Contractor shall provide the County access to the entire site as needed to address and correct the problem.

Z. Miscellaneous Items

1. Condition of Existing Valves:
Contractor is made aware that, County does not guarantee the condition of any existing valves. Contractor shall provide any and all means necessary to perform work in the event of leaking of existing valves.

2. Operation of Existing Valves:

Contractor shall not operate any existing valves at any time. The Contractor shall notify the County a minimum of one week prior to the dates anticipated for operation of the valves.

3. Cleaning of Wet Well:

Contractor shall be responsible to completely drain and empty the wet well to perform and complete the work.

4. Site and Equipment Storage Area

The existing pump station site is limited in size. The Contractor may require additional offsite storage to stockpile materials and equipment. The off-site storage area must be approved by the County and the Community Association, prior to entering into an agreement with the property owner.

01010.02 PRODUCTS

Not Used

01010.03 EXECUTION

Not Used

END OF SECTION
SECTION 01510

CONFINED SPACE ENTRY

01510.01 GENERAL

A. The Contractor’s confined space procedures must be in accordance with the space classifications defined by the County. The Contractor shall follow all confined space procedures in accordance with the Contractor's confined space program. Re-classification of spaces (i.e. from permit required to non-permit required) that are defined by the County is not permitted.

B. The Contractor is responsible for reviewing the County's space designations in the attached Confined Space Procedural Memorandum – DPW D-17. A copy of this document is provided as Appendix "G" of this Project Manual for informational purposes.

C. A copy of the Contractor's confined space program shall be submitted to the County for informational purposes at the pre-construction meeting.

D. The Contractor shall review the County's classification procedure pertaining to excavations greater than four (4) feet in depth and establish whether such excavations are to be considered permit-required confined spaces. If any excavations are determined to be permit-required confined spaces, the Contractor shall follow the appropriate confined space procedures.”

01510.02 PRODUCTS

Not Used

01510.03 EXECUTION

Not Used

END OF SECTION
SECTION 02200

EARTHWORK

02200.01 GENERAL

A. Description

In addition to Section 02250, this section includes the requirements for excavation, backfill, compaction, grading, embankment construction, and related items.

B. Inspection and Testing

1. All earthwork shall be performed under the continuous inspection of the Engineer. Submit test results to the Engineer.

2. All excavated material which is to be used for backfill shall be subject to testing. Testing shall consist of standard laboratory and field tests to determine density, organic content, bearing capacity, mechanical properties, stability or any other properties which will demonstrate the suitability of the materials for the proposed use.

3. When tests indicate that density or moisture content does not meet requirements hereinafter specified, the particular layer or portion shall be reworked until the required density and moisture content are obtained.

4. The method for determining maximum laboratory dry weight shall be in conformance with AASHTO method T180. The method for determining in place density and moisture content shall be in conformance with ASTM methods 02922 and D30 17. The method for determining optimum moisture content shall be in conformance with AASHTO method T180.

5. Sieve analysis shall be in accordance with ASTM C-136. Liquid limit shall be in accordance with ASTM 0-423. Plasticity index determination shall be in accordance with ASTM D-424.

6. Testing frequencies shall be as follows:

   a. Fill, backfill and existing subgrade materials. (For each classification of material used):

      i One sieve analysis (and one liquid limit and plasticity index determination for cohesive soils.)

      ii One moisture-density curve.
b. Field Density Test
   i. Subgrades:
      a. Paved areas, one per 200 square yards;
      b. Trenches, one per 250 lineal feet or fraction thereof.
   ii. Pipe Trench Backfill
       One per lift per 500 lineal feet or fraction thereof.

C. Excavation Work Stoppage

If work is stopped on an excavation and it is left open for an unreasonable length of time pending construction, the Engineer may order the excavation to be backfilled. If this occurs, it shall not be opened again until the Contractor is prepared to place work therein. If the Contractor does not backfill such an excavation after being ordered to do so by the Engineer, the Engineer shall perform said backfilling operations at the Contractor’s expense.

D. Dewatering

1. Excavations shall be kept free of water once construction has begun until the excavation is backfilled. Pumps, deep wells, well points, dams, underdrains, or whatever other devices that may be necessary for dewatering shall be used. No construction or backfilling operations may proceed if there is water in an excavation.

2. Any permits required for removal of groundwater for dewatering excavations or other purposes shall be secured by the Contractor. The Contractor shall be responsible for paying all fees associated with acquiring said permits.

3. Whether or not groundwater is indicated, the Contractor is responsible for making his own determination of groundwater occurrence. The presence or absence of water shall not entitle the Contractor to additional compensation.

E. Existing Utilities

1. Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Engineer immediately for directions on how to proceed. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.
3. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

F. Protection of Trees

In general trees shall be left standing unless construction requires their removal. Trees to remain shall be protected during the construction. The Contractor may elect, with the permission of the Engineer, to tunnel tree left standing in lieu of removing.

02200.02 PRODUCTS

A. Trench Backfill

All excavated materials which are to be used for backfill shall be accepted for the Engineer. Materials used for these purposes shall be material complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP and shall meet the following requirements:

1. Trench Backfill

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<tr>
<th>Maximum Laboratory Dry Weight</th>
<th>Minimum Field Compaction</th>
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<tr>
<td>95 PCF and Higher</td>
<td>90 for unpaved areas</td>
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<td>92 for paved areas except</td>
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<td>95 for top 12” of pavement</td>
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B. Borrow Excavation and Trench Refill

1. Borrow used for trench refill shall comply with the requirements for trench backfill within Section 02200.02A.

2. The Contractor shall use excess suitable backfill material excavated elsewhere in the Contract prior to using borrow excavation.

3. If the Engineer deems excavated material to be unsuitable for backfill, the Contractor shall remove and dispose of such unsuitable material at his own expense.

C. Stone Refill

Stone refill for pipe bedding trench subgrade stabilization and excavation dewatering ordered by the Engineer shall be provided in accordance with the requirements of Section 901 of the

D. Select Backfill

Select backfill shall meet the requirements of Section 02245 and shall be a well graded granular material that will completely pass a one inch sieve and compact readily when the usual methods of tamping are used. Select backfill shall meet the requirements specified for structure backfill, trench backfill and embankments in accordance with paragraph 02200.02A.

E. Unsuitable Materials

1. The following materials will be unsuitable for backfill subject to the requirements for applications stipulated in paragraph 02200.02A:
   a. Materials having a dry density of less than 95 PCF.
   b. Refuse and putrescible materials.
   c. Organic material.
   e. Any other material which the Engineer deems as unsatisfactory.

2. Where material deemed unsuitable by, the Engineer is encountered within the proposed limits of excavation, the Engineer may direct its removal. Depth of removal will be determined by the Engineer. Unsuitable material shall be removed from the site and disposed of in approved spoil areas at the Contractor's expense.

F. Filter Fabric

Filter fabric shall be woven polypropylene geotextile fabric. Filter fabric shall be Poly Filter X as manufactured by Erosion Control Company, Cincinnati, Ohio or Mirafi as manufactured by Celanese Fibers Marketing Co., New York or equal.

02200.03 EXECUTION

A. Excavation

1. All excavated materials shall be unclassified. Excavation shall be carried to the lines and grades indicated on the Drawings as stipulated in the Specifications and as directed by the
Engineer. All irregularities in the bottom of excavations shall be filled to the required level with suitable select backfill and firmly compacted without extra compensation unless the irregularities are formed at the direction of the Engineer.

2. Trench Excavation

   a. Trenches shall be excavated to the lines and grades indicated on the Drawings and Standard Details and as specified or directed by the Engineer. Provide continuous and uniform support and bearing for piping and structures on suitable bedding.

   b. Rock and other unsuitable material, when encountered, shall be removed, as directed by the Engineer, and to a minimum depth of six inches below the pipe or structure and the same depth below the pipe bell. Materials below the pipe deemed unsuitable by the Engineer shall be removed and replaced with stone refill to the depths and widths as shown or as directed by the Engineer.

   c. Excavation in the vicinity of adjacent structures and utilities shall be performed by means that will not damage the facility. Any damage to structures and utilities caused by the Contractor's operations shall be repaired to the satisfaction of the Owner at the Contractor's expense.

   d. Sides of excavations shall be practically plumb.

   e. The trench pipe bedding subgrade shall be shaped to conform to a cylindrical surface with a radius equal to that of the outside of the pipe, with a width of six tenths of the pipe barrel.

3. Miscellaneous and Test Pit Excavation

   a. The Contractor shall perform miscellaneous and test pit excavation as may be necessary or directed by the Engineer.

   b. Miscellaneous excavation shall include extra width of trenches made necessary by change of location and miscellaneous other excavation directed by the Engineer.

   c. All test pits shall be dug by hand unless directed otherwise by the Engineer.

   d. Test pits shall be dug by the Contractor when indicated on the Drawings or as directed in writing by the Engineer prior to construction to locate existing utilities.

   e. Test pits may be dug by the Contractor at his own discretion without the Engineer's direction; however, all excavation not indicated on Drawings or directed by the Engineer shall be at the Contractor's expense.
4. Rock Excavation

Whether or not rock is indicated or shown on the Drawings the Contractor is responsible for making his own investigation to determine if rock is present. The presence or absence of rock shall not entitle the Contractor to additional compensation.

5. Material Storage

a. Satisfactory excavated materials shall be stockpiled where directed by the Engineer until required for backfill. Stockpiles shall be placed, graded and shaped for proper drainage and to minimize soil erosion.

b. Soil materials shall be located and retained away from edges of excavations and upslope wherever possible.

c. Excess and/or unsatisfactory materials shall be disposed of off the site.

6. Excess Material

After backfilling and embankment construction is completed, all material which was not used shall be removed and disposed of in such a manner and at such point as shall be approved or directed by the Engineer. All roads, sidewalks, and other places affected by the work shall be left clean, free of debris and in good order.

B. Dust Control

1. The Contractor shall prevent dust nuisance.

2. The Contractor shall furnish and place calcium chloride on disturbed areas when directed by the Engineer. Calcium chloride shall be spread at a rate of two pounds per square yard.

END OF SECTION
SECTIN 02250
TRENCH EXCAVATION, BACKFILL AND COMPACTION

Amend subsection 02250.02 MATERIALS of the County Standards as described below:

02250.02 MATERIALS

C. Detailed Material Requirements

Amend subsection 1. as provided below:

1. Use and Ownership of Excavated Material

   a. All suitable material excavated from utility trenches shall be used, as far as practicable, for backfill in trenches.

   b. Suitable Material

       Suitable materials shall be materials that conform to the following Unified Soil Classification Groups as defined in ASTM D2487 and that do not meet any of the criteria designated under unsuitable materials:

       | Code | Description          |
       |------|----------------------|
       | GW   | Well graded gravel   |
       | GP   | Poorly graded gravel |
       | GM   | Silty gravel         |
       | SW   | Well graded sand     |
       | SP   | Poorly graded sand   |
       | SM   | Silty sand           |

   c. Unsuitable Material

       Unsuitable material shall be any material which does not conform to the Unified Soil Classification Groups designated for suitable material and/or any materials containing frozen material, boulders, rocks/stones or soil lumps which are larger than 6" in the greatest dimension, organic material, roots, stumps, sludge, muck, ash/cinders, trash, rubble, construction debris, or other refuses. Soils which are highly plastic, contain more than 20% rock, and/or have a maximum dry weight of less than one hundred (100) pounds per cubic foot shall also be considered unsuitable material.

   d. The Contractor shall properly store, stockpile and protect all materials that are to be reused in the work. The Contractor shall replace, at his own expense, material that was suitable when excavated, which has subsequently become unsuitable because of careless, neglectful, wasteful or unprotected storage. The Contractor shall have no
property right in any material taken from any excavation and no excavated material shall be wasted or otherwise removed from the project site without permission of the Engineer.

e. If the excavated material is judged by the Engineer to be unsuitable for backfilling, the Contractor shall remove and dispose of such unsuitable material at his own expense. The Contractor shall use for backfill, at no additional cost to the Owner, excess suitable or granular backfill material excavated elsewhere on the Contract. If all available excess material is used, but additional suitable granular backfill material is needed, the Contractor shall, when ordered by the Engineer, furnish and substitute borrow material or selected backfill.

END OF SECTION
SECTION 02561
SANITARY SEWERS AND SANITARY HOUSE CONNECTIONS

Add the following to Section 02561.03 of the Anne Arundel County Standard Specifications:

02561.03 EXECUTION

A. Pipe Installation

1. Metallic Detection Tape

   a. Metallic detection tape shall be provided for all buried sewer pipe. The tape shall be located a minimum of 8 inches below the surface to a maximum depth of 18 inches. In paved areas metallic detection tape shall be buried beneath stone pavement base in compacted soil.

   b. Metallic detection tape shall have a total thickness of 5.0 mils, and shall have a minimum 0.5 mil aluminum foil core running the full width and length of the tape. The aluminum foil shall be coated with mylar, polyethylene or other flexible plastic material.

   c. Metallic detection tape shall be safety green in color and 3 inches wide. The following imprint shall appear on the tape: "CAUTION BURIED SEWER LINE BELOW".

   d. Metallic detection tape shall be as manufactured by Allen Systems, Inc., Reef Industries, Inc., or equal.

2. DVD of Sewer

   Contractor shall submit DVD of sewer to Engineer for approval upon completion of the construction.

END OF SECTION
SECTION 02641

BITUMINOUS CONCRETE PAVING

Add the following to Section 02641.03 of the Anne Arundel County Standard Specifications:

02641.03 EXECUTION

A. Preparation

1. Surface Condition

   a. Forming for Paving

      i. Form perimeter of all paving with 1/8" x 6" bituminous coated steel strip where paving abuts landscaped, stoned or vegetative areas.

END OF SECTION
SECTION 02710

SITE FENCES AND GATES

Delete Specification Section 02710 - FENCES from the Anne Arundel County Standard Specifications and replace with the following:

02710.01 GENERAL

A. Description

1. This division includes requirements for steel fences, gates, and mowing strips with expansion joints on each side of posts, or ten feet maximum.

B. Description of Work

1. The extent of steel fences and gates is shown on the Drawings.

2. Steel fences and gates includes vinyl coated, galvanized steel systems and aluminum sliding gates.

C. Quality Assurance

1. Work shall comply with the standards of the Chain Link Fence Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric," and "Industrial Steel Specifications for Fence Posts, Gates and Accessories," and as herein specified.

2. Provide steel fence and aluminum gates as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.

3. Examine the conditions under which the fence and gates are to be installed. Notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

4. Damage to the vinyl coating of any element of the fence system which compromises the corrosion protection and/or aesthetic qualities will result in rejection of the affected material. Determination by the Project Engineer is final and not subject to appeal.

D. Submittals

1. Submit certificates of compliance for all fencing materials.

2. Submit shop drawings in accordance with the General Provisions for fencing materials and components. The shop drawings shall show dimensional information, coating materials, methods, and details, and other information that may be required to determine conformance with these Specifications. Submit material samples of fabric, wire and accessories if requested by the Engineer.
2710.02 MATERIALS

A. General

1. Pipe sizes indicated are commercial pipe sizes. H-section sizes are nominal flange dimensions.

2. Galvanized finish shall be in conformance with the following:

3. Pipe: ASTM A120 (1.8 oz. zinc per square foot)

4. H-Sections: ASTM A123 (2 oz. zinc per square foot)

5. Hardware and accessories: ASTM A153 (zinc weight per Table I)

6. Other items not specifically covered: ASTM A153 and ASTM A386.

B. Fabric

1. Chain link fabric shall be as follows:

2. One-piece fabric widths, for fabric height of seven (7) feet.

3. No. 9 gauge (0.148") wires. Fabric wire shall be galvanized and vinyl coated after weaving. The vinyl coating shall be a minimum of 7 mil thickness, color black.

4. 2-inch diamond mesh.

5. Top selvage twisted, bottom selvage knuckled.

C. Posts and Braces

1. End, corner and pull posts shall be a minimum size of 2.875 inches O.D. pipe weighing 5.79 pounds per linear foot.

2. Line posts shall be a minimum size of 2.375 inches O.D. pipe weighing 3.65 pounds per linear foot. Space posts 10 feet on center maximum unless otherwise indicated.

3. Gate posts shall be 4.0 inches O.D. pipe weighing 9.10 pounds per linear foot.

4. Provide bracing assemblies at end and gate posts and at both sides of corner and pull posts, with the horizontal brace located at mid-height of the fabric. Use 1.660 inches O.D. pipe weighing 1.80 pounds per linear foot for horizontal brace and 3/8 inch diameter rod with turnbuckle for diagonal truss.

5. Tension wire at top and bottom of fabric shall consist of No. 7 gauge galvanized coiled spring wire, vinyl coated as specified for the chain link fabric. Tension wires shall be fastened to fabric with galvanized pig rings on two (2) foot centers.
6. Stretcher bars shall be one piece lengths equal to full height of fabric, with a minimum cross-section of 3/16 inches by 3/4 inches. Provide one stretcher bar for each gate and end post, and two (2) for each corner and pull post, except where fabric is integrally woven into the post.

7. Stretcher bar bands shall be steel, wrought iron, or malleable iron, spaced not over 15 inches on center to secure stretcher bars to end, corner, pull and gate posts.

8. Posts, bracing assemblies, stretcher bars and all accessories shall be vinyl-coated as specified for fence fabric.

D. Gates

1. Fabricate gate perimeter frames of tubular members in accordance with ASTM F 1184, Class 2, using 2-inch square aluminum members complying with ASTM B221-91, alloy 6063-T6, 0.94 pounds per foot. Provide additional horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware and accessories. Space so that frame members are not more than nine (9) feet apart.

2. Assemble gate frames by welding or with special malleable or pressed steel fittings and rivets for rigid connections. Use same fabric as for fence, unless otherwise indicated. Install fabric with stretcher bars at vertical edges. Bars may also be used at top and bottom edges. Attach stretcher bar bands to gate frame at not more than 15 inches on center. Attach hardware with rivets or by other means which will provide security against removal or breakage.

3. Provide diagonal cross bracing consisting of 3/8 inch diameter adjustable length truss rods on gates where necessary to provide frame rigidity without sag or twist.

4. Gate assemblies and all accessories shall be vinyl-coated as specified for fence fabric.

5. Slide gates shall utilize two roller truck assemblies, one mounted on the gate support post and the other mounted on the overhang post. The track section of the top frame member shall slide over both truck assemblies.

6. Cantilever slide gates shall be by Anchor Fence, Inc.

E. Miscellaneous Materials and Accessories

1. For tying fabric to line posts, use nine (9) gauge wire ties spaced 12 inches on center. For tying fabric to rails and braces, use nine (9) gauge wire ties spaced 24 inches on center. For tying fabric to tension wire, use 11 gauge hog rings spaced 24 inches on center. Manufacturer's standard procedures will be accepted if of equal strength, durability, and appearance. All wire ties and hog rings shall be vinyl-coated as specified for fence fabric.
2. Provide concrete consisting of Portland cement complying with ASTM C 150, aggregates complying with ASTM C33, and clean potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi, using at least four (4) sacks of cement per cubic yards, 1-inch maximum size aggregate, maximum 3 inches slump, and two (2) percent to four (4) percent entrained air.

3. Padlocks shall be provided for each gate. Padlocks shall be Best 4 LB Series, keyed to the County master key system. Provide padlocks per Section 08700.

F. Pipe Bollards

1. Pipe bollards shall be 4-inch diameter Schedule 40 steel pipe. Pipe bollards shall extend three (3) above finished grade. Pipe bollards shall be anchored in concrete to a depth of (3) feet, and the concrete anchorage shall have a diameter of 18 inches. Each pipe bollard shall be fitted with a 1/2-inch diameter stainless steel eyebolt fastened through the Schedule 40 steel pipe. Upon completion of the pipe bollard setting and eyebolt assembly, the Schedule 40 steel pipe shall be filled with concrete. The concrete fill shall extend one (1) inch above the top of the bollard, and shall be domed at the top to shed water. The entire finished bollard assembly shall be covered with a safety yellow vinyl sleeve. The vinyl sleeve shall be dome top low-density polyethylene thermoplastic material. Bollard locations as shown on the Contract Drawings.

G. Chain

1. Chain shall be 5/16 inch welded steel links, zinc plated. Chain shall have a minimum rated working load of 2,000 pounds. Chain shall be permanently attached to one of the pipe bollard eyebolts. Provide locks as specified above.

EXECUTION

A. General

1. Do not begin fence installation and erection before the final grading is completed, with finish elevations established, unless otherwise permitted.

2. Concrete footings for corner, end, and line posts shall be 12-inch diameter, minimum, and three (3) feet deep, minimum. Gatepost footings shall be 16-inch diameter, minimum, and three (3) feet deep, minimum. Corner, gate and end posts shall be embedded a minimum of 32 inches in the concrete. Line posts shall be embedded a minimum of 26 inches. Concrete mowing strip beneath fence shall be as shown on the drawings.

B. Setting Posts

1. Remove all loose and foreign materials from sides and bottoms of holes,
moisten soil prior to placing concrete.

2. Center and align posts in holes.

3. Place concrete around posts in a continuous pour, and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Do not set posts or concrete in frozen ground.

4. Trowel finish tops of mowing strip or exposed post fittings, and slope or dome to direct water away from fence posts.

5. Keep exposed concrete surfaces moist for at least seven (7) days after placement, or cure with membrane curing material, or other acceptable curing method.

C. Assembly

1. Allow concrete to attain at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than seven (7) days after placement, before rails, tension wires, or fabric is installed. Do not stretch and tension fabric and wires, and do not install gate until the concrete has attained its full design strength.

2. Leave approximately two (2) inches between finish grade and bottom selvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on secure side of the fence, and anchor to framework so that fabric remains in tension after pulling force is released.

3. Install tension wires to the fabric with hog rings and tie to each post with not less than nine (9) gauge galvanized wire.

4. Repair damaged coatings in the shop or during field erection by recoating with hot applied repair compound, applied per manufacturer's recommendations.

5. Stretcher bars shall be threaded through or clamped to fabric four (4) inches on center and secured to posts with metal bands spaced 15 inches on center.

6. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two (2) full turns. Bend ends of wire to minimize hazard to persons or clothing.

7. Install nuts for tension band and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

8. Special bottom closures shall be installed where fences cross ditches and swales.
9. Install gates plumb, level and secure for full opening without interference. Attach hardware to prevent unauthorized removal, and adjust for smooth operation.

END OF SECTION
SECTION 02800
LANDSCAPING

Delete Specification Sections 02820 - TURF ESTABLISHMENT, and 02860 - FURNISH AND PLANT TREES, SHRUBS, VINES, GROUNDCOVERS AND SEEDLING STOCK from the Anne Arundel County Standard Specifications and replace with the following:

02800.01 GENERAL

A. Description

1. This division includes the requirements for topsoiling, seeding and mulching, sodding, shrubs, trees and miscellaneous other related work.

B. Areas Requiring Seeding or Sodding

1. All areas that have been disturbed or damaged by construction operations, with the exception of areas to be sodded, shall be seeded and mulched to provide a dense, uniform and healthy stand of grass, unless otherwise directed by the Engineer. Tack coat mulch over seeded areas.

2. Surface drainage ditches that have been disturbed or damaged by construction operations shall be re-shaped and sodded to one foot beyond the top of the ditch.

C. Quality Assurance

1. Ship landscape materials with certificates of inspection as required by government authorities. Comply with governing regulations applicable to landscape materials.

2. Do not make substitutions. If specified landscape material is not obtainable, submit to Engineer proof of non-availability and proposal for use of equivalent material. When authorized, adjustment of Contract amount will be made.

3. Package standard products with manufacturer's certified analysis.

4. Seed shall be certified by the Maryland State Board of Agriculture and shall conform to requirements of Maryland Turf Grass Law and Regulations, Publication No. 41.

D. Submittals

1. Submit certificates of compliance for seed material stating mixture percentages of species, purity, germination, weed seed.
2. Submit certificates of compliance for sod.

3. Submit certificates of compliance for shrubs.

4. Submit certificates of compliance for trees.

5. Submit certificates of compliance for soil amendments.

E. Product Delivery, Storage and Handling

1. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.

F. Guarantee

1. Guarantee landscaping work through the specified maintenance period until final acceptance.

G. Job Conditions

1. Examine the subgrade, verify the elevations, observe the conditions under which work is to be performed, and notify Engineer of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

2. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.

3. Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities.

4. Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by the Owner.

H. Tree and Shrub Replacement

1. Replace trees and shrubs on developed property disturbed by construction activities that are dead, weakened, diseased or damaged.

2. Replacement trees and shrubs shall be the same type and size as those that require replacement due to construction activities.
3. Replacement trees and shrubs shall be at the Contractor's expense.

**02800.02 MATERIALS**

**A. Soil Amendments**

1. **Lime**
   
   a. Lime shall be natural dolomitic limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10 mesh sieve and not less than 50 percent passes a 100 mesh sieve.

2. **Fertilizer**
   
   a. Fertilizer shall be a commercial fertilizer, uniform in composition, free flowing, of neutral character with less than 5% phosphorous content. Fertilizer shall be delivered to the site fully labeled according to applicable state fertilizer laws and shall bear the name, trade name or trademark and warranty of the manufacturer. Fertilizer shall be supplied with the percentage of total nitrogen, available phosphoric acid and total potash as indicated for specific applications as specified hereinafter.

3. **Peat Moss**
   
   a. Peat moss shall be a sphagnum peat moss and shall be free from woody substances.

**B. Grass Materials**

1. Seed shall be fresh, clean, new crop grass seed complying with the tolerance purity and germination established by the Official Seed Analysts of North America. Provide seed of the grass species, proportions and minimum percentage of purity and germination, and maximum percentage of weed seed, as specified.

2. The following seed mixtures shall be used for all areas to be seeded except as otherwise noted:
   
   a. General Turf Areas (Fertilized and mowed on a regular basis): Home lawns, Commercial sites, Parks, Playgrounds.
      
      i. Kentucky Bluegrass - Full sun mixture - For use in areas that receive intensive management. Irrigation required.
         
         a. Recommended Certified Kentucky Bluegrass Cultivars** 100%
         
         b. Seeding Rate: 1.5 to 2.0 pounds/1,000 square feet
** A minimum of three bluegrass cultivars should be chosen ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

ii Kentucky Bluegrass/Perennial Rye - Full sun mixture - For use in full sun areas where rapid establishment is necessary and when turf will receive medium to intensive management.

a. Certified Perennial Ryegrass Cultivars 10-15%
b. Certified Kentucky Bluegrass* 85-90%
c. Seeding Rate: 2 pounds mixture/1,000 square feet.
d. A minimum of 3 Kentucky bluegrass cultivars must be chosen, with each cultivar ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

iii Tall fescue/Kentucky Bluegrass - Full sun mixture - For use in drought prone areas and/or for areas receiving low to medium management in full sun to medium shade.

a. Certified Tall Fescue Cultivars** 95-100%
b. Certified Kentucky Bluegrass Cultivars 5-0%
c. Seeding Rate: 5 to 8 lb. mixture/1,000 square feet.

** One or more cultivars may be blended.

iv Kentucky Bluegrass/Fine Fescue - Shade Mixture - For use in areas with shade in Bluegrass lawns. For establishment of a high quality, intensively managed turf area.

a. Certified Kentucky Bluegrass Cultivars* 30-40%
b. Certified Fine Fescue 60-70%
c. Seeding Rate: 1 1/2 to 3 lbs/1,000 square feet.

*A minimum of 3 Kentucky bluegrass cultivars must be chosen, with each cultivar ranging from a minimum of 10% to a maximum of 35% of the mixture by weight.

NOTE: Varieties should be selected from those listed in the current University of
b. Rough Areas: Not generally mowed and cannot be prepared with conventional equipment. Hydroseeding will be the normal method of seeding these areas.

i Level Areas
   March 1 to May 15  50-100% Tall Fescue
   August 1 to November 15  5-25% perennial Ryegrass
                                0-15% Canada Bluegrass
                                0-15% Kentucky Bluegrass (Common Type)
                                0-15% Fine Fescue
                                0-10% Red Top

   Seeding Rate: 150 lb/Acre
   May 16 to July 30  Add Lovegrass at 2 lb/acre or Foxtail Millet at 10 lb/acre
   November 16 to February 28  Add Cereal Rye at 56 lb/acre

ii Sloped Areas - Add 16 lbs per acre of crown vetch or 20 lb per acre of Sericea Lespedeza. Inoculant should be used at 10 times the manufacturers recommended rate when hydroseeding.

C. Sod

1. Sod shall be Certified or Approved grade as graded by the Maryland State Board of Agriculture and shall conform to Requirements of Maryland Turf Grass Law and Regulations, Publication No. 41. Sod shall be machine cut at a uniform thickness of 3/4-inch ± 1/4-inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends will be unacceptable.

2. Sod shall be as follows:
   a. "Maryland State Approved" Multi-Use Turf Sod
   b. Tall Fescue: 100% Certified Kentucky 31

D. Screening

1. Overall Design Objectives
   a. Existing vegetation should be utilized whenever possible.
b. A minimum 10-foot planting strip must be maintained on all sides between chain link fence and adjacent property lines or right-of-ways.

c. Overall objective is to provide 75% evergreen screening with 25% deciduous trees to provide color and variety.

d. Provide screening/landscaping that requires minimal maintenance.

2. Design Requirements

a. Plant materials must be installed by a qualified nurseryman, and in accordance with the Landscape Specification Guidelines for the Baltimore - Washington Metropolitan Area. Sample planting details are to be as shown on Standard Pump Station Drawings.

b. Soil conditions shall be considered when selecting approximate plantings using the attached list “Recommended Plants for Droughty/Wet Soils”.

c. Landscape plans shall include contour lines, existing vegetation, nearby houses/structures, proposed plantings, utility locations, and provide a planting list.

E. Plants & Plant Materials

1. Plants and plant materials shall meet the detailed description as given on the plans and as described herein.

2. All plant material, unless otherwise specified, shall be nursery grown, of good average uniform growth, free from irregularities, typical of the species and variety, well formed, uniformly branched and have a vigorous root system. They shall be healthy, vigorous plants free from defects, decay, disfiguring roots, sunscald injuries, abrasions of the bark, plant disease, insect pest eggs, boxers and all forms of infestations of objectionable disfigurements. Plant materials that are weak or which have been cut back from larger grades to meet certain specified requirements will be rejected. All plants shall be freshly dug: no heeled in plants or plants from cold storage will be acceptable.

3. All plant characteristics including, but not limited to; ball diameter, caliper and height measurements, shall be in accordance with the current edition of the "U.S.A. Standard for Nursery Stock", as recommended by the American Association of Nurserymen, Inc.

4. All trees shall be symmetrically balanced according to their normal habit of growth. No forked leader stock will be accepted.

5. All plants shall be planted within the planting season that shall be defined as September
6. All planting furnished under this contract shall be guaranteed to remain viable and to thrive in a healthy condition for a period of one (1) year. Trees that are not thriving satisfactorily, as determined by Engineer, within said one (1) year period shall be replaced by the Contractor at his sole expense. All plant materials shall be planted in accordance with the plans and specifications for the original plantings. Replacement shall include the cost of tearing up and replacing that portion of sidewalk or paving, if any, required for tree replacement, all at the contractor's sole expense. All replacement plants shall be guaranteed for a minimum period of one (1) year.

7. The Contractor shall notify all utility companies five (5) days prior to beginning work.

8. Any damage to the existing utilities, building, paving, curb, walls and vegetation (not so designated for removal on these plans) shall be repaired to previous condition or replaced by the contractor at his expense.

9. All planting beds shall have three inches of medium pine bark mulch placed on top of 4 inches of topsoil.

10. Topsoil shall be free from brush, weeds and other litter; and shall be free from clay lumps, stones, or other objects larger than one inch in diameter, and any other substance that may be harmful to plant growth. Prepared topsoil shall conform to the following specifications:

11. Prepared topsoil for evergreen plants: shall consist of two parts topsoil to one part humus or other approved organic material. Fertilize with 3 lbs. 10-10-10 evergreen (acidic) fertilizer or approved equal per cubic yard of prepared topsoil or as soil test dictates.

12. Prepared topsoil for deciduous plants: shall consist of two parts topsoil, to one part well-rotted cow or horse manure. Fertilize with 3 lbs. standard 10-10-10 fertilizer or approved equal per cubic yard of prepared topsoil or as soil test dictates.

13. After fertilizer application, all plant beds (not individual plant pits) shall be covered with weed barrier fabric installed per manufacturer's specifications. The barrier shall be neatly trimmed at edges to conform to bed configuration. Cut holes to size and location of excavated plant pits.

F. Miscellaneous Landscape Materials

1. Mulch for protection of permanent seeding shall be clean, weed free, unrotted straw.

2. Mulch for tree and shrub planting shall be 100 percent true pine bark ground mulch, with
minimum 90 percent organic content, and a white wood content not to exceed 10 percent. Mulch shall be a uniform brown color, with not more than 50 percent capable of passing a 3/4-inch sieve.

3. Soil mix for trees and shrubs shall consist of a mixture of 50 cubic feet of peat moss in 12 cubic yards of topsoil, with no lime added.

4. Binder for straw mulch shall be emulsified asphalt, conforming to the requirements for MSHA Grade SS-1 emulsified asphalt, Table 20.12.11.

5. Soil stabilization netting shall be polypropylene. Netting shall be "Erosion Control Netting", 1.5 x 1.3 strands/inch, mesh opening 5/8-inch by 3/4-inch as manufactured by American Excelsior Company, or equal. Staples for securing soil stabilization matting shall be No. 11 or heavier steel wire bent to form a U shape. Staples shall be one inch wide and minimum six inches long after bending.

6. Weed barrier in planted landscape areas shall be Biobarrier II fabric by Reemay or approved equal, with ten year guarantee.

02800.03 EXECUTION

A. General

1. All seeded areas not covered with soil stabilization netting shall be covered with straw mulch. Mulched areas shall be coated with binder.

2. All seeded areas with a slope of 4:1 or greater shall be covered with soil stabilization netting. Netting shall extend one foot beyond crown of slopes, one foot beyond limit of disturbed area, or one foot beyond 4:1 grade as applicable.

B. Spreading Topsoil

1. All areas to be seeded or sodded shall be covered with four inches of topsoil.

2. Prior to topsoiling and finish grading operations, all rough graded areas shall be corrected, mounds and ridges shall be cut off, gullies and depressions filled, and other necessary repairs performed to enable all surfaces to be brought to the original grades, or, for areas where grading is indicated, to the grades shown on the Drawings, in an even and properly compacted condition.

3. After the area to be topsoiled has been prepared, the surface shall be loosened and made friable by raking or other approved methods, to a full depth of at least two inches to permit blending of topsoil to the subgrade. All stones and debris one inch or more in any
dimension shall be raked up and removed from the site.

4. All stockpiled topsoil shall be spread and compacted to a uniform thickness over the areas to be topsoiled. The Contractor shall verify the amount of topsoil previously stockpiled to determine the thickness of the topsoil layer.

5. Topsoil shall not be placed when either the subgrade or the topsoil is wet or frozen enough to cause clodding.

6. The finished surface shall be free of stones, sticks or other material one inch in any dimension, smooth and true to the required grades.

C. Seeding

1. The areas to be seeded shall be cleaned of any rough grass, weeds and debris, with the ground brought to an even grade and the top four (4) inches of topsoil thoroughly worked into a satisfactory seedbed.

2. Apply dolomitic lime at a rate recommended by USDA for the soil conditions per current soil test.

3. Apply fertilizer of 10-10-10 strength at a rate of 25 pounds per 1,000 square feet, minimum.

4. Thoroughly mix lime and fertilizer into the top four inches of topsoil.

5. Moisten seedbed during periods of high temperature and when directed by the Engineer.

6. Apply seed mixture uniformly with mechanical power driven seeders, mechanical cyclone hand seeders or with hydroseeding equipment. Sow the seed mixture at a rate of 200 pounds per acre, or five pounds per 1,000 square feet, minimum, between March 1 and May 31 and between August 15 and October 31.

7. Rake seed lightly into the top 1/4-inch of topsoil, roll lightly and water using a fine spray.

D. Mulching and Soil Stabilization

1. Immediately after seeding apply mulch to a rate of 70 pounds per 1,000 square feet, minimum, to a loose depth between one and three inches, to all seeded areas not covered with soil stabilization netting.

2. Apply binder over mulch at a rate of 5 gallons per 1,000 square feet on flat areas and slopes no more than 8 feet high. On slopes 8 feet or more in height apply binder at a rate of 8 gallons per 1,000 square feet. Application of binder shall be doubled 4 feet around
edges, in valleys and at the crest of slopes to prevent wind from lifting mulch. The remainder of binder application shall be uniform in appearance.

3. The Contractor shall place protective coverings over structures prior to application of binder material. The Contractor shall take every precaution against damaging or disfiguring structures or property on or adjacent to the work. The Contractor shall repair all damage caused by his operations to the satisfaction of the Engineer, at the Contractor's expense.

4. Immediately after seeding, apply soil stabilization netting to all slopes 4:1 and greater that have been seeded. Extend netting to one foot beyond top of slope. Netting shall be rolled in the direction of the flow of water. Strips shall overlap a minimum of four inches. Ends shall overlap a minimum of six inches. The upgrade end of each strip of netting shall be turned down and buried to a depth of six inches, minimum. Overlap with the upgrade section on top. Place staples two feet apart along edges and center of netting strips. At ends of netting, place staples six inches apart. Drive staples vertically into the soil and flush with the surface.

E. Sodding

1. The areas to be sodded shall be cleaned of any rough grass, weeds and debris. Loosen the subsoil to a depth of four inches. Sod shall be placed on all disturbed areas not to be paved which are: slopes steeper than 3:1, drainage ditches, improved lawn areas, and where shown on the Drawings.

2. Remove stones 1-1/2 inches and larger, clods, brush, roots, trash and other objectionable material from the top four inches of soil.

3. Apply dolomitic lime at a rate of 50 pounds per 1,000 square feet, minimum, to areas to be sodded.

4. Apply fertilizer of 10-10-10 analysis at a rate of 25 pounds per 1,000 square feet, minimum.

5. Thoroughly mix lime and fertilizer into the top four inches of topsoil.

6. Moisten sod bed if dry and when directed by the Engineer.

7. Deliver sod to the site and install sod within 48 hours after being cut.

8. Place sod in straight parallel lines. Stagger lateral joints and butt tight.

9. On slopes 2:1 and greater, stake each strip of sod with at least two stakes or with wire
staples.

10. After laying sod, roll, tamp and water until the underside of the sod pad and soil surface beneath it are thoroughly wet and in contact with each other. Rolling, tamping and watering shall be completed within an eight-hour period after laying sod.

11. Sod shall not be laid on frozen ground or when the air temperature is below 32 degrees F. Perform sodding before December 1 and after February 15.

F. Maintenance

1. Begin maintenance immediately after planting, seeding or sodding.

2. Maintain seeded, sodded and planted areas for one full year after installation to produce good stands of grass free from eroded or bare areas, and healthy trees and shrubs, acceptable to the Engineer.

3. Maintain grass areas by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, replanting, and resodding as required.

G. Cleanup and Protection

1. During landscaping work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.

2. Protect landscaping work and materials from damage. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscaping work as directed.

3. Fertilizer spilled on impervious surfaces shall be promptly cleaned up.

H. Inspection and Acceptance

1. When the landscaping work is in progress, the Engineer will, upon request, make inspections to determine acceptability.

2. Where inspected landscaping work does not comply with the requirements, replace rejected work and continue specified maintenance until reinspected by the Engineer and found to be acceptable.
I. Objective

1. The objective of all landscapes is to keep construction and maintenance costs at a minimum, and create an aesthetically pleasing site that will blend in with the surrounding neighbor(s).

END OF SECTION
SECTION 03010

FORMS AND FORMWORK

03010.01 GENERAL

A. Description

1. This section specifies formwork for concrete work.

2. Related Work Specified Elsewhere
   a. Concrete Reinforcement; Section 03200.
   b. Cast-in-Place Concrete; Section 03300.
   c. Concrete Finishes; Section 03040.
   d. Precast Structural Concrete; Section 03050.

3. Quality Assurance

4. Reference Codes and Specifications
   b. "Formwork for Concrete" ACI Special Publication No. 4.
   c. Codes and regulations of jurisdictional authorities.

B. General Design Criteria

1. Design formwork for vertical loads and lateral pressures in accordance with ACI 347-01.

2. Design formwork system which is adequately braced and has adequate strength and stability to ensure finished concrete within the specified tolerances.

3. When necessary to maintain the specified tolerances, design camber into the formwork to compensate for anticipated deflection and creep due to the weight and pressure of the fresh concrete and construction loads.


03010.02 MATERIALS
A. Products

1. Plywood Forms
   a. Grade marked.
   b. B-B Plyform, Exterior Class 1 and 2 and HDO Medium Density Overlaid Plywood concrete Form, B-Matte Formguard or equal, conforming to the requirements of the U.S. Products Standard PS-1.
   c. Steel forms are not required for junction or elbows.
   d. Hardboard

      Tempered, smooth one side, not less than 3/16-inch thick conforming to the requirements of U.S. Commercial Standard CS 251.

2. Form Ties
   a. Factory fabricated, snap off metal type of adequate design to minimize form deflections and preclude concrete spalling upon removal.
   b. Fabricated so that set back in the concrete is such that the portion of the tie remaining after snap-off and removal of the exterior portions is at least 1 1/2-inches back from the concrete surface.

3. Bond Breaker

   Non-staining liquid product which imparts a waterproof film to prevent adhesion of the concrete and will not leave a paint impeding coating on the face of the concrete of release agents which will transfer to the concrete.

03010.03 EXECUTION

A. Construction and Workmanship

1. Construct adequately braced formwork so that the resulting concrete surfaces will conform to the tolerances specified.

2. Brace forms, falsework, and centering adequately to retain forms in the position as shown on the approved working drawings.

3. Provide mortar tight forms of approved materials to retain forms in position as shown on the approved working drawings.
B. Field Quality Control

Construct elements to meet the allowable tolerances of the dimension, elevations and positions shown and specified in Section 03300, Cast-in-Place Concrete.

C. Coating Forms

1. Coat forms with bond breaker prior to the placement of reinforcing steel.

2. Do not allow excess coating material to stand in puddles in the forms. Coating material shall not come in contact with concrete against which fresh concrete is to be placed.

3. Coat bolts and rods that are to be completely removed or that are to be free to move with bond breaker.

D. Embedded Items

1. Clean items to be embedded in concrete free from oil or foreign matter that would weaken the bond of the concrete to these items.

2. Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these Specifications. Close ends of conduit, piping, and sleeves embedded in concrete with caps or plugs.

3. Concrete pads, curbs, pedestals, and similar means devised by the Contractor to support the forms will be subject to review by the Engineer.

4. Before depositing concrete, check the location and support of items that are to be wholly or partially embedded.

E. Opening and Recesses in Concrete

Provide openings and recesses and place sleeves in the concrete as may be required and furnished by other sections of these Specifications.

F. Joints

1. Unless otherwise directed, make contraction, expansion, and construction joints only where shown.

2. Form keyways as shown.

3. Continue reinforcing steel and wire fabric across construction joints which are not indicated as being free to move.
G. Removal of Forms, Falsework and Centering

1. Maintain forms, falsework, and centering in place until the concrete has attained the minimum percentage of specified design strength for the structural members to carry their own weight and any loads to which they will be subjected without exceeding the permissible stresses and without deforming.

2. Compute permissible stresses on the basis of 0.6 of the compressive strength attained by the concrete at the time of removal.

3. Maintain forms, falsework, and centering in place until the concrete has attained the minimum percentage of specified design listed in Schedule 1, Table 1.

Table 1

<table>
<thead>
<tr>
<th>Structural Member</th>
<th>Schedule 1</th>
<th>Schedule 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings: Invert, sides of beams, slabs and girders, slabs and beams on grade.</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Open cut structure exterior walls; retaining walls</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Soffits and beams, slabs and girders under 20 feet clear span between supports.</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>Cantilevers and intersecting sections</td>
<td>90</td>
<td>70</td>
</tr>
</tbody>
</table>

4. Remove forms, falsework, and centering for values between Schedule 1 and Schedule 2 for listed and non-listed members only after:

   a. The Engineer has approved calculations showing the anticipated concrete strengths at the time of the proposed early removal based on:

      1. ratio of dead load over live load;
      2. span, height and shape;
      3. ratio of rise over span;
4. reshoring;

5. loads, resultant stresses, and deformations to which the concrete and reinforcing steel will be subject at the time of removal, subsequent to the removal and until the concrete has attained its design strength; prevailing site conditions.

b. The concrete strength attained prior to form removal has been determined from tests of cylinders cured adjacent to and under the same conditions as the placed concrete.

c. Three (3) test cylinders taken by the test laboratory have been tested by an independent testing laboratory retained by the Contractor and approved by the Engineer and the tests performed in accordance with Section 03030, Cast-in-Place Concrete.

d. Do not alter the loading conditions on the concrete subsequent to the removal of the forms if it results in exceeding the permissible stresses and deformation at the attained concrete strengths.

END OF SECTION
SECTION 03040
CONCRETE FINISHES

03040.01 GENERAL

A. Description

Work performed under this section shall include but is not limited to finishing all concrete surfaces for all concrete work as shown on Contract Drawings and as specified herein.

B. Related work specified elsewhere:

1. Concrete Formwork; Section 03010.
2. Cast-in-Place Concrete; Section 03300.
3. Precast Structural Concrete; Section 03050.

03040.02 MATERIALS

See related Section 03300, Cast-in-Place Concrete and Section 03010, Forms and Formwork.

03040.03 EXECUTION

A. Surface Finishes (Except Floor and Slab on Grade)

1. Repair of Surface Defects

   a. All surface defects including tie holes, minor honeycombing, and otherwise defective concrete shall be repaired with cement mortar. Cement mortar for patching shall be the same composition as that used in the concrete except that for exposed surfaces part of the cement shall be white Portland cement to provide a finish color matching the surrounding concrete. Patching shall be done as soon as the forms are removed; areas of surfaces that are to be cured with a curing compound shall be covered during the application of the compound. All areas to be patched shall be cleaned thoroughly. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of not less than one inch. The edges of the cut shall be perpendicular to the surface of the concrete. The areas to be patched and at least six inches adjacent thereto shall be saturated with water before placing the mortar. The mortar shall be mixed approximately one hour before placing and shall be remixed occasionally during this period with a trowel without the addition of water. A grout of cement and water mixed to the consistency of paint shall then be brushed onto the surfaces to
which the mortar is to be bonded. The mortar shall be compacted into place and screened slightly higher than the surrounding surface. Patches shall be cured as specified for the concrete. Holes extending through the concrete shall be filled by means of a plunger type gun or other suitable device from the unexposed face. The excess mortar shall be wiped off the exposed face with a cloth. Finished surfaces shall be protected from stains and abrasions. As cast finish against steel, plywood, forms, and rubbed finish shall be equal in workmanship, texture, and general appearance to that of sample panels specified herein. Concrete with excessive honeycombing, which exposes the reinforcing steel or other defects which affect the structural strength of the member, shall be rejected or the defects corrected as directed by the Engineer, and at the expense of the Contractor.

2. Finishing of Formed Surfaces

Finishing of formed surfaces shall be accomplished as soon as practicable after form removal and repair of surface defects. Finishing shall be accomplished as specified herein where indicated.

a. As Cast Finishes

   i Smooth Form Finish

      a. The form facing material shall produce a smooth, hard, uniform texture on the concrete. Tie holes and defects shall be patched. All fins shall be completely removed.

   ii Rough Form Finish

      a. No selection from facing materials are required for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 1/4 inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

b. Applied Finishes

   i Floated Finish

      a. After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a ten foot straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to produce a surface with true
planes within 1/4- inch in ten feet as determined by a ten foot straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.

ii Broom or Bolt Finish

a. Immediately after concrete has received a floated finish, give surface a coarse transverse scored texture by drawing a broom or burlap bag across the surface.

c. Unindicated Finish

Finishes not indicated on the Contract Drawings or otherwise specified shall be as follows:

i Smooth Form Finish

a. For all concrete surfaces exposed to public view.

ii Rough Form Finish

a. For all concrete surfaces not exposed to public view.

d. Unformed Surfaces

i Related Unformed Surfaces: Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the adjacent formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

B. Floor Finishes

1. General Requirements

a. The finishes specified herein include surface finishes, treatments, and toppings for floors and slabs. For floors in which drains occur, special care shall be exercised to slope the floors uniformly to the drains. All floor slabs where finish is not indicated or specified shall receive a single steel toweling. Dry cement shall not be placed directly upon the new concrete surface to absorb excess moisture.

2. Placing and Screening Normal Concrete Slab or Base Slab

a. Concrete of slump within the limits specified herein shall be placed, consolidated, and immediately struck off to bring the top surface of the slab to proper contour, grade,
and elevation. This operation may be followed immediately by a darbying or bull floating on the surface with wooden, aluminum or magnesium tools so as to correct any unevenness. Striking-off and darbying shall be completed before bleed water appears on the surface of the freshly-placed concrete. No further work shall then be performed until the concrete has attained a set sufficient for floating and sufficient to support the weight of the finisher and/or equipment. If the bleed water has not disappeared by the time floating of the surface is to start, the excess water shall be first dragged off the surface using a rubber hose. At no time shall dry cement be used to absorb bleed water. The finish surface shall be free of troweled marks, uniform in texture, and shall be true to plane 1/8 inch in 10 feet when checked with 10-foot straight edge placed anywhere on the slab in any direction. Walkway and stair surfaces shall be floated with a wood float to produce a uniformly gritty surface free from depressions or high spots.

3. Curing

Finished floor surfaces shall be cured adequately as specified herein.

a. Curing with Water

i Moist or wet-curing with water or by complete covering with waterproof membrane sheets shall be continuous for seven days at temperatures of 60 degrees F and above, and for longer periods at lower temperature, as necessary.

b. Chemical Floor Hardeners

i Chemical floor hardeners shall be applied to interior floor slabs of buildings. They shall be applied to a dried concrete surface, only after the concrete has been first adequately moist or wet-cured, or to one that has been cured with nonstaining vapor-proof sheeting or paper. Treatment of new concrete surfaces shall be in accordance with the recommendations of the manufacturer, in the amount used and as to the number of applications.

END OF SECTION
SECTION 03050

PRECAST STRUCTURAL CONCRETE

03050.01 GENERAL

A. Description

This Section specifies the requirements for precast structural concrete noted on drawings, specifically the manufacturer, transportation and erection of precast concrete pump stations and vaults.

B. Related Work Specified Elsewhere

1. Forms and Formwork; Section 03010.
2. Cast-In-Place Concrete; Section 03300.
3. Concrete Finishes; Section 03040.
4. Precast Concrete Utility Structures; Section 03400.

C. Quality Assurance

1. Acceptable Manufacturers
   a. Manufacturing plant shall be certified by the Precast Concrete Institute.
   b. Manufacturers of precast structural concrete products used in the work for this project shall have a minimum of 5 years experience in the manufacture of the type of elements used in the work or shall post a bond or deposit in the amount of 100% of the value of precast structural concrete items supplied for this project. Manufacturers without 5 years acceptable experience shall post the specified bond or deposit for a period of 5 years after conditional acceptance of the work. Bond or deposit shall be returned to precast structural concrete manufacturer upon expiration of the 5 year period and satisfaction of the Owner of adequate precast structural concrete products performance.

2. Allowable Tolerance
   a. Width or thickness (Cross Section Dimension) ± 1/4 inch.
   b. Length ±1/2 inch.
   c. Inserts, bolts and pipe sleeves: Maximum ±3/8 inch (9.5mm) deviation from drawing
location.

d. Horizontal Alignment: Deviation from straight line parallel to theoretical centerline of member: 1/4 inch.

D. Submittals

1. Shop Drawings
   a. Content
      i. Dimensions and finishes.
      ii. Reinforcing and connection details.
      iii. Anchors.
      iv. Lifting and erection inserts.
      v. Other items cast into members.
      vi. Show location of unit by same identification mark placed on member.
      vii. Include design calculations bearing the seal of a Professional Engineer licensed in the State of Maryland. Shop drawings shall have seal of Professional Engineer registered in State of Maryland.
   b. Test Reports: Reports of tests on concrete.
   c. Manufacturers’ certifications of material conformance with specifications, and PCI manual for Quality Control, (MNL-1 17-70).

E. Product Delivery, Storage and Handling

1. Delivery and Handling
   a. Transport and handle precast concrete units with equipment to protect from dirt and damage. Minor damage, such as spalls or chips shall be repaired using an epoxy bonding agent and grout.
   b. Do not place units in position which will cause overstress, warp, or twist.
   c. Handle by means of lifting inserts.
   d. Major damage to units during transit or handling, as determined by the field engineer,
will be cause for rejection.

2. Storage
   a. Store units off ground to protect from contact with soil and from physical damage.
   b. Place stored units so that identification marks are discernible.
   c. Separate stacked members by battens across full width of each bearing point.
   d. Stack so that lifting devices are accessible and undamaged.
   e. Do not use upper member of stacked tier as storage area for shorter members of heavy equipment.
   f. Store units in a position consistent with their shape and design in order to avoid excessive stresses.

03050.02 MATERIALS

A. Materials

1. Portland Cement
   a. ASTM C 150, Type II
   b. Use same brand, type, and source of supply throughout.
      i. Air-Entraining Agent: ASTM C 260
      ii. Aggregates: ASTM C 33

2. Water: Potable or free from foreign materials in amounts harmful to concrete.

3. Reinforcing Steel
   a. Deformed billet steel: ASTM A 615 Grade 60.

4. Anchors and Inserts
   a. Materials: Type 304 Stainless Steel.

5. Grouts for repair of units.
a. One part Portland cement to two parts sand by volume.

b. Keep water to a minimum.

c. The sand and cement shall be as specified for concrete.

6. Bonding Agent

   a. Moisture insensitive, epoxy-resin bonding agent as manufactured by one of the following or an equal:

      i. Epoxitite; W.R. Grace.

      ii. Euco Epoxy; Euclid Chemical Company.

      iii. Sikastix 370; Sika Chemical Company.

   b. Use of specified for repair of units.

   c. Use in conformance with manufacturer's printed instructions.

7. Precast Reinforced Concrete Wet Well Risers

   a. Wet wells less than 10 feet diameter shall consist of manhole riser sections conforming to ASTM C478.

   b. Wet wells 10 feet in diameter and larger shall consist of reinforced concrete pipe riser sections conforming to AWWA C-302.

8. All penetrations shall be link-seal type penetrations except for incoming gravity sewer lines.

   a. Valve vaults: All pipe penetrations to be link-seal type.

B. Mixes

1. Mixing Procedures: Same as for cast-in-place concrete, Section 03030.

2. Concrete Properties

   a. Water-cement ratio: maximum 40 lbs. (18 kg.) of water to 100 lbs. (45 kg.) of cement.

   b. Air-entrainment: Minimum 3%; maximum 6%.
c. 28 day compressive strength: Minimum of 5,000 psi.

d. Do not use calcium chloride or other salts.

3. Fabrication

a. Formwork
   i. Construct forms to maintain units within their specified tolerances.
   ii. Securely attach anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.

b. Place concrete in continuous operation to prevent formation of seams.

c. Consolidate placed concrete by vibration without dislocation or damage to reinforcement and built-in items.

d. Provide permanent markings on precast unit to identify pick-up points and location in structure.

e. Cure precast units until 70 percent of the minimum 28 day compressive strength has developed before removing the units from the forms.

03050.03 EXECUTION

A. Inspection

Before starting to erect precast concrete units, verify that structure and anchorage inserts are within required tolerances.

B. Erection

1. Set units into position by means of hoist or crane. Vertical alignment must be instrument checked with plumbness approved by the Engineer.

2. Repair all minor damage, such as spalls and chips, using an epoxy bonding agent and grout. Major damage occurring during erection, as determined by the field engineer, will be cause for rejection.

C. Patching

1. Patch damaged units to match adjacent area.

2. Add patch to concrete with bonding agent.
3. Cut off lifting device and grout.

D. **Waterproofing**

Waterproofing the exterior of buried precast concrete construction in accordance with Section 07110.

END OF SECTION
SECTION 03200
CONCRETE REINFORCEMENT

Delete Specifications Section 03200 – CONCRETE REINFORCEMENT from the Anne Arundel County Standard Specifications and replace with the following:

03200.01 GENERAL

A. Description

This section specifies reinforcement for concrete and other facilities.

B. Related Work Specified Elsewhere

1. Cast-in-Place Concrete, Section 03300
2. Precast Structural Concrete, Section 03050

C. Quality Assurance

1. Allowable Tolerances
   a. Cut and bend reinforcing steel to conform to the dimensions shown and within the following tolerances:
      i. Sheared length +/- 1 inch
      ii. Stirrups, ties and spirals +/- 1/2 inch
      iii. All other bends +/- 1 inch

D. Submittals

1. Shop Drawings
   a. Detail reinforcing in accordance with the requirements of ACI 315-99 Details and Detailing of Concrete Reinforcement.
   b. Submit with the shop drawings, bar lists and bending diagrams showing the individual weight of each bar, the total weight of each bar size, and the total weight of bars on the list. Base the calculated weights on the theoretical unit weights shown in Table 1, ASTM A615.

2. Certificates
a. Submit certified copies of reinforcing mill tests showing chemical and physical analyses.

b. Have testing performed in accordance with ASTM A615 as modified by ACI 318 building code requirements for reinforced concrete.

c. Submit certificates of compliance for all reinforcing materials.

E. Product Delivery, Storage and Handling

1. Shop reinforcing steel in bundles.

2. Tag each bundle at the mill with a waterproof tag showing the name of the mill and heat number, the grade and size of the bars, and identifying number.

3. Protect reinforcing steel and wire fabric from damage and dirt, oil, grease, other foreign matter, and rust causing conditions.

03200.02 MATERIALS

A. Reinforcing

1. Reinforcing Steel Bars: ASTM A615, Grade 60, modified in accordance with ACI 350.


3. Metal Accessories: As recommended by CRSI Manual of Standard Practice. Where concrete surfaces will be exposed to public view in the finish structure, use supports with plastic protected or stainless steel legs.

03200.03 EXECUTION

A. Cutting and Bending

1. Perform cutting and bending in the shop. Bend steel cold. Do not bend or straighten bars in a manner that will injure the material.

2. Do not bend bars in the field except to correct minor errors or damage in shipment or handling, or to make shipment of certain bars practicable.

B. Bar Support and Spacers

1. Support bars by means of bolsters or chairs with no less than the minimum required by ACI 315-99, Details and Detailing of Concrete Reinforcement.
2. Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks.

3. Hold reinforcing steel in position in walls, columns, piers, and abutments by means of mortar blocks, bar supports, or spacers wired to reinforcing steel.

4. Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

5. Do not place bars or fabricated mats on layers of fresh concrete as the work progresses.

C. Placing and Fastening

1. Arrange and place reinforcing steel as shown on the Contract Drawings.

2. Secure reinforcement positively against displacement during placing of concrete.

3. Wire or clip bars together as recommended in Concrete Reinforcing Steel Institute Recommended Practice for Placing Reinforcing Bars.

4. Place steel which is free from dirt, mill and rust scale, oil, grease, and other foreign matter.

5. Placing Reinforcing Steel
   
i Variation of protective coating 2-inch cover 1/4 inch
   
ii Variation of protective coating 3-inch cover 1/2 inch
   
iii Variation from indicating space 1 inch

D. Splicing

1. Furnish reinforcing bars in full lengths as shown on the Contract and Shop Drawings.

2. Do not splice bars unless approved by the Engineer in writing.

E. Inspection

Deposit concrete only when the placement of the reinforcement has been checked and approved by the Engineer. The Contractor shall provide notice to the Engineer at least 24 hours in advance of any contemplated concrete pour.
F. **Embedment**

Place reinforcement so that there will be a clear distance of at least 2 inches between the reinforcement and any anchor bolts or other embedded metal work.

G. **Concrete Protection for Reinforcement**

Reinforcement shall be protected by the thickness of concrete indicated in the Contract Drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

1. Where concrete is deposited against the ground without the use of forms - not less than 3 inches.

2. Where concrete is exposed to weather, ground, sewage, or sewage gases, but placed in forms - not less than 2 inches for bars larger than No. 5 and 1-1/2-inches for No. 5 bars or smaller.

3. In slabs and walls not exposed to ground, weather, sewage or sewage gases - not less than 3/4 inches.

4. In beams, girders, and columns not exposed to ground, weather, sewage, or sewage gases - not less than 1-1/2 inches

END OF SECTION
SECTION 03300
CAST-IN-PLACE CONCRETE

Delete Specification Section 03300 - CAST-IN-PLACE CONCRETE from the Anne Arundel County Standard specifications and replace with the following:

03300.01 GENERAL

A. Description

1. This section specifies the requirements for Portland Cement cast-in-place concrete.

2. Related Work Specified Elsewhere
   a. Forms and Formwork; Section 03010.
   b. Concrete Reinforcement; Section 03200.
   c. Concrete Finishes; Section 03040.
   d. Precast Structural Concrete; Section 03050.

B. Quality Assurance

1. Properties of Concrete
   a. General Requirements
      i. Design mixes to produce concrete of proper workability, durability, compressive strength, maximum density, and minimum shrinkage and permeability.
      ii. Design mixes to have a minimum water-cement ratio, the largest permissible maximum size specified coarse aggregate, and an optimum percentage of fine aggregate.
      iii. Use maximum size of coarse aggregate in accordance with ACI Committee 613 Report, Recommended Practice for Selecting Proportions for Concrete.
   b. Durability
      For durability purposes, use a water-cement ratio in accordance with either ACI Committee Report 613, Table 4 as determined by the type of structure and exposure conditions, or 0.50 by weight whichever is the lesser.
c. Workability

Use approved chemical or air-entraining admixtures, or suitable combinations thereof to improve workability, as well as to reduce water and cement contents, and minimize shrinkage and permeability of concrete, provided that these admixtures do not adversely affect other required properties of concrete.

d. Strength

i Design the mix for each class and type of concrete of a specified compressive strength based on the required overdesign factor according to ASTM C94, and assuming a coefficient of variation equal to 15. Unless otherwise shown, working stress method of design will apply to structures.

ii For working stress method of design, each class of concrete shall be designed so that not more than 20 percent of the compressive strength tests will have values less than the specified compressive strength, and the average of six consecutive strength test will be equal to or greater than the specified compressive strength.

e. Method of Proportioning

i For proportioning mixes use methods as described in ACI Report 613.

ii Vary mixing water content as specified in ACI Report 613, Table 3.

iii Do not vary the proportions of the ingredients of the approved mixes without the written approval of the Engineer.

C. Submittals

1. Samples

Membrane-forming curing compound: Two one-pint samples, each type.

2. Design Mixes

a. At least 30 days prior to start of placing concrete, submit design mixes for each class and type of concrete, indicating that the concrete ingredients and proportions will result in a concrete mix meeting the requirements specified.

b. Include for each class and type of concrete as many mix designs as there are combinations of different ingredients, or type of ingredients, anticipated to cover the requirements of the contract work.
c. Compression test cylinders from all footings, walls and slabs shall be made at the Contractor's expense by an independent testing laboratory approved by the Engineer and tested in accordance with the ACI Code and "Method of Test for Compressive Strength of Molded Concrete Cylinders (ASTM C39)". One set of cylinders will be required for the first 5 cubic yards and one set for each 25 cubic yards thereafter for each day's pour.

d. Furnish two (2) copies of each report to the Engineer and one copy to local government building department and structural engineer. Concrete which does not meet the Specifications will be required to be removed and replaced at the Contractor's expense or may be subjected to a load test, also at Contractor's expense.

e. Establish the mix designs and have them tested through the laboratory.

f. Submit cylinder test results for the various mix designs showing compressive strength at 2, 7, and 28 days.

D. Proposed methods for controlling concrete temperature.

E. Certificates of Compliance

1. Ingredients

   a. Submit with the mix design, laboratory test reports and mill or manufacturer's certificates attesting to the conformance of ingredients with these specifications. Use ingredients in the design mix which are representative samples of the materials to be used in the contract work.

   b. In case the source, brand or characteristic properties of the ingredients need to be varied during the term of the contract, submit revised laboratory mix report, in conformance with the above procedures.

2. Batch Tickets

   Submit a delivery ticket from the concrete supplier with each batch delivered to the site setting forth the following information. Submit certificate to the Engineer before unloading at the site.

   a. Name of Supplier

   b. Name of batching plant and location

   c. Serial number of ticket
d. Date  
e. Truck Number  
f. Specific job designation (contract number and location)  
g. The volume of concrete (cubic yards)  
h. Specific class and type of concrete (in conformance with the specification requirements)  
i. Time loaded  
j. Type and brand of cement  
k. Weight of cement  
l. Maximum size of aggregates  
m. Weights of coarse and fine aggregates, respectively  
n. Maximum amount of water to be added and amount of water added at the site, if any. 
o. Kind and amount of admixtures  

F. Product Delivery, Storage And Handling  
1. Aggregates  
   a. Transport and stockpile aggregates according to their sources and gradations. Handle in a manner which will prevent segregation and loss of fines or contamination with earth or foreign materials.  
   b. If aggregates show segregation or the different grades become mixed, rescreen before placing in the proportioning bins.  
   c. Do not use aggregates from different sources or of different gradations alternatively. Mix only to obtain different gradations.  
   d. Do not transfer aggregates directly from trucks, railroad cars or barges to the proportioning bins when the moisture content is such that it will affect the accuracy of the proportioning of the concrete mixture. In such case, stockpile aggregate until the excess moisture drains off.  

2. Packaged Cement
a. Deliver to the project site in original sealed packages labeled with the weight, name of the manufacturer, brand, and type specified.

b. Store packages in a water-tight building.

c. Do not use cement which has been reclaimed by cleaning bags.

d. Do not use cement which has been damaged by exposure or overstocking.

e. Do not deliver packages varying more than three percent from the specified weight.

f. Packaged cement will be subject to test at any time.

3. Bulk Cement

   a. Store bulk cement separately from other cement and protect from deterioration from exposure to moisture and intrusion of foreign matter.

4. Provide facilities to maintain separation of cement meeting the requirements of these specifications from other cement.

5. Provide in cement manufacturer's plant, facilities for sampling of cement at the weighing hopper or in the feed line immediately before entering the hopper.

6. Do not use different brands of cement, or the same brand of cement from different sources without approval.

03300.02 MATERIALS

A. Materials

1. Portland Cement: ASTM C150 Type I or II

2. Admixtures

   a. Admixtures to be used in concrete shall be subject to prior approval by the Engineer.

   b. Calcium chloride or admixtures containing chloride other than impurities in admixture ingredients shall not be used.

3. Membrane Forming Curing Compound shall comply with provisions of ASTM C309, Type I (100 resin) with fugitive dye, and Type 2.

4. Waterproof Curing Sheet shall comply with provisions of ASTM C171, Type 1.1.1 and 1.1.2.
5. Burlap Sheet shall comply with provisions of AASHTO M182, Class 3 and 4.

6. Tarpaulins shall comply with provisions of FS K-P-146.

7. Water requirements
   a. Containing no impurities, suspended particles, algae, or dissolved natural salts in quantities that will cause:
      i. Corrosion of reinforcing steel.
      ii. Volume change that will increase shrinkage cracking.
      iii. Efflorescence.
      iv. Excessive air entraining.
   b. The pH to be not less than 6.5 nor greater than 7.5.
   c. When tested in accordance with ASHTO T26, standard mortar briquette tests to show no indication of unsoundness, change in time-of-setting not in excess of 30 minutes, or reduction in strength not more than ten percent.

8. Concrete Aggregate shall comply with the provisions of ASTM C33, with the following additional requirements:
   a. Coarse aggregate:

<table>
<thead>
<tr>
<th>Deleterious Substance</th>
<th>Maximum Allowable Percent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coat and lignite particles</td>
<td>0.5</td>
</tr>
<tr>
<td>Friable particles</td>
<td>0.25</td>
</tr>
<tr>
<td>Material passing No. 200 sieve (for crushed aggregates if</td>
<td>1.0</td>
</tr>
<tr>
<td>the material finer than the No. 200 sieve consists of dust of</td>
<td></td>
</tr>
<tr>
<td>fracture essentially free from clay or shale the percentage</td>
<td></td>
</tr>
<tr>
<td>may be increased to 1.5)</td>
<td></td>
</tr>
<tr>
<td>Thin or elongated pieces (length may be greater than five</td>
<td>5.0</td>
</tr>
<tr>
<td>times the smallest dimensions of a circumscribing rectangular prism)</td>
<td></td>
</tr>
<tr>
<td>Other deleterious substances</td>
<td>1.0</td>
</tr>
</tbody>
</table>

   b. Percentage of wear not exceeding 45 when tested in accordance with ASTM C131 and C535.
c. Weighted percentage of loss not more than 15 percent by weight when subjected to five cycles of the magnesium sulphate soundness test in accordance with ASTM C88.

d. Gradation in accordance with Table 2 of ASTM C33 and represented by a smooth gradation curve with the required limits.

9. Fine Aggregate

a. Washed natural and or washed manufactured sand. Manufactured sand may be subject to special gradation requirements as directed by the Engineer.

b. Gradation in accordance with ASTM C33 and represented by a smooth gradation curve within required limits. The minimum percentages of the material passing the Number 50 and Number 100 sieves may be reduced to five and zero respectively if the aggregate is to be used in concrete with three percent minimum air-entainment, or concrete containing more than 5.5 bags of cement per cubic yard.

c. Weighted percentage of loss not more than 12 percent by weight when subjected to five cycles of the magnesium sulphate soundness test in accordance with ASTM C88.

d. Deleterious Substance

<table>
<thead>
<tr>
<th>Deleterious Substance</th>
<th>Maximum Allowable Percent by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coat and lignite particles</td>
<td>0.5</td>
</tr>
<tr>
<td>Friable particles</td>
<td>1.0</td>
</tr>
<tr>
<td>Material passing No. 200 sieve, other deleterious substances such as shale, alkali, mica, coated grain, soft and flaky particles.</td>
<td>5.0</td>
</tr>
</tbody>
</table>

e. Free from injurious amounts of organic impurities as determined by ASTM C40. Should material fail to pass test for organic impurities in sand for concrete, retest in accordance with ASTM C87. If the fine aggregate shows by the calorimetric test a darker color than that of the sample originally approved for work, stop using the aggregate until tests satisfactory to the Engineer have been made to determine whether the change in color is indicative of an injurious amount of deleterious substances.

10. Reinforcement

a. All reinforcing steel except No. 2 bars shall be deformed. Reinforcement not specified or indicated otherwise shall have minimum yield strength of 60,000 psi, and shall conform to one of the following ASTM specifications:
b. Reinforcing Bars

i. A 615 Deformed billet-steel bars for concrete reinforcement Grade 60

ii. Welded Wire Fabric

Welded wire fabric shall be electrically-welded fabric of cold-drawn wire of gauge and mesh size indicated or specified herein, and shall conform to ASTM A185. Where the size mesh and weight of the fabric are not indicated or specified otherwise, fabric shall be 6-inch by 6-inch mesh, No. 6 gauge of 0.192-inch nominal diameter wire weighing approximately 42 pounds per 100 square feet.

11. Elastomer Waterstops

Elastomer waterstops shall be made of polyvinyl chloride, shall be dense, homogeneous, free from porosity and other imperfections, and symmetrical in shape. Materials shall be resistant to chemical action with Portland cement, acids and alkalis, and not affected by fungi. They shall show no effect when immersed for 10 days at room temperature in 10 percent solutions of sulfuric acid, hydrochloric acid, and sodium chloride, and a saturated lime solution. Resistance to fungi shall be determined by ASTM G 21. Material shall not be adversely affected when subjected to tests for low temperature brittleness (-35 degrees F), in accordance with ASTM D 1329, and for water absorption (maximum 5 percent by weight). Waterstops not indicated otherwise shall be 6-inches by 3/8 inch.

12. Materials for Curing Concrete

a. Cotton Mats: Cotton mats shall be free from any substance which may have a deleterious effect on fresh concrete.


c. Polyethylene Sheeting: Polyethylene sheeting shall be natural color and shall have a nominal thickness of 0.004-inch. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.

d. Polyethylene - Coated Burlap: Polyethylene-coated burlap shall be 4 mils thick white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard and shall conform to Federal Specifications CCC-C-467. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface.
e. Liquid Membrane-Forming Compound: Liquid membrane-forming compound shall conform to ASTM C309, white-pigmented Type 2, and be free of paraffin or petroleum.

f. Liquid Chemical Compound Curing: Liquid chemical compound curing shall be accomplished by the application of a suitable sealer-hardener designed for sealing and hardening in addition to curing of the concrete, applied by the method and at the rate recommended by the manufacturer. It shall not reduce the adhesion of paint, waterproofing or other material to be applied to the concrete. The chemical compound shall be free of petroleum resins or waxes. The loss of moisture when determined in accordance with ASTM C 156 shall not exceed 0.055 gram per square centimeter of surface or, if determined by Federal specifications TT- C-800, the loss of moisture shall not exceed 0.037 gram per square centimeter of surface. The abrasion loss shall not exceed 80 percent of that of the same concrete, untreated, when tested in accordance with ASTM C 418 at age 28 days. The adhesion to the treated concrete shall be at least 90 percent of the adhesion to the same concrete, untreated. The test for adhesion will consist of forming mortar or concrete slabs, three moisture cured and three liquid chemical cured for each type of covering to be applied. After curing for 28 days, the slabs shall be permitted to dry in air. The covering shall be adhered to the troweled face of the slabs with the adhesive to be used in the work. After the adhesive has set, cuts one inch apart and 6 to 10 inches long shall be made through the adhered covering, forming strips to one end of which a calibrated spring type balance or other device shall be attached. The strips shall be peeled off at a rate of 2 to 100 inches per minute. The pull required to peel the covering from the slabs shall be the average of three specimens.

13. Chemical Floor Hardener: Chemical floor hardener shall be a liquid concrete hardener applied in accordance with the manufacturer's recommendations.

a. Sonneborn Lapidolith
b. Chem – Masters Sciolith
c. W. R. Meadows Pena-lith
d. Protex Lithoplate

14. Joint-Sealing Materials: Joint-sealing materials shall conform to ASTM D 1850 or Federal Specifications SS-S-1401, except that all joints exposed to the weather shall be sealed with material conforming to Federal Specifications SS-S-1401.

15. Expansion Joint Filler: Expansion joint filler shall be pre-formed type conforming to
ASTM D 1751.

16. Slots and Inserts for Masonry Anchors
   a. Dovetail Anchor Slots: Dovetail anchor slots shall be formed of zinc-coated sheet steel, U.S. 24 minimum gauge, provided in concrete faced with or abutting masonry.
   b. Inserts: Shall be formed of minimum 9 gauge zinc-coated steel wire, engaged between a two-piece half-round wood core, and having loops for embedding in concrete.

17. Epoxy Bonding Compound: Epoxy bonding compound shall conform to ASTM C881.

18. Vapor Barrier: Vapor barrier shall be polyethylene sheet .006 inch (6 mil) thickness of widest practicable widths.

03300.03 EXECUTION

A. Field Quality Control

1. Air Entrainment: Determine the air content of concrete in accordance with the recommendations of ASTM C231.

2. Testing of Concrete
   a. General Requirements
      i Furnish molds and concrete required for casting specimens and testing. In addition, furnish to the Engineer the necessary standard testing equipment and tools to perform sampling, slump tests, air-entrainment tests, yield tests, and boxes for shipping samples.
      ii Compressive strength tests will be performed by the Contractor by making not less than one set of standard cylindrical test specimens for the first 5 cubic yards and every 25 cubic yards of concrete or any portion thereafter for each structure.
      iii For each work shift, when concrete is delivered, at least one set of specimens will be made. A set of test specimens will consist of at least six standard cylinders from a batch. At least two specimens of the set will be tested for 2-day, 7-day, and 28-day compressive strength. The tests for 2-day compressive strength, approximately 25 percent of the 28-day compressive strength, will be used to aid in the determination of form, falsework and centering removal. The tests for 7-day compressive strength, approximately 60 percent of the 28-day compressive strength, will be likewise used.
iv Slump tests, yield tests, and air content tests will be performed by the Contractor with no less frequency than that of casting strength specimen sets.

b. Concrete Strengths

i Determine compressive strengths from standard test specimens taken according to ASTM C31 and ASTM C172, and cured and tested in accordance with ASTM C39 by the Laboratory. Core drilling and testing will be in accordance with ASTM C94.

ii Compute and evaluate in accordance with ASTM C94.

c. Air content: Determine in accordance with ASTM C231.

d. Cement Factor: Determine in accordance with ASTM C138.

e. Modulus of elasticity: Determine the modulus of elasticity and Poisson's Ratio in accordance with ASTM C469 as directed by the Engineer.

f. Slump: Determine in accordance with ASTM C143.

g. Unit Weight: Determine the unit weight in accordance with ASTM C138 as directed by the Engineer.

3. Design Mix

a. Specified 28 days compressive strength of concrete shall be as follows:

i $f'_c = 3000$ psi for all structurally reinforced concrete work.

ii $f'_c = 3000$ psi concrete for exterior work and all flatwork underfoot, such as walks, steps, ramps, drives, porch floors, all work vulnerable to the use of "de-icers". Also use for pipe thrust blocking and masonry cell fill.

iii $f'_c = 2000$ psi concrete for mud mats, limited site voids, soil boring voids, and for under foundations where excavated to excessive depth.

iv $f'_c = 2000$ psi concrete for grout with maximum size coarse aggregate not exceeding 3/8 inch.

b. Mix Proportioning

i Mix proportioning for wastewater treatment structures shall produce watertight concrete resistant to naturally occurring or commonly used chemicals, with a 28-
day compressive strength of 3500 psi in accordance with Method I (ACI 301) and the following:

a. Maintain a minimum water to cement ratio consistent with the point of placement.

b. Provide the following minimum cement content:

\[
\begin{array}{|c|c|}
\hline
\text{ASTM C33 Coarse Aggregate No.} & \text{Lbs. per cu. yd.} \\
\hline
467 & 517 \\
57 or 67 & 564 \\
\hline
\end{array}
\]

c. Provide air entrainment as follows:

\[5\% \pm 1\% \text{ coarse aggregate No. 467}\]

\[6\% \pm 1\% \text{ coarse aggregate No. 57 or 67}\]

c. Classes for Concrete

i. Classes of concrete are designated by numerals corresponding to their specified 28-day compressive strengths in pounds per square inch as determined by ASTM C94

ii. When class is not indicated use 3,000.

iii. Each class of concrete may comprise one or more mixes determined by the maximum size of aggregate, cement factor and types of admixtures used.

d. Minimum Cement Factor

i. Observe the minimum cement factor for the various classes of concrete as follows:

\[
\begin{array}{|c|c|}
\hline
\text{Class of Concrete} & \text{Minimum Cement Factor} \\
& \text{Bags per cu. yd. of Concrete} \\
\hline
4,500 & 6.5 \\
3,500 - 4,000 & 6.0 \\
3,500 - 3,000 & 5.0 \\
\text{Less than 3,000} & 4.5 \\
\hline
\end{array}
\]
B. Material Preparation

1. Mixing Concrete
   a. Operations
      i. Provide concrete mixers that discharge the concrete from the mixer uniform in composition and consistency throughout the mixed batch.
      ii. Do not use fine aggregates from different sources of supply alternatively in the same class of construction mix.
      iii. Combine coarse aggregates of different gradation and identical sources, providing the corresponding concrete mix has been approved by the Engineer. The use of alternate batches of gravel, crushed gravel, or crushed stone of any one size will not be permitted.
      iv. The adequacy of mixing will be determined by the Engineer by mixer performance tests according to the Bureau of Reclamation Designation 26 Variability of Constituents in Concrete in the appendix of Concrete Manual of U.S. Bureau of Reclamation, Seventh Edition.
      v. The Engineer reserves the right to reduce the size of the batch to be mixed or to increase the mixing time when the charging and mixing operations fail to produce a concrete batch which conforms to the above criteria.
      vi. Add water prior to, during, and following the mixer charging operations. Do not use concrete which is retained in mixers so long as to require additional water in excess of design mix water to permit satisfactory placing.
   b. Central-mixed concrete
      i. Arrange mixers in centralized mixing plant so that the mixing action in the mixers can be observed by the Engineer and plant operator from a location convenient to the mixing plant operator's station.
      ii. Do not load mixers in excess of their rated capacity. Mix the concrete ingredients in a batch mixer for not less than the period of time herein specified for various mixer capacities after all of the ingredients except the full amount of water are in the mixer. Reduce the mixing time if thorough mixing as herein defined can be obtained in less time, as determined by the Engineer.
### Capacity of Mixer vs Mixing Time

<table>
<thead>
<tr>
<th>Capacity of Mixer</th>
<th>Mixing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 cu. yd. or less</td>
<td>1-1/2 minutes</td>
</tr>
<tr>
<td>3 cu. yd.</td>
<td>2 minutes</td>
</tr>
<tr>
<td>4 cu. yd.</td>
<td>2-1/2 minutes</td>
</tr>
<tr>
<td>Larger than 4 cu. yd.</td>
<td>*</td>
</tr>
</tbody>
</table>

*To be determined by mixer performance tests by Engineer. Equip each mixer with a mechanically operated batch counter, and a timing and signaling device which will indicate completion of the required mixing period.

iii Truck-mixed concrete: Use equipment and procedures that conform to the requirements of ASTM C94.

iv Temperature control:

   a. Use preparation methods capable of producing concrete with a temperature not more than 90 degrees F. and not less than 45 degrees F. at the time of placement.

   b. Do not heat concrete ingredients to a temperature higher than that necessary to keep the temperature of the mixed concrete as placed, within the specified temperatures.

   c. Do not allow cement to contact water or aggregate in excess of 120 degrees F.

c. Admixtures

   i Air entraining admixture: Use for concrete exposed to weathering or in contact with rock or moist soil.

   ii Chemical admixtures:

      a. Use water reducing admixtures in concrete areas below grade in contact with rock, earth, or fill.

      b. Employ admixtures without interfering with the specified air content dosage of air-entrained concrete.

      c. Except as specified, use water reducing, set retarding or set accelerating admixtures only with the Engineer's approval.

      d. If the introduction of certain admixtures to improve concrete strength is permitted by the Engineer, do not reduce the cement content below the
minimum amounts specified.

iii Use calcium chloride only as specifically authorized in writing by the Engineer. Do not use calcium chloride in prestressed concrete, underground structures, reinforced concrete, or in concrete used to encase or in contact with structural steel or cast iron.

d. Consistency

Slump shall not exceed 2-inches above design mix slump as approved by the Engineer, and shall be kept at a practical minimum for the point of placement.

e. Construction Joints

Joints not shown on the drawings shall be made and located so as to not impair the strength of the structure and shall be subject to approval of the Engineer. In general, construction joints must be placed such that no vertical pour may exceed 10 to 15 feet and no horizontal pour may exceed 20 to 30 feet. Horizontal joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the top of footing of grade slabs. Joints shall be perpendicular to the main reinforcement.

i Reinforcement in Construction Joints.

All reinforcing steel and welded wire fabric shall be continued across joints. Keys and inclined dowels shall be provided as indicated. Longitudinal keys at least 11/2-inches deep shall be provided in all joints in walls and between walls and slabs or footings.

ii Preparation of Surface

The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed.

iii Bonding: When a bonded construction joint is required, bond shall be obtained by one of the following methods.


b. The use of suitable chemical retardant which delays but does not prevent setting of the surface mortar. Retarded mortar shall be removed within 24 hours after placing to produce a clean exposed aggregate bonding surface.

c. By roughening the surface of the concrete in proper manner which will expose
the aggregate uniformly and completely expose fresh concrete at the surface.

f. Expansion Joints, Cleavage Joints, Waterstops and Embedded Items.

i. Expansion Joints and Cleavage Joints

a. Expansion joints shall be provided in any structure having a dimension of 120 feet in any principal direction. Desirable maximum spacing is 50 to 60 feet. Reinforcement shall stop 2 inches from the face of an expansion joint.

b. Expansion joints and cleavage joints shall not be less than 1/2-inch wide except as indicated otherwise. Expansion joints not exposed to weather shall be filled completely with preformed joint material conforming to ASTM D 1751. Expansion joints exposed to weather and cleavage joints between vertical masonry surfaces and floor slabs laid on earth shall be filled to a depth of one-inch from the surface or face of the concrete width deep space above the preformed material conforming to ASTM D 1751. The one-inch deep space above the preformed material shall be cleaned after the concrete has been cured, and when dry, filled flush with joint sealing material. Reinforcement or other embedded metal items bonded to the concrete, except dowels in floors bonded on only one side of joint, shall not be permitted to extend continuously through any expansion joints.

ii. Waterstops

a. All horizontal and vertical construction and expansion joints providing for fluid containment in a wet space as well as joints located in exterior walls below grade shall have placed in the joint a waterstop to develop effective watertightness. Wet space shall include tanks, channels, chambers, etc. used to store, convey or contain fluids or solids containing fluids.

b. The material, design, and location of waterstops in construction joints and expansion joints shall be as indicated or as specified herein. Each piece of premolded waterstop shall be maximum practicable length in order the number of end joints will be held to a minimum. Joints at intersections and at ends of pieces shall be made in the manner most appropriate to the material being used. Joints shall develop effective watertightness fully equal to that of the continuous waterstop material and shall permanently develop not less than 50 percent of the mechanical strength of the parent section and shall permanently retain its flexibility.
iii Embedded Items

All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting. All subcontractors, whose work is related to the concrete or must be supported by it, shall be given ample notice and opportunity to introduce or furnish embedded items before the concrete is placed. All ferrous metal sleeves, inserts, anchors, and other embedded ferrous items exposed to the weather or where rust would impair the appearance or finish of the structure shall be galvanized.

iv Placing Embedded Items

Expansion joint material, waterstops, and embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Aluminum shall not be embedded in concrete except where aluminum is protected from direct contact with the concrete.

v Reinforcing Bars

Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items, but not so as to impair design strengths of the members. If bars are moved more than one bar diameter, the resulting arrangement of bars shall be subject to the approval of the Engineer.

C. Conveying

1. General Requirements:
   a. Convey concrete from the point of delivery with a continuous flow of concrete to the point of placement without segregation.
   b. Provide an arrangement at the discharge end of a conveyor to prevent segregation.

2. Chutes and Troughs:
   a. Use only ferrous metal or approved plastic or rubber lined chutes and open troughs. Where steep slopes are required, discharge the concrete into a hopper. Keep chutes or open troughs clean of hardened concrete by thoroughly flushing with water after each use.
   b. Discharge the water used for cleaning outside the lines of the structure.

3. Adjustable Length Pipes (Elephant Trunks): Use flexible pipes only of ferrous metal,
rubber or plastic, six inches minimum diameter and use in a manner that will not cause segregation of the concrete.

a. Locate chute or flexible pipes so that concrete is delivered in a continuous flow to points not more than five feet horizontally and five feet vertically from its final location.

b. Thoroughly clean flexible pipes or elephant trucks after each use.

4. Buggies: Construct runways on which buggies will operate such that they will not come in contact with or be supported by the reinforcing steel of the structure.

5. Pumping Equipment:

a. Use pumping equipment, designed to handle the types, classes and volumes of concrete to be conveyed without segregation.

b. Operate the pump equipment so that a continuous stream of concrete without air pockets is conveyed. Position the discharge end of the line as near the final position of the concrete as possible.

D. Preparation For Placement

1. Do not place concrete until all formwork, steel reinforcement, installation of embedded parts, preparations for finishing unformed areas, scaffolding, lighting, power and methods and procedures for placing concrete have been accepted and an instrument check of vertical alignment and bracing sufficient to insure plumbness during pour has been approved by the Engineer. All surfaces of forms and embedded materials shall be cleaned of dried mortar or grout from previous pours. Poorly consolidated concrete at construction joints and all loose material shall be removed. Surfaces of concrete and embedded materials shall be cleaned of laitance, or oil and other bond destroying agents.

2. Surfaces against which concrete is to be placed shall be clean and free of running water, mud, loose material, oil debris, frost and ice. Rock surfaces shall be free of semi-detached and unsound fragments. Absorptive foundation surfaces shall be moistened thoroughly or otherwise treated so that moisture will not be drawn from freshly placed concrete.

3. Coat faces of removable concrete forms with form oil acceptable to the Engineer.

E. Placement
1. General Requirements

a. Place concrete continuously and as soon as possible after mixing. Do not use vibrators for shifting the mass of fresh concrete.

b. Place concrete in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. Cover each layer of concrete with fresh concrete within 45 minutes.

c. Do not place concrete which has attained its initial set or concrete which has contained its mix water for more than 90 minutes.

d. Notify the Engineer at least 24 hours in advance of the start of concrete placing.

e. Placing will not be permitted when, in the opinion of the Engineer, the sun, heat, wind or limitations of facilities furnished prevent proper finishing and curing.

f. Control concrete temperature at time of placement:
   
i. To be not less than 45 degrees F.
   
   ii. To be not more than 90 degrees F.

   g. Unless approved by the Engineer, do not start concreting when descending natural air temperature falls lower than 40 degrees F.

   h. Start placement of structural concrete on/or next to a construction joint with a 3-inch thick layer of oversanded mix with 3/4-inch maximum aggregate, an extra sack of cement per cubic yard, and a five inch slump.

   i. Deposit concrete as nearly as practicable directly in its final position so that the lateral movement will not result in segregation of the coarse aggregate, mortar, or water from the concrete mass. Do not use methods and equipment in depositing concrete in forms which result in clusters or groups of coarse aggregate being separated from the concrete mass. When concrete is placed through a dropchute, use one or more vibrators where concrete is falling to prevent stacking and separation.

   j. Place formed concrete, in continuous, approximate horizontal layers, the depth of which generally shall not exceed 24-inches. Lesser depths may be required where necessary to ensure that each new layer can be made monolithic with the previous layer by penetration of the vibrators.
2. Compaction
   
a. Consolidate all concrete by vibration to the maximum practicable density, so that it is
   free from pockets of coarse aggregate and entrapped air, and filled tightly against the
   subgrade of previously placed concrete, all formed surfaces and embedded materials.
   In consolidating each layer of concrete operate the vibrator at regular and frequent
   intervals, and in a near vertical position. Allow the vibrating head to penetrate and
   revibrate concrete in the upper zone of the underlying layers.

   b. Revibrate the top layer of each placement systematically at the latest time the
   concrete can be made plastic by means of vibration. Do not place layers of concrete
   until the layers previously placed have been vibrated thoroughly as specified.

   c. Consolidate concrete by electric or pneumatic drive vibrators of sufficient power and
   capacity to consolidate the concrete effectively and quickly. Operate concrete
   vibrators at speeds of at least 7,000 rpm when immersed in the concrete. Have
   standby vibrators in good condition readily available if needed during concrete
   placement. Use equipment capable of obtaining results and operating reliably and
   effectively with a concrete mix that is not excessively oversanded or high in slump
   and may occasionally be of lower slump than intended.

F. Curing And Protecting

1. General Requirements
   
a. Protect freshly placed concrete from excessive hot or cold temperatures. Maintain
   concrete surfaces without drying for the period of time necessary for the hydration of
   the cement and the proper hardening of the concrete.

   b. Cure newly placed concrete for a cumulative period of seven days at an air
   temperature in excess of 55 degrees F.

   c. During the curing period keep steel and wood forms set. If forms are removed during
   curing use one of the following methods of curing immediately and continue for the
   remainder of the curing period.

2. Normal Curing And Protection - Use any one of the methods specified below:

   a. Use ponding on horizontal surfaces providing the surface is submerged at all times
      for the required curing period.

   b. Apply continuous sprinkling with nozzle or nozzles which, during the first 24 hours,
      atomizes the flow of water providing a mist and not a spray. Do not apply the
moisture under pressure directly upon the concrete and avoid flowing or washing on the surfaces while susceptible to erosion.

c. Cover the entire surface of the concrete with double thickness burlap sheet, laid directly on the concrete and kept wet at all times. Maintain in good condition.

d. Sprinkle, as specified above, for at least 18 hours and then immediately cover the concrete surface with waterproof curing sheets, free from holes or tears. Hold in position in such manner that the entire surface of the concrete being cured is fully covered at all times.

e. Do not damage burlap or waterproof sheet or concrete surfaces.

3. Membrane-Forming Curing Compound

a. Use a curing compound when authorized for circumstances where the application of moisture is impracticable and where such compounds will not jeopardize the appearance of the concrete. Except as otherwise specified, use Type 1 compound, uniformly applied over the surface at the thickness recommended by the manufacturer. Thoroughly mix compound and apply within one hour after mixing.

b. Where the surfaces are subject to sunlight, apply Type 2 White compounds.

c. Do not apply wax-resin type curing compounds to a surface where bond is required for additional concrete or where a bonded surface coating such as paint, tile, dampproofing, waterproofing, or roofing is to be applied.

d. Warm the curing compound if required for satisfactory application in accordance with the manufacturer's recommendations. If the film of the compound is damaged before the expiration of the curing period, repair immediately with additional compound.

e. Give surfaces the required surface finish prior to the application of the curing compound. Do not use curing compound on construction joints.

f. Apply curing compound in two coats, apply the first coat immediately after stripping of forms and acceptance of the concrete finish.

g. If the surface is dry, thoroughly wet the concrete with water and apply the curing compound just as the surface film of water disappears. Apply the second coat after the first coat has set.

h. Protect the coating against damage for a period of at least 10 days after application. Apply an additional coating to coatings which are damaged.
G. Cold Weather Protection

1. Take the protective measures as are necessary to protect the concrete when the official weather forecast for the vicinity may be expected to reach 32 degrees F. Use one of the following methods:

a. Heating:

   i Enclose the forms or structures and heat to maintain the concrete and air within the enclosure at a temperature of not less than 38 degrees F. for a period of seven days after placement.

   ii Maintain the relative humidity at not less than 40 percent during the curing period where heat is applied to enclosures. Arrange the stoves, salamanders or heaters so as to provide a uniform distribution of heat. Vent combustion gasses to the outside air.

   iii After the seven days curing period, reduce the temperature within the enclosure gradually at a rate not to exceed 20 degrees F. per day until the outside temperature has been reached.

   iv Provide adequate fire protection and watchmen when heating units are in continuous operation.

b. Insulation of forms:

   i Completely insulate the forms with blanket insulation of sufficient thickness to maintain the concrete of a temperature of not less than 55 degrees F. for a period of seven days.

   ii Have the type and thickness of the insulation approved prior to use.

   iii Protect the top of placed concrete by tarpaulins or other approved waterproofing material over the insulation.

c. Place concrete during the cold weather at a temperature of not less than 55 degrees or more than 90 degrees F.

d. Heat and mix materials for concrete as specified.

H. Hot Weather Requirements

1. Hot weather conditions are deemed to exist when the temperature in the forms is 75 degrees F. or above.
2. After placement, protect the concrete from direct sunlight and keep the forms moist by means of cool water sprinkling, or the application of wet burlap or cotton mats.

I. **Defective Concrete**

Concrete will be considered defective if it is structurally unsound, not watertight, improperly finished, or not within the tolerances specified herein.

1. Concrete will be considered defective if the concrete cylinder tests fail to meet the specified strength requirements at any location of the work. In such cases, take drilled cores at locations specified by the Engineer. Core specimens will be tested by the Engineer in accordance with the requirements of ACI 301. If cored specimens do not indicate compliance with the compressive strength requirements, replace the defective portion of the structure.

2. Cold joints are not permissible. Upon form stripping and inspection by the Engineer, indications of cold joints may be cause for rejection of pour.

3. Windsor probe tests conducted in conformance with ASTM C-803-75T may be conducted by the Engineer in lieu of taking and testing core specimens.

4. The Engineer, at his discretion, will require replacement of the defective portion of the structure in accordance with the provision of ACI 201, Chapter 7. All strengthening or correction of defective concrete will be at no additional cost to the Owner.

J. **Damaged Work**

1. Before final acceptance of the work, damage to surfaces, corners of concrete and concrete finish, whether such damage shall have resulted from the action of the elements or damage from any cause whatsoever, shall be neatly repaired, as approved by the Engineer at no additional cost to the Owner.

2. At damaged place where surface repairs are permitted, the concrete shall be chipped out and a concrete patch installed. The patch shall have a minimum thickness of two inches, shall be dense and watertight to meet specifications requirements, and shall have a smooth exposed surface matching the neat line of adjacent concrete.

K. **Tolerance For Concrete Construction**

1. Permissible surface irregularities are defined as "finishes", and are to be distinguished from tolerances as described herein.

2. Allowable tolerances are:
a. Structures

Departure from established alignment .......................................................... 1 inch

Departure from established grade ................................................................. 1 inch

Variation from the plumb in the lines and surfaces of columns, piers, and walls exposed, in 10 ft ........................................................................................................... ½ inch

Backfilled, in 10 ft .......................................................................................... 1 inch

Variation in the level or from grades specified in slabs and beams exposed, in 10 ft ........................................................................................................... ½ inch

Backfilled, in 10 ft .......................................................................................... 1 inch

Variation in cross-sectional dimensions of columns, piers, slabs, walls and beams

Minus ............................................................................................................. 1/4 inch

Plus .................................................................................................................. 1/2 inch

Variation in sizes and locations of slab and wall openings .......................... 1/2 inch

END OF SECTION
SECTION 03732

CONCRETE REPAIRS

03732.01 GENERAL

A. The Requirement

1. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the repair, renovation, and replacement of concrete and/or reinforcing steel as indicated on the Drawings, specified herein, and determined by field survey.

2. The Contractor, in conjunction with the Engineer, shall determine the extent of cracked or deteriorated concrete to be rehabilitated and/or resurfaced. A summary of the work to be performed shall be submitted to the Engineer for review, and such summary shall be approved by the Engineer prior to commencement of the Work.

3. Concrete repairs include the following:

   a. Structural crack repair shall include repair of all cracks deemed necessary by the Engineer using epoxy crack repair binder as specified herein. Total length of crack repair required shall be determined during a joint field inspection with the Owner, Contractor, and Engineer. Repair shall be as specified herein. The quantity of crack repair to be paid for shall be the actual number of linear feet of crack which has been repaired and accepted. Work shall be paid for on a per linear foot basis at the Contractor's applicable unit price bid included on the bid form. For bid purposes, the Contractor shall assume an estimated quantity of 100 linear feet of structural crack repair.

   b. Actively leaking crack repair shall include repair of all leaking cracks or joints deemed necessary by the Engineer with waterproof injection grout as specified herein. Total length of leaking crack repair required shall be determined during a joint field inspection with the Owner, Contractor, and Engineer. Repair shall be as specified herein. The quantity of leaking crack and joint repair to be paid for shall be the actual number of linear feet of crack and joints which have been repaired and accepted. Work shall be paid for on a per linear foot basis at the Contractor's applicable unit price bid included on the bid form. For bid purposes, the Contractor shall assume an estimated quantity of 75 linear feet of leaking crack and joint repair.

   c. Surface spall repair shall include repair of all spalled areas not requiring formwork deemed necessary by the Engineer. Maximum thickness of surface spall repair shall be assumed as one inch. Total extent of surface spall repair required shall be determined during a joint field inspection with the owner, Contractor, and Engineer.
d. Formed spall repair shall include repair of all spalled areas requiring formwork deemed necessary by the Engineer. Formed spall repair shall be assumed as any repair greater than one inch in thickness. Total extent of formed spall repair required shall be determined during a joint field inspection with the Owner, Contractor, and Engineer. Repair shall be as specified herein. The quantity of formed spall repair to be paid for shall be the actual number of cubic feet of repair material which has been placed and accepted. Work shall be paid for on a per cubic foot basis at the Contractor's applicable unit price bid included on the bid form. For bid purposes, the Contractor shall assume an estimated quantity of 10 cubic feet of formed spall repair material.

B. Related Work Specified Elsewhere

1. Division 1 - General Requirements
2. Division 3 - Concrete

C. Subcontractor / Applicator Qualifications

1. The Contractor shall furnish the name of all subcontractors/applicators which he proposes to use for this work, including necessary evidence and/or experience records to ascertain their qualifications in the application of epoxy, urethane, and polymer-modified and silica fume enhanced mortars and grouts. Approved applicator qualifications shall include:

   2. A minimum of 5 years of experience in applying epoxy, urethane, and polymer-modified and cement-based compounds similar to those specified in this Section.

   3. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for applying the product, including surface preparation and mixing, placing, curing, and caring for the manufacturer's products. This letter shall further state that the subcontractor/applicator is on the manufacturer's approved list of contractors.

D. Submittals

1. Material certifications and technical data sheets on all grouts, mortars, epoxy resins,
aggregates and repair products specified in this Section.

2. Subcontractor/Applicator qualifications as specified above.

3. Shop Drawings detailing any planned deviation from the proposed construction sequence and/or method of repair.

4. The Contractor, based on their experience in their profession, may submit to the Engineer for approval, alternative materials and/or methods of work to assure the durability and watertight integrity of the repair work performed.

E. Additional Guarantee

1. The Contractor shall guarantee all repair work performed under this Contract against defects in workmanship resulting in leakage and/or failure of concrete bond for a period of two years from the date of Substantial Completion.

03732.02 MATERIALS

A. Water

1. The water used for mixing concrete repair products shall be clear, potable, and free of deleterious substances.

B. Aggregate

1. All aggregate shall conform to ASTM C-33. The aggregate supplier shall submit to the Engineer documentation that the proposed aggregates comply with ASTM C-33 and the requirements listed below:

2. Pea Gravel - Pea gravel shall meet the gradation and material requirements of Standard Size 14 as defined by ASTM C-33. Pea gravel shall be clean and free from deleterious matter and shall contain no limestone.

C. Epoxy Bonding Agent

1. An epoxy bonding agent shall be used when applying fresh concrete to previously placed concrete. Epoxy bonding agent shall conform to ASTM C-881 Type I, II, IV or V; Grade 2 for epoxy resin adhesives, depending on the application. The class of epoxy bonding agent shall be suitable for all ambient and substrate temperatures. The epoxy resin shall be "Sikadur Hi-Mod Series” as manufactured by the Sika Corp, Lyndhurst, NJ, "CR 246" as manufactured by Sto Corporation, Atlanta, GA, "Duralbond" as manufactured by Euclid Chemical Company, Cleveland, OH, “Euco #452 Series” by the Euclid Chemical Company, or “MBT Concresive Series” by BASF Construction Chemicals.
D. Anti-Corrosion Rebar Coating

1. All reinforcing steel cut or exposed during demolition and/or repair operations shall be protected with an anti-corrosive coating. The anti-corrosive coating shall be a two-component, polymer-modified cementitious material such as "Sika Armatec 110 EpoCem" manufactured by Sika Corp., Lyndhurst, NJ, "CR 246" manufactured by Sto Corporation, Atlanta, GA, “Corr-Bond” by the Euclid Chemical Company, or “MBT Emaco P24” by BASF Construction Chemicals.

E. Epoxy Crack Repair Binder

1. Epoxy crack repair binder shall be a two-component, 100% solids, high-modulus, low viscosity epoxy adhesive designed for structural repair. The epoxy adhesive shall be "Sikadur 52" manufactured by Sika Corp., Lyndhurst, NJ, "Duralcrete LV" manufactured by Euclid Chemical Company, Cleveland, OH, “Sto Poxy Binder CR633” manufactured by Sto Corporation, Atlanta, GA, “Eucopoxy Injection Resin” by the Euclid Chemical Company, or “Concrexive Standard LVI” by BASF Construction Chemicals.

F. Waterproof Injection Grout

1. Waterproof crack repair material shall be a one-component, water-activated polyurethane hydrophilic injection grout capable of 700% expansion. Polyurethane grout shall form a tough flexible foam seal that is impenetrable to water. Hydrophilic injection grout shall be "Prime Flex 900 XLV" manufactured by Prime Resins, Conyers, GA, "Scotch-Seal Chemical Grout 5600" manufactured by Avanti International, Webster, TX, "Hydro-Active Flex LV" manufactured by De Neef Construction Chemicals, Houston, TX, or “Concrexive 1210-IVG” by BASF Construction Chemicals.

G. Spall Repair Patching Material

1. All spall repairs not requiring formwork shall be repaired using a two-component, polymer-modified or silica fume enhanced cementitious mortar and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar for use in horizontal applications shall be "Sikatop 122 Plus" manufactured by Sika Corp., Lyndhurst, NJ, “Duraltop Fast Set” manufactured by Tamms Industries, Mentor, OH, "CR 700" manufactured by Sto Corporation, Atlanta, GA, “Thin-Top Supreme or Concrete Top Supreme” by the Euclid Chemical Company, or MBT SD-2 or Emaco R310 by BASF Construction Chemicals. Spall repair mortar for use in vertical applications shall be "Sikatop 123 Plus" manufactured by Sika Corp., Lyndhurst, NJ, "Duraltop Gel" manufactured by Tamms Industries, Mentor, OH, "CR 702" manufactured by Sto Concrete Restoration Division, Atlanta, GA, “Verticoat or Verticoat Supreme” by the Euclid Chemical Company, or MBT Gel Patch or HB-2 by
BASF Construction Chemicals.

2. All spall repairs requiring formwork shall be repaired using a two-component, polymer-modified or silica fume enhanced cementitious mortar/pea gravel mixture and shall have a minimum 28-day compressive strength of 7,000 psi. Spall repair mortar shall be "SikaTop 111 PLUS" manufactured by Sika Corp., Lyndhurst, NJ, "Duraltop Flowable Mortar” manufactured by Euclid Chemical Company, Cleveland, OH, “Sto Flowable Mortar CR730” manufactured by Sto Corporation, Atlanta, GA.

3. All spall repair materials shall conform to EPA/USPHS standards for surface contact with potable water supplies.

H. Storage of Materials

1. The Contractor shall provide an area for repair material storage free from exposure to moisture in any form, before, during, and after delivery to the site. Manufactured materials shall be delivered in unbroken containers labeled with the manufacturer's name and product type. All mortar products shall be stored on raised platforms. Materials susceptible to damage by freezing shall be stored in a dry, heated, insulated area. Any material that has hardened, partially set, become caked and/or has been contaminated or deteriorated shall be rejected. All aggregates shall be stored in clean bins, scows or platforms.

03732.03 EXECUTION

A. General Requirements

1. No repair work shall be undertaken when ambient temperatures are below manufacturer's safe recommendations. No admixtures, except those required by the manufacturer, shall be used in the repairs specified herein. All products shall be applied in strict accordance with manufacturer's recommendations. The Contractor shall furnish and install safe scaffolding and ladders for the Engineer's prework inspection, the repair work activities, and the Engineer's final inspection.

2. Sandblast or waterblast (3000-4000 psi waterjet) deteriorated areas to remove all loose concrete, existing coatings, unsound material, debris, and laitance. All surfaces shall be clean, free of dirt, grease, loose particles, and deleterious substances and shall be prepared according to manufacturer's requirements.

B. Epoxy Bonding Agent

1. Existing concrete surfaces shall be roughened prior to application of bonding agent. Concrete surface shall be clean and sound, free of all foreign particles and laitance.
Repair material shall be placed while bonding agent is still tacky. If bonding agent cures prior to placement of repair material, bonding agent shall be reapplied.

2. Repairing concrete with epoxy mortars shall conform to all the requirements of ACI 503.4 "Standard Specification for Repairing Concrete with Epoxy Mortars" (latest edition), except as modified herein.

C. Anti-Corrosion Rebar Coating

1. Reinforcing steel cut or exposed during demolition and/or repair operations shall be sandblasted and cleaned prior to coating with an anti-corrosive coating. Coating shall thoroughly cover all exposed parts of the steel and shall be applied according to manufacturer's recommendations.

D. Epoxy Crack Repair Binder

1. All existing structural cracks 1/4" or smaller shall be repaired by pressure injecting an epoxy crack repair binder into the prepared crack. Seal crack surface and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, inject crack with epoxy crack repair binder using standard pressure injection equipment as directed by the manufacturer.

2. All existing structural cracks wider than 1/4" shall be repaired by gravity feeding an epoxy crack repair binder into the prepared crack. First rout the concrete surface to form a 1/4" wide by 1/4" deep V-notch and clean the crack to remove all loose and foreign particles. Fill the crack with clean, dry sand and then pour epoxy crack repair binder into V-notch, completely filling crack. As binder penetrates into crack, additional binder shall be applied to the V-notch.

E. Waterproof Injection Grout

1. All existing, leaking cracks 1/4" or smaller shall be repaired by pressure injecting a waterproof injection grout into the prepared crack. Seal crack surface and install injection ports per manufacturer's recommendations. Holes drilled for injection ports shall not cut rebar. If rebar is encountered during drilling, the hole shall be abandoned and relocated, and the abandoned hole shall be patched immediately with non-shrink grout flush with the surface of the existing concrete. Once the surface sealing material has cured, inject crack with waterproof injection grout using standard pressure injection equipment as directed by the manufacturer.
F. Spall Repair Patching Material

1. All voids or spalled areas to be repaired shall be chipped back to sound concrete a minimum 1/8” deep, cleaned and repaired with spall repair patching material according to manufacturer's recommendations. All patching shall provide a final finished surface which is flat, level and even with the existing concrete surface. Repair mortar shall not be feathered to meet existing concrete surface. Final patching on horizontal surfaces shall receive a broom finish consistent with the finish on the existing structure.

G. Curing

1. All repair products shall be cured in strict accordance with manufacturer recommendations.

H. Work In Confined Spaces

1. The Contractor shall provide and maintain safe working conditions for all employees and subcontractors. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or by direct air supply to individual workers. Fumes shall be exhausted to the outside from the lowest level of the confined space. Electrical fan motors shall be explosion-proof if in contact with fumes. No smoking or open fires shall be permitted in or near areas where volatile fumes may accumulate.

END OF SECTION
SECTION 05200

MISCELLANEOUS METALS

Supplement Section 05500 MISCELLANEOUS METALS of the County Standards Specification as described below:

05200.01 GENERAL

A. Description

The requirements of this Section apply to the miscellaneous metal fabrications shown on the Drawings and as specified herein, including anchors, fasteners, hardware, castings, gratings and other miscellaneous specialty items.

B. Quality Assurance

1. Codes and Standards

   a. Comply with the latest provisions of the following codes, standards and specifications, except as otherwise shown and specified.

      American Society for Testing and Materials (ASTM) Publications:
      - Structural Steel
      - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
      - Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
      - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
      - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip
      - Carbon Steel, Externally and Internally Threaded Standard Fasteners
      - Aluminum-Alloy Sand Castings
      - Aluminum-Alloy Permanent Mold Castings
      - Aluminum-Alloy Sheet and Plate
      - Aluminum-Alloy Bars, Rods, and Wire
      - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
      - Aluminum-Alloy Standard Structural Shapes, Rolled and Extruded

2. Qualifications for Welding Work: Quality welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

3. Field Measurements: Take field measurements prior to preparation of shop drawings and
fabrication, where possible, to ensure proper fitting of the work. However, do not delay job progress; allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work.

4. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installations

C. Submittals

1. Manufacturer's Data: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in miscellaneous metal work, including paint products.

2. Shop Drawings
   a. Submit shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items.
   b. Include setting drawings for location and installation of miscellaneous metal items and anchorage devices.

3. Samples: Submit representative samples of materials and finished products as may be requested by the Engineer. Engineer's review will be for color, texture, style, and finish only. All other requirements for the work are the Contractor's responsibility.

05200.02 MATERIALS

A. General

For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding, or by welding and grinding, prior to cleaning, treating and application of surface finishes including zinc coatings.

B. Materials

1. Threaded-Type Concrete Inserts (T-Concin): Galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; either malleable iron complying with ASTM A47 or cast steel complying with ASTM A27; hot dip galvanized.
2. Fasteners: All fasteners should be corrosion resistant. Provide fasteners of 300 series stainless steel in all areas subject to corrosive atmosphere.

   a. The rake head shall have teeth spaced to accurately engage the bar rack with rake teeth a minimum of 1-1/4 inch long.

3. Grating Platform

   a. The wet well grating platform and bar rack assembly support shall consist of all aluminum structural shapes of sufficient section to withstand the loading specified herein. All grating platform support members shall be connected or anchored with stainless steel fasteners. The grating support members shall be completely removable and shall include anchored perimeter angle supports and fabricated, wall-mounted beam pockets as necessary.

   b. The Contractor shall submit shop drawings consisting of detailed design calculations and drawings for the grating and grating support system. The Contractor's attention is drawn to the requirements of removable grating sections located and sited to accommodate float mast, bubbler tube, and sewage pump removal or portable submersible sewage pump installation on the floor of the wet well. All grating sections shall have perimeter banding and shall be limited to a size which can be safely handled by any individual. All grating sections shall have serrated edges or other approved non-skid top surface.

   c. The grating and grating support system shall be aluminum construction and designed for a maximum point load of 600 pounds and a uniform load of 150 pounds per square foot with a suitable factor of safety. Grating sections shall be locked down except for removable access sections.

4. Paint

   Primer selected must be lead free and compatible with the required finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Section 09900 of these Specifications.

05200.03 EXECUTION

A. Inspection

   Examine the areas and conditions under which miscellaneous metal items are to be installed and notify Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
B. Preparation

Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate with the delivery of such items to the project site.

C. Fabrication

1. Workmanship: Use materials of the size and thickness shown, or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use. Work to the dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for the various components of work.

2. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32-inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

3. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

4. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown, or if not shown, use Phillips flat head (countersunk) screws or bolts.

5. Provide for anchorage of the type shown, coordinate with the supporting structure and the progress schedule. Fabricate and space anchoring devices to provide adequate support for the intended use of the work.

6. Cut, reinforce, drill and tap miscellaneous metal work indicated to receive finish hardware and similar items of work.

D. Shop Painting

1. Shop paint miscellaneous metal work except: aluminum, stainless steel, or those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded and galvanized surfaces, unless otherwise indicated.

2. Remove scale, rust and other deleterious materials before the shop coat of paint is applied. Clean off rust and mill scale in accordance with SSPC SP- 6 "Commercial Blast
Cleaning". Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".

3. Apply one shop coat of metal primer paint to fabricated ferrous metal items, except apply two (2) coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.

4. Immediately after surface preparation, brush or spray on metal primer paint, applied in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness of 1.5 mils for each coat. Use painting methods which will result in full coverage of joints, corners, edges and all exposed surfaces.

E. Installation

1. Refer to other sections of the Specifications for installation requirements for specific metal materials, products and systems.

2. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, wood screws and other connectors as required. Coat all aluminum in contact with concrete with bituminous coating prior to installation.

3. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for the installation of the miscellaneous metal items. Set the work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and level. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

4. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

5. Field Welding: Comply with AWS Code for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.

6. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness in accordance with Section 09900.
7. The Contractor shall provide shims, washers, anchors, etc. as necessary to achieve a well-constructed installation.

END OF SECTION
SECTION 07110

ELASTOMERIC MEMBRANE WATERPROOFING

Delete all references to membrane waterproofing in Specification Section 07100 of the Anne Arundel County Standard Specifications and replace with the following:

07110.01 GENERAL

A. Description of Work

The work to be included under this section includes everything necessary for and incidental to execution and completion of elastomeric membrane waterproofing work for pump station structure(s) and valve vault(s).

B. Quality Assurance

1. The manufacturer of the material shall have successful experience in supplying the principal materials for the required waterproofing work, or have a successful record of supplying materials for waterproofing.

2. The installer shall be a firm specializing in waterproofing work and either experienced in the use of the types of work required, or licensed by the manufacturer of the materials being installed. Include the following items for undivided responsibility:
   a. Waterproofing accessories
   b. Flashings in connection with waterproofing
   c. Expansion joints in the membrane
   d. Fluid-applied membrane materials
   e. Protection course over membrane, where required.

3. Project Working Conditions
   a. Proceed with the installation of waterproofing only after the substrate construction has been completed, and after penetrating components have been installed, so that the membrane will not be penetrated or damaged by subsequent work.
   b. The installer must examine the substrate and the conditions under which the work is to be performed, and notify the Engineer in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a
manner acceptable to the installer and the Engineer.

c. Weather Conditions: Proceed with work only when weather conditions comply with manufacturer's recommendations, and will permit the materials to be applied and cured in accordance with those recommendations.

4. Submittals

a. Manufacturer's Data, Elastomeric Membrane Waterproofing: Submit specifications by the manufacturer of materials. Include manufacturer's certified test data showing compliance with the requirements of this Section. Products of W.R. Grace Construction Products Division - "Bituthene system" or equal shall be used.

b. Samples: Submit one pint can of primer, two (2) sections of membrane 36 inches x 18 inches, one section of protection board 12 inches x 12 inches, and one pint can of liquid membrane flashing.

5. Precautions

a. Storage: All materials should be protected from rain and physical damage. Store all materials away from sparks or flames. Store membrane where it will not exceed 90 degrees F., for extended periods. Outdoors, place cartons on raised pallets and cover completely. Protection board shall be protected from the wind.

b. Safety: Membrane, primer, mastic adhesive and protection board are flammable products. Follow instructions on product labels. Protection board is a combustible, cellular product. Do not expose to flames, sparks or temperatures above 150 degrees F.

07110.02 MATERIALS

A. Materials

1. Primer: Bituthene Primer WP-3000 (500 to 600 square feet per gallon) for 40 degrees F or greater; use Bituthene Primer B2 LVC (low VOC) if temperatures are 25 degrees F or greater.

2. Membrane: Shall be a self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, 0.0625-inch minimum thickness, either Bituthene 3000, or Bituthene Low Temperature for work on vertical surfaces at temperatures between 25 and 60 degrees F.

3. Liquid Membrane: Bituthene Liquid Membrane shall be used for flashing of the base
membrane at minimum 0.09 inch thickness. In corner flashing applications, the Liquid Membrane should extend 6-inches in either direction from the corner.

4. Elastomeric Mastic: Bituthene Mastic shall be used for terminations of base membrane over other sheets.

5. Protection Board: 1-inch (25mm) expanded polystyrene protection board.

B. Total System

As the basic components are designed to work as a total system, no substitute components of the system will be permitted. If the Contractor wishes to substitute a total system, other than that which is specified, the Contractor shall request permission in accordance with the Anne Arundel County Standard Specifications, GP-5.04.2 Submittals.

07110.03 EXECUTION

A. Surface Preparation

1. Surfaces must be free of voids, spalled areas, loose aggregate and sharp protrusions with no coarse aggregate visible. Broom finishes must not be used. Allow concrete to be cured (minimum of seven (7) days) and dry before application of Bituthene waterproofing systems. Remove forms as soon as possible from below horizontal slabs to prevent entrapment of excess moisture. Do not apply Bituthene while forms are in place without proper drying and venting. Allow concrete to thoroughly dry following rain.

2. Repair defects such as spalled or poorly consolidated areas before applying Bituthene primer. Remove sharp protrusions and form match lines. Strike masonry joints off flush. A masonry wall should have a well-adhered parge coat applied to achieve a smooth monolithic surface. Remove grease, oil or other contaminants. Clean surface (broom, vacuum cleaner or compressed air) to remove dust, loose stones and debris.

B. Priming

Apply primer, Primer WP-3000, to all concrete or masonry by spray or by roller (500 to 600 square feet per gallon). See temperature requirements in Paragraph C, below. Allow primer to dry one hour or until tack free. Prime only the area which will be covered with membrane in a working day. Areas not covered with membrane in 24 hours must be reprimed. Dry primed surfaces should be covered immediately where contaminants from the air are accumulating on the surface as directed by the Engineer. Metal or other dense surfaces do not require priming but must be clean, dry, free of loose paint, rust or other contaminants. Follow manufacturer's recommendations closely for surface preparation.
C. Temperature

Apply waterproofing membrane, Bituthene 3000, only in fair weather when air and surface
 temperatures are above 40 degrees F. Between 25 and 40 degrees F., use waterproofing
 membrane, Bituthene 3100. Primer, Bituthene P-3100, must be used on vertical surfaces at
temperatures between 25 and 40 degrees F.

D. Sealing Edges

1. For vertical applications, Bituthene membranes should be applied over the edge of the
 slab or over the top of the foundation or parapet wall. If the membranes are terminated on
 the vertical surface, a reglet or counter flashing shall be used or the membrane may be
 terminated on the concrete by pressing firmly to the wall. Press edges with a metal or
 hardwood tool such as a hammer or knife handle. Failure to use heavy pressure at
 terminations can result in a poor seal. Nailing of the membrane is not required, but if
 nails are used, large head nails at 12-inch intervals must be covered with an 8-inch wide
 strip of Bituthene membrane. At the base of the foundation wall, Bituthene membrane
 must be drawn down the base of the wall and over the edge of the footing, rolled or
 pressed firmly.

2. Apply a troweled bead of Bituthene EM-3000 to all vertical and horizontal terminations.

E. Sealing Seams

All edge and end seams must be overlapped at least 2-1/2 inches. Apply succeeding sheet
with a minimum 2-1/2 inch overlap and stagger end laps. Roll the entire membrane firmly
and completely as soon as possible to minimize bubbles caused by "outgassing" of air or
water vapor from the concrete. For horizontal applications, use a standard water-filled garden
roller less than 30 inches wide. Cover the face of the roller with a resilient material such as
1/2-inch of plastic foam or two wraps of indoor/outdoor carpet to allow the membrane to
fully contact the substrate. For vertical applications, use heavy hand pressure. Patch
misaligned or inadequately lapped seams with Bituthene membrane. All "fishmouths" must
be slit and the flaps overlapped, repaired with a patch, pressed or rolled to make the seal, and
the edges sealed with a mastic sealant. Laps within 12 inches at all corner details shall be
sealed with a troweling of EM-3000.

F. Corner Details

Double cover all inside and outside corners with an initial strip a minimum of 11 inches wide
centered on the axis of the corner. This strip shall be completely covered by the regular
application of Bituthene membrane. Outside corners shall be free of sharp edges. Inspect
surfaces adjacent to all corners and repair if necessary to provide a smooth dense surface.
Inside corners should receive a fillet formed with epoxy mortar or latex modified cement mortar (such as Darawled-C mixed in with cement mortar) and a double coverage of membrane. Do not use fiber or wood cants.

G. Drains and Protrusions

Apply a double layer of Bituthene membrane around posts or projections to a length of at least 6 inches in all directions. At drains, apply a bead of Bituthene EM-3000 over a double layer of membrane under clamping rings. Apply Bituthene EM-3 000 at all terminations. Liquid membrane, Bituthene LM-3 000 may be used as an alternative method.

H. Protection of Membrane

1. The Bituthene membrane system shall be protected to avoid damage from other trades, construction materials or backfill. The Bituthene protection system shall be used on foundation walls and horizontal walls with light traffic, and consists of protection board, Bituthene PB-3000, adhered with protection board adhesive, Bituthene PBA-3000, applied at a rate of 250 to 300 square feet per gallon. Protection board shall be one inch lightweight cellular plastic which provides excellent cushioning to resist damage. Protect horizontal decks subject to heavy construction traffic with 1-inch asphalt headboard. Cover any Bituthene left exposed on parapets or the top of a foundation wall with weather-resistant neoprene flashing.

2. The entire Bituthene protection system shall be installed the same day the membrane is applied.

I. Exposed Edges

Seal all daily terminations with a troweled bead of Bituthene EM-3000.

J. Compatibility

The Bituthene membrane protection system is incompatible with fresh tars, pitches and certain liquid waterproofing products and sealants containing tar or polysulfide polymers. Always avoid direct contact of the adhesive layer of Bituthene membrane of Bituthene EM-3000 or substitutes with such products.

END OF SECTION
SECTION 09900

PAINTING

Delete Specification Section 09900 - Painting from the Anne Arundel County Standard Specifications and replace with the following:

09900.01 GENERAL

A. Description of Work

1. The Contractor shall furnish all material, labor, equipment and services necessary for and incidental to the finishing and application complete of all field painting on existing to remain and new components.

   a. The Contractor shall assume that all existing paint is Lead Based (LBP). All removed components shall be properly disposed of.

2. The Contractor shall, paint to completion all items and surfaces left unfinished by the requirements of other sections and normally requiring painting for protection, identification and/or decoration. The sole determination to be by the Engineer.

3. The Contractor shall examine the Contract Drawings and Specifications and thoroughly familiarize himself with all provisions regarding required painting of work done under other sections.

4. All designated surfaces shall be painted and finished as part of this section. This includes, but is not limited to, new and existing structures, equipment, fans, ducts, etc.

5. The specialty items which are delivered with a prime coat shall be finished as part of this section.

6. The painting of all exposed uncovered pipe, non-corrosive pipe hangers, convertors, grills and other mechanical work, requiring paint shall be included in this section.

7. Cleaning, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer’s recommendations. When the manufacturer’s minimum recommendations exceed the specified requirements, Contractor shall comply with the Manufacturer’s minimum recommendations.

8. The submission of a Proposal by the Contractor confirms an understanding of all conditions pertaining to this work and proper application of materials specified.

9. NOTE: Painting of exterior concrete walls and surfaces is not permitted. If a special situation exists which require painting of exterior concrete prior approval must be
obtained from Engineering and also the Chief of the Bureau of Operations.

B. Related Work Specified Elsewhere

1. In addition to the work specified in this section, requirements for painting and other coatings are included in the following section:
   a. Precast Structural Concrete; Section 03050
   b. Cast-in-place Concrete; Section 03300
   c. Miscellaneous Metals; Section 05200
   d. Elastomeric Membrane Waterproofing; Section 07110
   e. Division 11; Equipment
   f. Division 15; Mechanical
   g. Division 16; Electrical

C. Quality Assurance

1. Include on label of containers: manufacturer's name, type of paint, manufacturer's stock number, color number and instructions for reducing where applicable.

2. Samples of materials, when requested by the Engineer, are to be obtained from material stored at project site or source of supply.

3. Field Quality Control: Request review of first finished room, space and workmanship. This room to be held as a standard of performance and quality. For spray application, paint surface not smaller than 100 square feet as project standard.

D. Submittals

1. Furnish manufacturer's label or other printed product literature for each material to be used on the project for acceptance by the Engineer.

2. The manufacturer’s representative shall certify that the paint systems to be used are proper for the type of exposure and service and that all coats in each system are compatible with each other.

3. Contractor shall submit a complete schedule of paint systems and surface preparation proposed for all surfaces, equipment and components to be painted.

E. Products Delivery, Storage and Handling

1. Deliver in original sealed containers with seals unbroken and labels intact.

2. Deliver to project site or segregate at source of supply in advance of need so as to allow
four (4) working days for testing.

3. Store only acceptable project material on project site.

4. Store in suitable location, restricting storage to paint materials and related equipment.

5. Comply with all applicable health and fire regulations.

F. Job Conditions

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating system can be applied. Unless otherwise recommended by the manufacturer, finishes and coatings shall not be applied when surface temperatures are above 85 degrees F.

2. Do not apply finishes in areas where dust is being generated. All materials shall be applied free of runs, sags, wrinkles, streaks, skinners and brush marks.

3. Cover or otherwise protect finishes of other trades and surfaces not being painted concurrently or not to be painted. All materials shall be applied uniformly. If any reduction of the coating viscosity is necessary it shall be done in accordance with manufacturer's label directions.

4. The subcontractor shall be held responsible for the finished appearance and satisfactory completion of his work and, therefore, he shall not commence any painting until surfaces to be finished are in proper condition in every respect. New masonry surfaces shall not be primed until it has been determined that the substrates have dried sufficiently to safely accept paint material. A moisture meter shall be used to make this determination. Report to Engineer any area that does not meet the requirements.

5. A minimum interior temperature of 65 degrees F. shall be maintained during the actual application and drying of the paint and until occupancy of the structure occurs. Adequate ventilation shall be maintained at all times to control excessive humidity which will adversely affect the curing and coatings. The Contractor is solely responsible for maintaining suitable temperatures and ventilation.

6. Before painting begins, all other crafts shall have completed their work, and shall have removed all dirt and debris resulting therefrom. The rooms or areas are to be left in broom clean condition.

7. Enamel undercoats are to be sanded smooth prior to recoating. Top and bottoms of doors are to be finished in the same manner as door facing, after the carpenters complete the fitting of them.
8. No exterior painting shall be undertaken if air or surface temperature is below 50 degrees F. nor immediately following rain or until frost, dew or condensation has evaporated. Surfaces shall always be tested with a moisture meter before proceeding.

09900.02 MATERIALS

A. Acceptable Manufacturers

1. Except as otherwise specified, materials shall be the products of the following manufacturers:
   a. Tnemec
   b. Or Equal

2. Materials selected for a coating system for each type of surface shall be the products of a single manufacturer, except where required by the Contract Documents.

B. Materials

1. Products specified are as manufactured by Tnemec Company, Inc., unless otherwise indicated; equivalent or superior products of acceptable manufacturers listed in this Specification may be used in lieu of those listed.

2. All paints must meet current ecological standards and lead hazard regulations

C. Colors

1. Colors of paints shall match control samples. All colors not designated on the Drawings or in the Specifications will be selected by the Owner. All primers and undercoats are to be tinted to the approximate shade, but not the same, as the selected finish color.

2. Check finish schedules for areas to be treated with accent colors (deep colors), or special materials. Where deep tones are used it is the responsibility of the Contractor to utilize the appropriate deep base primer as recommended by the paint manufacturer for use on the surface for which they are intended.

D. Mixing and Tinting

1. Deliver paint and enamels ready mixed to job site, in manufacturer’s original labeled containers.

2. Accomplish job mixing and job tinting only when acceptable to the Engineer. These should be limited to primers, sealers and undercoats.
3. Use tinting colors recommended by manufacturer for the specific type of finish.

**09900.03 EXECUTION**

**A. Inspection**

1. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work as included in this Specification.

2. Do not proceed with surface preparation of coating application until conditions are suitable.

3. All unfinished surfaces and material except those excluded by the Contract Documents shall be painted. See painting schedule herein for types and locations of the various surface requiring painting or finishing and the number of coats. Basically, this project will be a three (3) coat installation. Consult the documents for work that will require more than three. An additional coat will be required on any surface when, in the sole judgment of the Engineer, the finish surface is not satisfactory; this will be done at no increase in Contact price.

**B. Preparation of Surface**

1. Ferrous Metal Surfaces (except stainless steel): Per approved coating manufacturers’ recommendations. SSPC-SP6/NACE6 Commercial Blast Cleaning for non-immersion services. SSPC SP10/NACE 2 for immersion and severe exposure service. Power Tool Cleaning to Bare Metal with a (1) mil profile. Remove all rust, paint and mill scale. Prime immediately with Tnemec Series 394 PerimePrime applied at 2.5 to 3.5 mils DFT. Feather edges of damaged shop coat to achieve smooth finish.

2. Galvanized Metal: SSPC-SP7 Abrasive Brush-off Blast Cleaning – uniformly scarify the surface. If SP7 is impractical uniformly scarify using power grinders.


4. Existing Wetwell Precast Concrete Interior - Brush-off abrasive blast cleaning to remove loose surface concrete and contaminants and provide "tooth" for good coating adhesion. Repair all interior surface imperfections with epoxy mortar in accordance with the manufacturer's recommendations. Remove all dust from surface to receive the interior coating. All concrete surfaces shall be dry. Prepare interior side of new precast concrete
cover in conjunction with #3 above.

C. Application

1. Do not apply coating until moisture content of surface is within limitations recommended by the paint manufacturer's test with moisture meter.

2. Apply paint coatings with suitable brushes, rollers or spray equipment which has been kept clean, free from contamination and suitable for finish required.

3. Rate of application of coating shall be as recommended by the paint manufacturer for the purpose and surface involved.

4. Comply with required drying time between coats as directed by manufacturer.

5. Sand and remove dust between each coat to remove defects visible from 5 feet. Finish coats shall be smooth, free from brush marks, streaks, laps, sags, skips, holidays, etc.

6. Do not apply additional coats until completed coat has been inspected and accepted by the Engineer. Only inspected coats of paint will be considered in determining number of coats applied.

D. Cleaning

1. Touch up and restore where finish is damaged.

2. Remove spilled, splashed or spattered paint from all surfaces.

3. Do not mar surface finish of item being cleaned.

4. Leave storage space clean and in condition required for equivalent spaces in project.

E. Exterior Painting Schedule

1. Metals (Except Aluminum and Stainless Steel)
   a. Semi-Gloss finish/Polyamide Epoxy Coating System
      i. First Coat: Metal Primer (if any, factory applied) Field: Tnemec Series 394 PerimPrime applied at 2.5 mils DFT
      ii. Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 4.0 mil minimum dry film thickness.
      iii. Third Coat: Tnemec Series 750 UVX @ 3.0 mil minimum dry film thickness.
F. Interior Painting Schedule

1. Metals, (General usage except Aluminum and Stainless Steel)
   a. Semi-Gloss Finish/Alkyd Enamel
      i. First Coat: 10-99 Tnemec Primer @ 3.0 mil minimum dry film thickness or Tnemec Series 27 WB Typoxy for galvanized or non-ferrous surfaces @ 2.5 mil minimum dry film thickness.
      ii. Second and Third Coats: Tnemec Series 1029 Enduratone @ 2.0 mil minimum dry film thickness per coat.

G. Emergency Storage Vault and Surge Valve/Bypass Connection Vault Schedule

2. Exposed Exterior Concrete: Uncoated.
3. Interior exposed concrete:
   a. Modified Polyamide Epoxy
      i. Parge coat/sealer: Tnemec Series 218 Mortar-Clad in conjunction with surface preparation and manufacturers recommendations. Minimum thickness of 1/16-inch. Feather edges to achieve smooth finish.
      ii. Intermediate Coat: Tnemec Series 434 Perma-Shield H2S (1/8-inch minimum) or Series 436 Perma-Shield FR
      iii. Top Coats: Tnemec Series 435 Perma-Glazed (15 – 20 mils minimum)
   b. Surge Valve/Bypass Connection Vault concrete floor
      i. Uncoated (floor area is approximately 8 feet x 8 feet)
4. Piping and Division 15 and 16 components
   i. Per manufacturer and coating manufacturer recommendations equal to Tnemec Series N69 Hi-Build Epoxoline II.

H. Existing Pump Station Wetwell (Interior and new precast cover interior side)

1. Interior exposed concrete
   a. Modified Polyamide Epoxy
      ii. Intermediate Coat: Tnemec Series 434 Perma-Shield H2S (1/8-inch minimum) or Series 436 Perma-Shield FR
iii Top Coats: Tnemec Series 435 Perma-Glazed (15 – 20 mils minimum)

2. Piping and Division 15 and 16 components
   i Per manufacturer and coating manufacturer recommendations equal to Tnemec Series N69 Hi-Build Epoxoline II.

3. Dry Well (Existing steel can structure and manway)
   i Semi-Gloss Finish/Alkyd Enamel As shown above “F Interior Painting Schedule”

4. Dry Well Piping, Valves and components
   a. Semi-Gloss Finish/Epoxy Polyamine:
      i First Coat: Tnemec Series N69 Epoxoline II Primer (Tn.) @ 3.0 mil minimum dry film thickness.
      ii Second and Third Coats: Series N69 Hi-Build Epoxoline II (Tn.) @ 4.0 mil minimum dry film thickness per coat.

I. Mechanical Work

1. Factory finish coats are specified elsewhere for certain items of mechanical equipment. Field painting will not be required for such items which have factory finish, except where finish is damaged by handling, weather or other reasons. Damaged portions shall be field primed and finished with sufficient finish coats to give a smooth, unmarred finish, with primer and finish being of the same type and color paint as originally used in the factory applications. Damaged portions shall either be field refinished or replaced, subject to the approval of the Engineer. Finish coat shall be uniform for factory painted equipment.

2. Prime coat paint used on mechanical equipment shall be compatible, so as not to be lifted by subsequent coats or cause other undesirable effects, with the field finish coats hereinafter specified. The equipment manufacturer’s standard shop prime coat may be used only if compatibility is proven to the Engineer's satisfaction. For any equipment delivered to the site with a shop prime coat not compatible with the finish coats, the Contractor may be ordered to sandblast or otherwise restore the equipment to the bare metal condition. A field prime coat, conforming to these specifications, shall then be applied to the equipment.

3. Color and marking of various exposed piping systems shall be as specified hereinafter or as subsequently furnished to the Contractor prior to the beginning of work. Valves, fittings, and accessories located in a particular pipeline shall be painted the same color as
the line piping, unless otherwise specified.

4. Galvanized pipe and equipment shall be pre-treated with Kopper No. 888 cleaner and 1 coat Kopper No. 40 passivator or equal and prime coated with one coat Kopper No. 654 primer or equal and finished with 2 coats Koppers No. 200 Epoxy or equal.

**J. Exposed Piping Color and Marking Schedule**

<table>
<thead>
<tr>
<th>LOCATION/PROCESS</th>
<th>COLOR</th>
<th>MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet well concrete (Existing)</td>
<td>Light grey</td>
<td></td>
</tr>
<tr>
<td>Sewage lines</td>
<td>Pale mint green</td>
<td>Sewage</td>
</tr>
<tr>
<td>Sewage pumps</td>
<td>Dark green</td>
<td>N/A</td>
</tr>
<tr>
<td>Valve handles and lid</td>
<td>Safety Yellow</td>
<td>N/A</td>
</tr>
<tr>
<td>Potable water lines</td>
<td>Safety Blue</td>
<td>Potable water</td>
</tr>
<tr>
<td>Sump Pump Lines</td>
<td>Safety Orange</td>
<td>Sump pump</td>
</tr>
<tr>
<td>Air lines</td>
<td>Aqua green</td>
<td>Air</td>
</tr>
<tr>
<td>Vent Pipes</td>
<td>Pipes Brown</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Exposed pipe installed under this contract shall be finished painted and marked in accordance with the above color and marking schedule.

**K. Electrical Work**

1. Major items of electrical equipment shall be furnished with factory finish. Field painting will not be required for such items except when finish is damaged. Damaged portions shall be field primed and finished with one finish coat, with primed and finish being of the same type and color paint as originally used in the factory application. Repainting shall be performed using the same methods as used by the manufacturers of the equipment. Damaged portions shall be refinished to give uniform color and texture. Finish coat shall be uniform for factory painted equipment.

2. Exposed electrical items of work which do not have a factory painted finish such as pull boxes, junction boxes, terminal boxes, conduits, racks, supports and ferrous accessories,
shall be painted in an identical manner to that specified for mechanical work items.

3. Bright metal parts such as stainless steel or chrome plate device plates, knobs and items provided with a plastic base or painted finish and trim shall not be painted. PVC-coated conduit systems shall not be painted.

L. Piping Identification Schedule

1. The exposed piping systems shall be identified by lettered legends clearly indicating the contents of the system as indicated in this Section.

2. Lettered legends shall be stenciled on the piping at the horizontal or vertical centerline thereof, except where pipe lines are too close together or above the operator's normal line of vision. In these situations the lettering shall be placed above or below the horizontal centerline as directed by the Engineer. The legends shall indicate the contents of the pipe and, when required for clarity, the associated process. All legends shall be submitted to the Engineer for acceptance. As a guideline some examples are listed in the piping system paint schedule, in this section.

3. Lettered legends shall be located at points where pipes enter and leave the rooms, buildings, or spaces; at junction points of distribution; close to valves and equipment; at changes in direction; and at intervals along the piping at least every fifteen feet.

4. Arrows indicating normal direction of flow shall be stenciled on the piping adjacent to the legends. The arrows shall be the same size as the letters and shall be located so that the arrow points away from the legend. Letter sizes are given in the schedule below:

<table>
<thead>
<tr>
<th>Outside Diameter of Pipe Covering</th>
<th>Height of Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ to 1 ¼ inches</td>
<td>½ -inch</td>
</tr>
<tr>
<td>1 ½ to 2 inches</td>
<td>¾ -inch</td>
</tr>
<tr>
<td>3 to 6 inches</td>
<td>1 ¼ -inches</td>
</tr>
<tr>
<td>7 to 10 inches</td>
<td>1 ½ -inches</td>
</tr>
<tr>
<td>Over 10 inches</td>
<td>3 ½ -inches</td>
</tr>
</tbody>
</table>

5. In lieu of stenciled legends and flow arrows, snap-on type labels will be allowable substitutes. Labels shall be Set Mark System, manufactured by Seton Name Plates Corp., or equal.
SECTION 10027

HATCHES

10027.01 GENERAL

A. Description of Work

The work required under this section shall be furnished and installed complete in place, as shown on the Drawings.

B. Submittals

Submit shop drawings for all hatches in accordance with Section 5.04 of the General Provisions.

10027.02 MATERIALS

A. Single and Double Door Aluminum Access Hatches

1. Door leaves shall be 1/4-inch aluminum diamond pattern plate to withstand a live load of 300 lb/square foot, with a maximum deflection of 1/150th of the span. Channel frame shall be 1/4-inch aluminum with an anchor flange around the perimeter and shall have a minimum cross-section area of 7-1/2 inches to allow for adequate water drainage. Door shall be equipped with heavy duty stainless steel hinges having 3/8" minimum diameter stainless steel pins and pivot so that the cover does not protrude into the channel frame. Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature. The door shall automatically lock in the vertical position by means of a heavy steel automatically locking hold-open arm with release handle to allow the leaf to lay open flat. A Type 316 stainless steel snap lock with a gasket cover plug and removable turn handle shall be provided. A ½- inch drainage coupling shall be located in the front right corner of the channel frame.

2. Hatch frames shall be an aluminum extrusion of alloy 6063-T6. Hatch frame surfaces shall be "mill finish;" those in contact with concrete shall be bituminous coated. The hatch and frame shall be Bilco type J-AL or JD-AL with Type 316 stainless steel hardware.

3. All exterior hatches shall be provided with flushed type locking device with removable handle and recess pad lock.
10027.03 EXECUTION

A. General

1. Preassemble and check the operation of all hatch components prior to incorporating this item into the work.

2. Store and handle the hatch assembly so as to avoid damage to the hatch frame or any accessory assemblies.

B. Installation

1. Installation shall be in accordance with manufacturer’s instructions for incorporation into a precast concrete slab.

2. Prior to installation of the hatch frame into the cast concrete slab, remove to the extent possible hatch leaves, latches and other accessory items. Coat all aluminum surfaces in contact with concrete with an asphaltic compound to prevent corrosion of aluminum.

3. Adequately and firmly block the hatch frame to ensure that the frame members remain true and straight during the pouring of concrete.

4. Coat all surfaces not intended to be in contact with concrete with a substance which will prevent the adhesion of any concrete spillage or overpour.

5. Extend hatch drain through concrete slab or wall with 1½-inch PVC Schedule 80 DWV pipe to drain above grade.

6. Exercise extreme care in placing concrete around the hatch frame to ensure that the frame is neither twisted nor deflected in any manner. Adequately work the concrete around the frame to ensure that no voids occur.

7. Completely clean all hatch frame surfaces of tramp concrete and concrete release coating previously applied. Reassemble and check the operation of all hatch components.

END OF SECTION
SECTION 10028

ALUMINUM LADDERS

10028.01 GENERAL

A. Description of Work

Furnish and install aluminum ladders and accessories as specified herein.

B. Submittals: Submit shop drawings for ladders and accessories.

10028.02 MATERIALS

A. Ladders

1. Vertical ladders shall be as manufactured by Washington Aluminum Company, Inc. or approved equal. Ladders shall have 3" x 3/8" stringers with 1" square non slip, serrated rungs spaced 12" on center. Ladders shall be aluminum alloy 6061-T6.

2. All necessary anchor bolts will be stainless steel and furnished with ladder. All material will have a standard mill finish. The portion of the ladder in contact with concrete shall have a heavy shop coat of bituminous paint.

B. Safety extension poles shall be aluminum alloy 6061-T6 and castings shall be aluminum, alloy 356-T6. All necessary hardware shall be stainless steel and furnished with safety extension for mounting to ladder. All material will have a standard mill finish.

C. Safety extension poles shall be spring loaded. Extension poles shall lock in the extended position.

10028.03 EXECUTION

A. General

1. Preassemble ladder and check the operation of all components prior to incorporating this item into the work.

2. Store and handle the ladder assembly so as to avoid damage to the ladder or any accessory assemblies.

B. Installation Ladders are to be installed in such a way that they shall conform to and support loads required by the current regulations published by the Occupational Safety and Health Administration.

END OF SECTION
SECTION 11235
ODOR CONTROL SYSTEM

11235.01 GENERAL

A. Description

1. Work performed under this section includes furnishing and installing a fully assembled skid mounted odor control system and accessories.

   a. The odor control system shall be designed and sized for use for the existing pump station wetwell only.

   b. System responsibility: The Odor Control System includes drum, lid, blower, skid mounted pre-wired control panel and dry media as specified herein. All components of the Odor Control System shall be manufactured by a single manufacturer for total system responsibility. The Odor Control System shall be a standard product of the manufacturer. The dry media shall be non-hazardous and landfill disposable without special permits and disposal procedures.

   c. The Contractor shall provide equipment and installation as needed for a complete and fully functional odor control system. Auxiliary items not provided by the Odor Control System manufacturer shall be provided and installed by the Contractor (ie electrical control panels, equipment mounting pads, inlet piping).

   d. MANUFACTURER: The manufacturer shall have a minimum of ten years’ experience in the design, fabrication, and testing of systems that are 99.5+% efficient at removing gaseous contaminants, and 40 years’ experience in the Design and Manufacture of Gas Phase Products. The manufacturer shall be a single source provider of equipment, dry media, and laboratory testing services and be certified to ISO-9001:2000 standards. The manufacturer shall have local, factory-trained startup/service field technicians who are regularly engaged in startup/service work. The technician shall be based within 150 miles of the job site.

B. Submittals

   a. Submit shop drawings in accordance with Section 5.04 of the General Provisions and shall include the following information;

      i. Product information, technical specifications, manufacturer’s certification, electrical requirements and installation recommendations.
b. Submit Operating and Maintenance Data in accordance with GP5.04.8 of the General Provisions.

c. Manufacturer's Instruction and start up field services

i. Prestart up inspection ½ day

ii. Startup/training 1 day (separate trip)

d. Submit certificates of compliance that materials comply with the requirements stipulated herein.

e. Manufacturer's Certificates that the installation of the equipment is in accordance with the manufacturer's recommendations.

11235.02 MATERIALS

A. Skid Mounted Odor Control System

1. The major components include

a. Drum

b. Dry Media

c. Electric motor driven skid mounted blower

d. Skid mounted and completely pre-wired control panel

2. Drum

a. The drum shall be linear, low density, polyethylene, 1/4" min wall/floor thickness. Drum shall be designed to mount on top of a concrete slab poured by the contractor.

b. The drum shall have a minimum internal capacity of 200 gallons and shall measure 36" min. diameter and 48" min. height.

c. Latches shall be stainless steel and rubber.

d. Fasteners shall be stainless steel for corrosion resistance.

e. The drum shall be provided with a minimum of 17 ft^3 of odor removing dry media as described below.

f. The drum shall include a minimum of two media sampling ports. Sampling ports
shall be a minimum of 1" in diameter. They shall be strategically positioned so that sampling can easily be accomplished in each media when two types of odor removing dry media are used in one drum scrubber.

g. The drum shall include HPDE column supports to support the dry media. Thermoplastic packing shall be integral to allow even air flow through the media bed.

h. Polymedia filters shall be used to separate the thermoplastic packing from the lower media, and the blower from the upper media keeping the media in place under high air flows.

i. The blower inlet shall have a minimum 8" FERNCO type flexible coupling. Contractor shall be responsible to provide and install piping and supports from Fernco fitting to the wet well as shown on the drawings. The installed configuration shall be arranged so that the contaminated air shall flow into the blower, and from the blower to the bottom inlet plenum of the drum and be drawn upwards through the media bed. Treated air shall discharge out the top of the vessel, with a rain hood.

j. All drain pipes shall have a min. 0.75" diameter, condensate to be drained from the drum periodically by the operator. Drain shall be heat-traced if vessel is outdoors.

3. Blower

a. The blower shall be centrifugal type and manufactured of aluminum, and be sized to deliver a minimum 320 cfm (544 m3/hr) and open, and a maximum of 608 cfm at 3.4 IWG. Pressure drops listed are the maximum allowable head loss through the dry media bed, and do not included friction loses in the piping system.

b. The blower shall consist of a direct drive motor-fan assembly mounted to the same skid as the scrubber vessel.

c. The motor shall be a 1.5 hp, 3450 RPM, 460 volt / 3 phase/ 60 Hz TEFC motor. Rain shield shall be required to protect the motor from the elements.

d. The unit shall come pre-wired with a junction box, electrical wiring, control panel, and control logic provided by the odor control system manufacturer/supplier.

4. Chemical Dry Media

The Odor Control System manufacturer shall specifically customize the media for the application, and shall supply two media types in an effort to maximize media life and efficiency. Media shall be manufactured by the Odor Control System Manufacturer, and use the chemsorption process, which removes contaminant gases by a means of
adsorption, absorption and chemical reaction. Gases shall be trapped within the pellet where an irreversible chemical reaction changes the gases into harmless salts, eliminating the possibility of desorption. Maximum head loss through the media shall be 1.8 IWG at 320 CFM, and 3.4 IWG at 608 CFM. Media shall be as described below:

a. Total volume of media to be installed: 17 Ft^3.

b. H2S removal- Activated alumina-based: Media shall be a combination of activated carbon, alumina, binders and reactive components. Media shall have the following properties:

c. 13 ft^3 to be installed in this application.

d. Media shall be Odorcarb Ultra media as supplied by Purafil, or equal.

e. Maximum moisture content: 35%

f. Pellet diameter: 1/16"-1/4"

g. Abrasion: 4.5% maximum

h. Minimum removal capacity: 0.30 g H2S per cm^3 of media. Minimum 47.0% by weight.

i. Minimum performance: 99.5% H2S removal capacity

j. Landfill disposable, non-toxic, UL Classified Class 2

k. Media life indicator pellets (changes from blue to white when media is spent), visual indication of remaining media life.

5. Broad spectrum odor removal - powered activated alumina, binders and impregnated with sodium permanganate. Media shall have the following properties:

a. 4 ft^3 to be installed in this application.

b. Media shall be Odormix SP Media as supplied by Purafil, or Engineer's pre-approved equal.

c. Maximum moisture content: 35%

d. Pellet diameter: 1/16"-1/8"

e. Abrasion: 4.5% maximum
f. Minimum Bulk Density: 50 lb/Ft^3 (+/- 5%)

g. Minimum Sodium Permanganate Content: 12%

6. Odor System Control Panel

   a. An Odor System Control Panel shall be provided by the Odor System manufacturer/supplier to operate the Odor System Blower and all associated apparatus. The control panel and all electrical ancillary equipment and devices shall be mounted on the Odor Control System Skid and be completely prewired and pretested at the factory prior to shipment to the site. The control panel shall be UL listed and provided with a three (3) position Hand-Off-Automatic selector switch; have indicator lights for power on, failure, and run conditions.

   b. The control panel shall be rated for operation at 460 volts, 3-phase, 60 Hz and provided with a properly sized main circuit breaker which shall de-energize all power to the control panel and associated apparatus in the open position. The main circuit breaker shall have provisions for being padlocked in the open position.

   c. The control panel enclosure shall be NEMA 4X, fiberglass reinforced polyester, suitable for outdoor mounting on the skid with corrosion resistant stainless steel hinges and latches. The panel shall be furnished with all necessary control devices, relays, terminal blocks, and NEMA size 1 full voltage motor starter, control transformer (120v) protected by two primary fuses and one secondary fuse. The 120 volt secondary shall have one leg grounded.

   d. Control Panel shall be furnished with the following features:

      i. Laminated, engraved, bakelite nameplates for all major components and sub-assemblies.

      ii. Condensation heater properly sized for the panel consisting of a thermostat, resistance type heating grid and fan to circulate air through the enclosure.

      iii. Lightning arrestor connected to each line of the incoming side of the power input terminals. The arrestor shall protect the motor and controls against damage due to lightning strikes on the incoming power line.

      iv. Normally open (NO) contacts for remote fail and remote run signals, rated ten (10) amperes, 240 Vac.
7. Manufacturer
   a. Equipment shall be Purafil Model DS-500 as manufactured by Purafil, Doraville GA.
   b. Or approved equal

11235.03 EXECUTION

A. General

1. Media Sampling and Analysis: The manufacturer shall, after start up, analyze dry media samples to predict the remaining service life of the dry media. Such service will be provided as needed at the manufacturer's expense.

2. Manufacturer's Representative On-Site Services: The factory trained manufacturer's representative shall provide the following services for this project.

3. Pre-startup inspection - 1/2 day in a separate trip to inspect the completed installation, and confirm it is in conformance with the Engineer's drawings, specifications, and Odor Control Manufacturer's installation instructions. If a problem is discovered, the manufacturer's representative shall correct or supervise the correction of the defect. Correction of the defect shall be the responsibility of the contractor.

4. Startup/Training - 1 day in a separate trip to inspect the completed installation, and startup the equipment. A formal report shall be typed and issued to the owner, engineer, and contractor which shall include the following as a minimum:
   a. Certification that the blower damper has been adjusted and the final setting of the damper.
   b. Volt/amp readings taken when blower is on, and when it is off.
   c. Confirmation that the equipment is installed per the manufacturer's recommendations.
   d. H2S reading (in ppm) in the wet well, and H2S readings as the air is leaving the blower. Readings to be taken when the damper is in its final damper position.
   e. 3 representative photos of the installed equipment.

5. Immediately following startup, operation and maintenance training shall be provided for the owner.

6. Media life analysis - Odor Control System Manufacturer shall provide free media life analysis one time per year to estimate the remaining life of the dry media. During startup/training of the equipment, the manufacturer's representative shall supply 5 media analysis kits to the owner. The Owner shall be responsible to take media samples and
send them to the Manufacturer for media life analysis. Media life analysis shall be performed by the manufacturer and be available via the World Wide Web and accessible by the customer through a standard web browser. The analysis shall include the following as a minimum:

a. Owner's contact information.

b. Description of the equipment including Model and Serial numbers.

c. Results/Projects for each media bed shall include: Date of sample, moisture content, activity level, life remaining (months), recommended replacement date (months from current date), recommended reanalysis date, bar graph showing available media life, manufacturer's local representative name and address/contact information.

END OF SECTION
SECTION 11310
SEWAGE PUMPS

11310.01 GENERAL

A. Description

1. Work performed under this section includes furnishing and installing two (2) vertical built together dry-pit solids handling sewage pumps and accessories.
   a. The new pumps shall replace existing pumps within the existing USEMCO packaged pumping station drywell.
      i. Pump 1 rotates clockwise when viewed from above
      ii. Pump 2 rotates counterclockwise when viewed from above
   b. The existing drywell, as show in the drawings is 12-feet in diameter by 10-feet high. Drywell access is through a 36-inch diameter manway by +/- 15 feet long.
   c. The new pumps shall match existing pumps dimensionally and shall match existing steel pump base and anchor bolts and shall be furnished by and the product of one manufacturer.
   d. All existing dimensions shall be accurately field measured and submitted with the shop drawings.

2. Vibration design and installation requirements for rotating equipment in accordance with Section 15990 shall also apply to work performed under this section.

3. Field vibration testing shall be performed on the sewage pumps in accordance with Appendix E of these specifications.

4. Pump and major components specified herein shall be the product of a single manufacturer. The pumps shall not overload the motors at any point on the pump curve within the stations operating limits as recommended by the pump manufacturer.

5. Pumps are to be engineered and manufactured under the certification of ISO-9001:2000.

B. Submittals

1. Shop Drawings
   a. Submit shop drawings for the sewage pumps in accordance with Section 5.04 of the
General Provisions. Shop drawings for the sewage pumps shall include pump performance curves by the pump manufacturer for the pumps to be supplied, showing model number, pump size, impeller diameter, RPM, head, horsepower and efficiency versus capacity for the specified operating conditions. Design point shall be clearly marked on the curves. Shop drawings must clearly show that pump impeller supplied is capable of passing a minimum 3-inch solid sphere.

b. Shop drawings for the sewage pump motors shall include motor performance data, certified by the manufacturer, including manufacturer, model number, voltage and Hertz rating, full-load amperage, motor enclosure type, insulation class, efficiency and power factor at 50, 75, 100 and 115 percent of rated full load for each motor.

c. Shop drawings for the sewage pumps and motors shall also include shaft dimensions.

d. Shop drawings shall include contractor’s statement of dimension certification of existing pumps, the proposed pumps match existing conditions and shall confirm the replacement pumps will match existing conditions.

2. Operating and Maintenance Data

Operation and maintenance data shall be submitted for the sewage pumps in accordance with GP5.04.8 of the General Provisions.

3. Manufacturer's Instruction/Field Services

Manufacturer's instructions shall be provided for the sewage pumps as follows:

a. Provide the services of a manufacturer's representative experienced in the installation, maintenance, and operation of the equipment supplied under this specification for installation inspection, start-up, the specified testing, and for instructing the Owner's personnel in the operation and maintenance of the equipment.

b. The number of man days of these services and trips to the project site shall be as required to successfully complete all of the installation, start-up, and testing requirements specified herein.

c. Instruction of the Owner's personnel in the operation and maintenance of the equipment shall be performed over two (2) 8-hour workdays.

4. Submit certificates of compliance that materials comply with the requirements stipulated herein.

5. Manufacturers special requirements regarding vibration considerations/data or
instructions shall be submitted as part of the shop drawing review.

6. Certified factory pump performance curves shall be provided and approved by the Engineer before the pumps are shipped.

7. Submit factory certifications that pump impellers and motor rotors have been dynamically balanced in accordance with Section 15990 or as otherwise specified herein. These certifications shall be provided and approved by the Engineer before the pumps are shipped. The certifications shall include the standard to which the items were balanced and the shop balancing results. All measurements shall be presented in ounce-inches, inches/second vibration velocity, or vibration amplitude displacement in mils.

8. Manufacturer's Certificates that the installation of the equipment is in accordance with the manufacturer's recommendations shall be secured by the Contractor and submitted to the Engineer.

11310.02 MATERIALS

A. Vertical Built-Together Dry-Pit Solids Handling Sewage Pumps

The pumps shall be vertical built together type where the impeller is directly mounted to the motor shaft. The pumps shall be solids handling type of heavy cast iron construction and specially designed for the use of mechanical seals. Suction and discharge connection points shall be flanged, faced and drilled to 125-lb American Standard.

1. The pumps shall be capable of handling raw, unscreened sewage and meet the following design criteria. The replacement pumps shall match existing pumps dimensionally.

   a. 4-inch discharge

   b. 4-inch suction

   c. Minimum spherical solids passage 3-inch

   d. Efficiency at primary design capacity, 70% (minimum)

   e. Motor 40 horsepower, 1800 rpm, vertical solid shaft 3/60/230-460-volt, non-overloading throughout the entire pump curve

   f. Design Pumping Capacity 713 GPM @ 112 feet TDH
      a. Secondary (low system pressure) design point is 1000 gpm @ 95 feet TDH

   g. Normal Operating Range, 500 - 1100 GPM
h. NPSH Required 20 feet (maximum)

2. Pump Construction

a. Major pump components shall be of gray cast iron, ASTM A-48, Class 30 (minimum) with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts and bolts shall be of stainless steel construction. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage resistant coating.

b. The pump/motor shaft shall be solid one-piece stainless steel or 4140 alloy steel, minimum 100,000 PSI tensile strength and 75,000 PSI yield strength. The shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 2-1/4 inches not inclusive of the shaft sleeve diameter if provided. Shaft design shall be such that the amplitude of shaft deflection shall not exceed 0.002" at the lower shaft seal under the worst operating conditions imposed by the design points on this project. When provided, shaft sleeves shall be hardened 400 Series stainless steel. When the pump is installed and viewed from above, Pump 1 shaft shall rotate clockwise. Pump 2 shall rotate counterclockwise.

c. Each pump shall be provided with a double carbon-ceramic mechanical shaft seal and housing with registered fit. For special applications, other seal materials shall be available. The mechanical seal housing shall be constructed of cast iron, bronze or stainless steel with a registered fit. Seal springs and hardware shall be stainless steel with Buna-N or EPR elastomers. The housing shall be recessed into the pump backhead and securely fastened with stainless steel cap screws or stainless steel studs with bronze nuts. The seal shall be pressurized and lubricated by filtered water taken from the pump backhead or volute discharge nozzle. The seal system shall incorporate a filter of corrosion resistant materials to screen out all solids larger than 50 microns. Filter shall be as manufactured by Schrade, or equal. The filter water line shall be 3/8” using stainless steel nipples and isolation ball valve between the pump and filter and 3/8” polyethylene tubing with compression fittings between the filter and mechanical seal housing. The mechanical seal housing shall also be provided with a mechanical seal vent with manually operated brass valve.

d. The pump volute case shall be of gray cast iron, ASTM A-48, Class 30(minimum) with smooth surfaces devoid of blow holes and other irregularities. The pump volute casing shall also contain a replaceable front head/suction plate with field- replaceable non-galling heat-treated 400 series stainless steel wear ring to maintain accurate suction end clearances between the impeller wear ring and pump case wear ring. The casing ring hardness shall exceed the impeller ring hardness by at least 100 BHN. The volute casing shall be provided with a minimum 3/8” tap for pump venting and
 priming unless otherwise indicated. Provide volute casing handhole cleanout where available. The volute shall be coated with an erosion resistant, ceramic coating where available.

e. The impeller shall be of gray cast iron, ASTM A-48, Class 30 (minimum), and shall be statically and dynamically balanced in to ISO 1940/1-1986E Grade 2.5 or better. The impeller shall be double-shrouded solids handling design having a long thru-let without acute turns. The impeller shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in normal sewage applications. The impeller shall be a two or three vane design. When viewed from above, Pump 1 shall rotate clockwise and Pump 2 shall rotate counterclockwise. The impeller shall be capable of passing a minimum 3-inch solid sphere. The impeller shall have a tapered fit to the shaft, be keyed and secured to the shaft by a stainless steel cap bolt equipped with a self-locking device. The impeller shall not be screwed or pinned to the motor/pump shaft and shall be readily removable without the use of special tools. Impeller trimming to meet design conditions shall be applied to the vanes alone. Final impeller diameter shall be stamped on nameplate. Impeller shrouds shall not be trimmed and shall remain full diameter. The impeller shall be fitted with a replaceable 400 series non-galling heat-treated stainless steel wear ring with a Brinell Hardness of no less than 300. Impellers shall be provided with an erosion resistant ceramic epoxy coating where available.

f. Each pump shall have a one-piece cast iron ASTM A48, Class 30 or 35 backhead and motor adaptor with impeller adjustment cap screws and to adjust clearances between the impeller and the volute suction cover. The pumps shall be arranged so that the rotating assembly (motor, shaft, backhead and impeller) can be easily removed from the pump volute without disassembly. Multiple motor fits shall be provided to accommodate the largest motor required by the pump at the specified RPM.

g. The bearing nearest the impeller shall be designed to carry the maximum hydraulic radial loads encountered under the service conditions. The thrust bearing shall be designed to carry the maximum pump hydraulic axial thrust and dead-load thrust. All bearings shall be grease lubricated and shall be rated in accordance with AFBMA L-10 life of not less than 100,000 hours at the most severe loads imposed by the specified continuous duty conditions.

h. Pump base construction shall be of the rigid, heavy-duty cast iron pedestal or ring base design with ribs or bracing to prevent distortion of machine surfaces when the pumps are mounted against a soleplate as shown on the drawings. The mounting feet on the pedestal bases shall be machined flat with tolerances of no more than +/-0.002 inches difference between mounting pads.
i. Provide a pump suction elbow of gray cast iron, ASTM A-48, Class 30 (minimum) of long swept reducing design to help insure smooth flow into the impeller. Provide a minimum ½” NPT tap for pump draining (unless otherwise shown) and handhole cleanout where available.

3. Pump Motor

a. The pump motors shall be NEMA P-base, vertical, solid shaft, squirrel-cage induction type, suitable for 3-phase, 60 cycle, 480-volt power supply and shall be suitable for operation on variable frequency drives (VFD). They shall be continuous duty rated, have Class F insulation, suitable for temperatures up to 115 degrees C with temperature rise limited to 40 degrees C above ambient without exceeding an insulation temperature limit of 90 degrees C. The motors shall have normal starting torque and low starting current as specified for NEMA Design B characteristics. Motors shall be cast iron construction, open drip-proof, premium efficiency design with forced air ventilation by integral fan and be furnished with motor over-temperature switches (Klixons). Leads shall be terminated in an “oversize” cast connection box and clearly identified. The motors shall have a 1.15 service factor and shall not be overloaded at any head with the operating range as specified in the design conditions. The motor shaft diameter at the mechanical seal shall be a minimum diameter of 2-1/4 inches not inclusive of the shaft sleeve diameter if provided The motor shall be fitted with at least two lifting eyes, each capable of supporting the entire weight of the pump and motor.

b. Pump motors applied to Variable Frequency Drives (VFD) shall be "Inverter Duty" rated and shall meet the power quality levels of NEMA MG-1, 1993, Part 31. Motors applied in VFD service need not be premium efficiency.

c. The motor rotor shall be statically and dynamically balanced to a Special Balance tolerance to give a vibration amplitude of no more than 0.8 mils measured on the bearing housings at operating RPM and no load when tested at the factory. If the motor manufacturer’s standard tolerances are more stringent, then they shall apply.

4. Manufacturer

Replacement sewage pumps shall be:

a. Model B5433C (4-inch) as manufactured by Fairbanks Nijhuis

b. Approved equal manufactures are Cornell, and Smith & Loveless

5. Nameplate Data
Each pump shall be supplied with a stainless steel nameplate listing the following pump data:

a. Manufacturer and model number

b. Pump Size

c. Design Capacity & Head

d. Serial number

e. Date of manufacture

f. Horsepower rating

g. Nominal speed, RPM

h. Impeller diameter

Each motor shall be supplied with a stainless steel nameplate listing the following motor data:

a. Manufacturer

b. Model number

c. Serial number

d. Horsepower rating

e. Frame Number

f. NEMA Code Letter

g. Insulation Class

h. Operating voltage and amperage

i. Full load speed

j. Enclosure Type

k. Bearing information
6. Spare Parts
   a. The following spare parts shall be supplied for the wastewater pumps:
      
      i  Two (2) Impeller (dynamically balanced), Impeller Key and Impeller Retaining Cap Bolt. Provide one (1) for each pump (clockwise and counterclockwise).
      
      ii Two (2) Seal Filter Elements
      
      iii Two (2) Volute Gaskets
      
      iv Two (2) Sets Double Mechanical Seals
      
      v Two (2) Shaft sleeve
      
      vi Two (2) Sets of Wear Rings
      
   b. Spare parts shall be packaged for long-term storage in heavy-duty cardboard or wooden boxes. Boxes shall be clearly labeled with typed or printed labels identifying the name of the plant, project description, equipment name, part manufacturer, part number, part description and part quantity contained in the packaging.

B. Miscellaneous

1. All bearings, except those specifically requiring oil lubrication, shall be pressure grease lubricated. All lubrication points shall be readily accessible, away from locations dangerous to workmen. Pressure grease lubrication fittings shall be the "Hydraulic" type. The pattern of the fitting shall be selected for accessibility in lubrication and shall be acceptable to the Engineer. The Contractor shall furnish two hydraulic guns compatible with the fittings used.

2. If the top motor bearing grease fitting located behind or under the motor cooling fan hood, the grease lines and fittings shall be extended outside the hood. Removal of cooling fan hoods to lubricate bearings is not acceptable.

3. Special tools shall include any type of tool that has been specially made for use on an item of equipment for assembly, disassembly, repair or maintenance. All special tools that are required to assemble, disassemble, repair or maintain any mechanical equipment shall be furnished with the equipment.

11310.03 EXECUTION

A. General
1. Accurately field measure and verify all existing conditions, including but not limited to.
   a. The existing steel base plate and anchor bolt spacing.
      i. The existing base and anchor bolts shall remain for the new pumps.
   b. The centerline elevation and location of existing pump suction connection.
   c. The centerline elevation and location of existing pump discharge connection.

2. Design and fabricate the new pump stand to match existing base plate and anchor bolts.

3. Design each new pump so that it will fit through the existing drywell access manway.

4. Installed pump shall be free of piping strain. To check for piping strain, piping flanges shall be loosened up separately with flange movement observed continuously. Should movement exceed 1/8 inch, piping strain is considered excessive and shall be corrected by adding or adjusting pipe supports, hangers, expansion joints, etc. Installation of piping at pump casing connections shall be in accordance with Section 15210, Subsection .03 A, with particular attention to sub-item 12.

5. Pump support stand shall be resting firmly on the mounting bases and soleplates with equal loading on each support.

6. Pump support stand, base plate pads and soleplates shall be free of burrs, rust and obstructions. Clean, remove old paint and rust, prime and repaint existing base pads. Clean and dress-up threads on existing anchor bolts.

7. When required stainless steel pre-cut shims shall be used to provide a firm, solid, adjustable link between pump and base plate.

8. Pump mounting feet and surfaces must be free of soft foot. To check for soft foot, the pump must be firmly bolted to the base plate. Each support foot is checked with the dial indicator or feeler gauges, loosening hold down bolts one at a time. If movement exceeds 0.003 inches, soft foot is indicated. Shim and torque uniformly to minimize soft foot.

9. After erection the Contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibrations, overheating, or signs of distress at specified capacity. The Engineer shall be notified in advance of all tests, and all tests shall be conducted to his entire satisfaction. Pump vibration testing and pump performance testing shall be done in accordance with Section 15990 and the Appendices of these specifications.
10. Any drywell-mounted motor or pump that becomes submerged or damaged before final acceptance shall be replaced at no cost to the Owner.

B. Coatings

1. All exposed ferrous materials, except stainless steel, shall be painted in accordance with Section 09900 PAINTING.

2. Coat all bolt threads prior to assembly with a compound to prevent seizing.

END OF SECTION
SECTION 11331

SEWAGE GRINDER

11331.01 GENERAL

A. Summary

1. Where indicated on the Drawings, the Contractor shall furnish and install a new, twin shaft, Hydraulic Sewage Grinder, complete with a hydraulic power pack and motor controller that will continuously screen and grind on a demand basis, solids in raw sewage flow. The grinder shall be configured as a municipal wastewater channel unit, recessed as required so that the grinder section is flush with the channel floor. The power pack and the motor controller shall be installed in adjacent, existing building, with the hydraulic hoses routed to the sewage grinder in a 4-inch, below grade pvc conduit. The sewage grinder shall be removable from above via a guide rail/frame system. Control and operation shall be as shown on the drawings and specified in this section.

2. The equipment shall be installed as shown on the drawings, as recommended by the manufacturer, and in compliance with all OSHA, local, state, and federal codes and regulations.

B. Quality Assurance

1. Grinder(s) shall, as applicable, meet the requirements of the following industry standards:
   
   
   
   c. American Iron and Steel Institute (AISI) 303, 304, and 316 Stainless Steel
   
   d. American Iron and Steel Institute (AISI) 8620 Heat Treated Alloy Steel
   
   e. American Iron and Steel Institute (AISI) 4140 Heat Treated Hexagon Steel
   
   f. Rockwell C

2. Qualifications

   a. Qualified suppliers shall have a minimum 25 years experience at manufacturing two-shafted grinding equipment and motor controls with a minimum of 5000 installations with similar equipment. Supplier shall provide a list of names and dates of installations for verification by the Engineer or Owner's Representative.
b. Supplier shall provide the services of a factory-trained representative to check the installation and to start-up each grinder and controller. The factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative shall inspect the final installation and supervise a start-up test of the equipment.

3. Regulatory Requirements: Motor controllers shall as applicable, meet the requirements of the following Regulatory Agencies.

   a. National Electrical Manufacturer's Association (NEMA) Standards
   b. National Electrical Code (NEC)
   c. Underwriters Laboratory (UL and cUL)

C. Submittals

1. Complete sets of shop drawings shall be submitted in accordance with Section 5.04 of the General Provisions for items as specified herein, including, but not limited to equipment descriptions, assembly drawings, parts lists, job specific drawings and schematic and wiring diagrams.

2. Operation and maintenance manuals for supplied equipment, including controller logic and reprogramming instructions in accordance with the General Provisions.

3. Structural computations, performed by a Maryland Registered Professional Engineer showing the guide rail and frame system will adequately support the weight of the grinder assembly.

11331.02 MATERIALS

A. Equipment

1. The sewage grinder shall be a hydraulic, twin shaft continuous operating type, wet or dry, capable of passing the peak design flow rate of 450 gpm without the use of divert screen(s), within an open channel. The maximum head drop across the sewage grinder shall be 10-inches. The design downstream channel depth is 6-inches.

2. The unit shall be complete with a stainless steel channel frame and guide rail system, automatic jam sensing and reversing controller and a minimum stack height of 18-inches.

3. The sewage grinder shall be;
a. JWC Environmental Muffin Monster 30005-0018

b. Or equal

B. Support System

1. Provide wall mounting frame of suitable dimension and strength to support grinder in place and direct flows toward cutters. The wall frame shall be of stainless steel Type 304 construction and firmly anchored to the channel walls.

2. A guide rail system shall be provided to permit easy removal of grinder for maintenance. The guide rail system shall be firmly anchored to the roof (near the access hatch opening). There shall be no need for personnel to enter the emergency storage tank.

3. An aluminum basket strainer shall be provided for installation in the channel wall framework to insure continued screening when the grinder is removed for maintenance or inspection.

C. Grinder

1. The grinder shall include cutters, spacers, shafts, bearings and seals, side rails, end housings, covers, reducer, and hydraulic torque motor.

2. The grinder shall be of two-shaft design and be capable of continuous operation, processing wet or dry.

3. Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The two shafts shall counter-rotate with the driven shaft operating at approximately two-thirds (2/3) the speed of the drive shaft.

D. Components

1. Individual Cutters and Spacers

   a. The cutting chamber shall be a nominal height of 18 inches

   b. Individual cutters and spacers shall be 8620 heat treated alloy steel, surface ground for uniformity and through-hardened to a minimum 60-65 Rockwell C.

   c. The inside configuration of both the individual cutters and the individual spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.015 inch (0.38 mm) across the flats to assure positive drive, minimize wear on the cutters, and increase the compressive strength of the spacers.
d. Cutter configuration shall consist of 11 tooth cam cutters. To maintain particle size, the height of the tooth shall not exceed 1/2 inch (13 mm) above the root diameter. Cutter to cutter root diameter overlap shall be not less than 1/16 inch (1.6 mm) or greater than 1/4 inch (6 mm) to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.

e. The cutters shall exert a minimum force at the tooth tip of 991 lbs/hp (5,911 N/kW) during momentary load peaks.

2. Shafts

a. Grinder drive and driven shafts shall be made of 4140 heat treated hexagon steel with a tensile strength rating of not less than 149,000 psi (1,027 kPa).

b. Each hexagonal shaft shall measure a nominal 2 inches (51 mm) across parallel surfaces.

3. Intermediate Shaft Support

a. An intermediate shaft support shall be provided in the center of the cutter stack for all grinders with 40 inch (1,016 mm) cutter stacks. Grinders with 50 inch (1,270 mm) or 60 inch (1,524 mm) cutter stacks shall have two intermediate shaft supports.

b. The intermediate shaft support shall provide additional support for heavier than normal influent grinder demand loads and protection for the seal assemblies.

c. The intermediate shaft support shall be made of a cast 303 stainless steel collar and two bushings. The bushings shall act as bearings to allow the free rotation of the shafts.

4. Shaft Bearings and Seals

a. The radial and axial loads of the cutter shafts shall be borne by sealed, oversized, deep-groove ball bearings at each end.

b. The bearings shall be protected by a combination of a replaceable and independent tortuous path device and mechanical seals.

c. Face materials shall be of tungsten carbide to tungsten carbide.

d. O-rings shall be made of Buna-N elastomers.

e. Products requiring continuous or occasional lubrication or flushing shall not be accepted.
f. The mechanical seal shall be rated at 90 psi (620 kPa) continuous duty by the seal supplier.

g. The bearings shall be housed in a replaceable cartridge that supports and aligns the bearings and seals, as well as protects the shafts and end housings. The seal elements shall be independent of the stack height, therefore cutter stack tightness shall not affect seal performance. The seal elements shall maintain their factory set preload independent of the cutter stack tightness.

h. Seals shall meet required pressure rating regardless of cutter stack fit. The seal cartridge shall provide seal protection against axial loading on shafts and bearings during shaft deflection.

i. Each seal element shall be positively locked to its corresponding rotating or static cartridge element. This positive lock on the seal elements is critical to long seal life in applications where grit or other abrasive materials are present.

5. Side Rails

a. The inside profile of the cutter side rails shall be concave to follow the radial arc of the cutters.

b. Clearance between the major diameter of the cutter and the concave arc of the side rails shall not exceed 5/16 inch (7.9 mm).

c. The side rails shall have evenly-spaced slots that increase flow and decrease head loss.

d. The side rails shall be cast of A536-84 ductile iron.

6. End Housings and Covers

a. Grinder end housings shall be of cast A536-84 ductile iron with a cast-in-place flow deflector, designed to protect the bushings while guiding particles directly into the cutting chamber.

b. Top covers shall be A536-84 ductile iron and bottom covers shall be A36 hot rolled plates.

7. Hydraulic Motor

a. The grinder motor shall be a low-speed, high-torque, rotary-power hydraulic torque motor that utilizes the hydraulic pressure developed by the hydraulic power pack.
8. Required Running Torque per Horsepower (kW):

   a. At Momentary Load Peaks: 2,298 in-lbs/hp (348 Nm/kW).

E. Hydraulic Power Pack

1. The hydraulic power pack shall provide hydraulic pressure and flow to operate the grinder. The hydraulic power pack shall provide pressure, temperature, and level outputs to the controller. The power pack and grinder hydraulic motor shall be designed for smooth operation during frequent starts, stops and reversals.

2. The entire hydraulic system shall be designed for 3,000 psi (20,690 kPa) maximum pressure. Under no load conditions the system operating pressure shall be in the 200 to 400 psi (1,370 to 2,759 kPa) range. Continuous operating pressure greater than 2,000 psi (13,793 kPa) shall not be acceptable.

3. As solids are encountered, pressure shall be automatically increased on a demand basis providing the required torque necessary to continue rotation of the cutters.

   a. Should an obstruction cause the grinder demand pressure to exceed 2,850 psi (19,655 kPa), a pressure switch shall be activated and a 2-way valve shifted. The rotation of the cutters shall immediately reverse for about one-half (1/2) to one (1) revolution. Following this, the valve shall be shifted and the cutters returned to forward rotation.

   b. When the obstruction is cleared the unit shall continue to operate in the forward direction.

   c. If the obstruction is not cleared, the reversing sequence shall repeat until the obstruction is cleared or 9 reversals have occurred within 45 seconds. If the reversing sequence has completed and the obstruction has not been cleared, the controller shall de-energize the hydraulic power pack electric motor and activate an overload relay and a fail indicator.

4. The hydraulic power pack shall be rain-resistant and suitable for mounting within existing building, as required by the project’s design parameters.

5. The power pack shall include the following components:

   a. 16 inch (406 mm) x 16 inch (406 mm) x 15 inch (381 mm), epoxy coated, 10 gallon U.S. (38 liter) capacity reservoir.

   b. Suction strainer.

   c. Positive displacement pump driven by a vertically mounted 5 hp (3.7 kW), TEFC, C
face, electric motor.

d. Relief valve preset at 3,000 psi (20,690 kPa)

e. 2-1/2 inch (64 mm), 0 to 5,000 psi (34,450 kPa) oil filled gauge

f. Pressure switch preset at 2,850 psi (19,655 kPa)

g. 110 volt two-port directional valve

h. High pressure return line filter

i. Combination oil level and oil temperature gauge

j. Combination oil level switch and oil temperature limit switch

k. Temperature switch set at 160°F (71°C)

l. Filler breather

m. Electrical enclosure

6. Hydraulic connections between the torque motor and the power pack shall consist of two 1/2 inch (13 mm) flexible hoses, within 4-inch below grade PVC conduit. Connection to the torque motor and the power pac shall be with hydraulic quick disconnect couplings.

a. The flexible hoses shall be rated for a minimum 3,500 psi (24,138 kPa) working pressure with a 14,000 psi (96,552 kPa) burst pressure.

b. The hose pressure loss between the hydraulic power pack and the grinder torque motor shall not exceed 150 psi (1,034 kPa) at 50°C (10°C) above ambient temperature.

c. Provide each flexible hose with stainless steel hydraulic quick disconnect couplings (2 sets total).

   a. One set of quick disconnect couplings will be at the power pac inside the building.

   b. The second set will be for connection to the hydraulic torque motor inside the emergency storage tank.

7. The hydraulic power pack shall be filled with a high quality hydraulic fluid.

   a. The hydraulic fluid shall have a viscosity of approximately 100 to 250 SSU at 100°F
(38°C) with good chemical stability and anti-foaming properties.

b. The grades of hydraulic fluid shall be in accordance with the supplier’s recommendations.

F. Motor Controller

1. The controller shall provide independent control of the hydraulically driven grinder

2. Controller shall be the supplier’s standard UL/cUL listed Model PC2240.

3. The controller shall be rated for 5 hp, 480-volt, 3-phase, 60HZ.

4. The controller shall be equipped with a GRINDER ON-OFF/RESET-REMOTE three (3) position selector switch.
   a. In the OFF/RESET the grinder shall not run. In the ON position the grinder will run.
   b. In the REMOTE position the grinder shall start and stop as controlled by a remotely-located dry contact.
   c. The grinder shall only be reset by switching the GRINDER ON-OFF/RESET-REMOTE switch to the OFF/RESET position.

5. Safety Features
   a. When a grinder jam condition occurs in the grinder ON or AUTO mode the controller shall stop the grinder, then reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller will return to normal operation. If the jam condition still exists, the controller will go through eight additional reversing cycles within 45 seconds (nine times total) before signaling a grinder overload condition. Upon a grinder overload condition, the controller will shut the grinder off and activate an overload contact.
   b. If a power failure occurs while the grinder is running, operation will resume running when power is restored.
   c. If a power failure occurs while the grinder is in a fail condition the fail indicator shall be reactivated when power is restored.
   d. The controller shall provide overload protection for the motor through an overload relay mounted directly on the grinder starters.
   e. The Controller shall be provided with a properly sized main circuit breaker which
shall de-energize all power to the controller in the open position. The main circuit breaker shall have provisions for being padlocked in the open position.

6. Components

   a. Enclosure
      
      i. NEMA 4X, fabricated of fiberglass-reinforced polyester resins, and shall be suitable for wall mounting. Doors shall have hinges and corrosion resistant latches.

      ii. Enclosure shall house the control devices, relays, terminal blocks, grinder non-reversing hydraulic power pack oil pump motor starter.

   b. Control Devices
      
      i. Operator interface and pilot devices shall be mounted on the enclosure front panel door.

      ii. The controller shall have indicator lights for GRINDER RUN, and FAIL.

      iii. Indicator lights are LED pilot lights. Lights and the selector switches shall be heavy duty NEMA 4X type.

      iv. Control transformer shall be protected by two primary fuses and one secondary fuse. The 120 volt secondary shall have one leg grounded.

      v. Relay contacts shall be included for GRINDER run and FAIL signal outputs. The contacts shall be rated ten (1) ampere, 240 VAC, resistive load.

   c. Motor Starter
      
      i. A NEMA rated non-reversing contactor type motor starter shall be provided for the hydraulic power pack oil pump motor.

      ii. Overload relay (OL) shall be adjustable so that the range selected includes the FLA (full load amperes) rating and service factor.

**11331.03 EXECUTION**

**A. Source Quality Control**

1. Each grinder, hydraulic power pack, and controller shall be factory tested to ensure satisfactory operation.
B. Installations

1. Grinder, hydraulic power pack and motor controller shall be installed in accordance with the supplier’s installation instructions, and in compliance with all OSHA, local, state, and federal codes and regulations.

2. Contractor shall install the hydraulic hoses with a 4-inch PVC conduit, between the existing building and the proposed emergency storage tank, as shown on the drawings and within manufacturer’s recommendations. The conduit shall be sealed and capped where it enters each structure.

3. Contractor shall provide all stainless steel mounting hardware and conduit and wiring between the grinder, the control enclosure and emergency stop switch in accordance with Section 16010 and the drawings.

4. The Contractor shall demonstrate the equipment is operating in a satisfactory manner, including alarms and connection to the station telemetry system.

5. The Contractor shall demonstrate to the owner the proper removal of the unit completely from the wastewater channel within the emergency storage tank and the reinstallation and reseating of the unit.

C. Services and Training

1. The grinder manufacturer shall provide two (2) copies of the PLC programming documentation and the controller software package for reprogramming, including all source codes for reprogramming access.

2. Upon final acceptance, software registration shall be transferred to the Owner.

3. Contractor shall provide two (2) 2-hour training sessions for operations personnel.

4. Contractor shall provide two (2) 4-hour training sessions for maintenance personnel.

5. Sessions shall be scheduled prior to conditional acceptance and shall include hands on training with manufacturer supplied demonstration equipment, same as the unit specified.

END OF SECTION
SECTION 11400
TEMPORARY BYPASS PUMPING SYSTEM

11400.01 GENERAL

A. Summary

The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the duration of the project. All bypass pumping systems shall be manned and operated by the Contractor twenty-four (24) hours per day, seven (7) days per week for the duration of the work.

1. There are two (2) existing sanitary collection systems that empty into the wetwell. Existing manholes are near the wetwell (approximately 20 lineal feet away) and are summarized as follows:

   a. Sewage flow from Existing SMH 12909 enters the wetwell from the south
   b. Sewage flow from SMH 23007 enters the wetwell from the east

   Bypass pumping will be required from both systems at all times while the work is being completed. The proposed improvement will combine both lines into one system, which will require bypass pumping system modifications.

   See Drawing C-1 for existing conditions and Drawing C-3 for proposed improvements.

2. Two (2) temporary pumping systems may be required during construction of the emergency storage tank and collection system improvements. It is anticipated that only one bypass pumping system will be needed for completion of the wetwell and drywell improvements.

3. After the work in the existing wetwell is completed and the new pump suction plug isolation valves are installed, bypass pumping can be reduced to one temporary pumping system, pumping from the wetwell for the remainder of the work.

B. Quality Assurance

The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate experience in the design and operation of temporary bypass pumping system(s). The vendor shall provide at least five (5) references of projects of a similar size and
complexity as this project performed within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

C. Submittals

1. The Contractor shall submit detailed plans and descriptions outlining provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows during wetwell improvement and the replacement and startup of the sewage pumps. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. The plan shall include a “HIGH WATER ALARM” in the manholes or structures used for bypass pumping. The alarm shall be tied to the County’s existing SCADA system. The submittals shall include electrical schematics and control panel information for the pumps including start/stop and alarming configurations. No construction shall begin until all provisions and requirements have been reviewed by the Engineer/Owner. The Contractor shall allow 30 days for review and comment of this plan.

2. The plan shall include but not limited to details of the following:
   a. Staging areas for pumps.
   b. Plan showing proposed equipment and piping layouts including details of tie-ins to existing sewer lines and force mains.
   c. List of pump sizes, valves, piping, fittings and other appurtenances.
   d. Method of noise control for each pump and/or generator.
   e. Method for controlling and monitoring the pumps.
   f. Method for maintaining County SCADA system energized during the entire construction.

11400.02 MATERIALS

A. Equipment

1. All pumps used shall be automatic self-priming units that do not require the use of foot valves in the priming system. The pumps must be diesel powered. All pumps used must
be constructed to allow dry running for long periods of time to accommodate the cyclical nature of pumping station sewage flows.

2. Pumps shall be Godwin Dri-Prime® Automatic self-priming pumps with sound attenuation enclosures as manufactured by Godwin Pumps of America, Inc., (856) 467-3636 or equal. Sound attenuation enclosures shall reduce operating noise to 66 dB at 30 feet. Sizing of pumps is per this Specification.

3. The by-pass pumping system shall include the necessary stop/start controls for the pumps.

4. A back-up pump of size equal to the largest by-pass pump shall be included.

5. The back-up pump shall be on-line, isolated from the primary system by a valve.

6. Temporary discharge piping shall be constructed of rigid pipe with positive, restrained joints. Aluminum “irrigation” type piping or glued PVC pipe will not be allowed. Discharge hose will only be allowed in short sections and as accepted by the Engineer.

7. Allowable piping materials will be Godwin “QD” Steel Pipe (Godwin Pumps of America, Inc.) Or fused, high-density polyethylene pipe as manufactured by Phillips Driscopipe, Inc. or equal.

B. System Description

1. Design Requirements:
   a. The bypass pumping system(s) shall have sufficient capacity to pump a peak flow of 600 gpm at 120 Feet TDH, not including the back-up pump capacity. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle the peak flow, and temporary discharge piping to ensure that the total flow influent flow can be safely diverted around the section to be repaired. Bypass pumping system(s) will be required to be operated and manned twenty-four (24) hours per day for all work, until completed, field tested, satisfactorily operated for a minimum of seven (7) consecutive calendar days, and the Conditional Acceptance Notification and Inspection by the County.

   b. Temporary bypass pumping during construction may be accomplished by utilizing an existing sanitary sewer manhole and the new Emergency Bypass Connection or line stop structure as shown on the Contract Drawings. The Contractor shall verify location of all utilities, size of fittings, couplings and all other bypass requirements as previously noted. The bypass connection and piping shall be installed and tested prior to bypassing.
c. The Contractor shall verify that all existing valves and newly installed valves necessary for the bypassing operation are in good working condition. The County shall be responsible for operating these valves during construction/upgrades at existing facilities. The Contractor shall coordinate with Anne Arundel County personnel regarding the operation of these valves and providing a minimum of five (5) days’ notice to the County prior to any verification or construction operation.

2. Performance Requirements:

   a. The design, installation and operation of the temporary pumping system shall be the Contractor’s responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

   b. The Contractor shall provide all necessary means to safely convey the incoming sewage past the work area. The Contractor will not be permitted to stop or impede the flows in existing force mains.

   c. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding. Any sanitary sewer overflow that occurs due to a failure in the bypass system will be the responsibility of the Contractor. Any penalties issued to the County by Maryland Department of the Environment (MDE) will be reimbursed to the County Utility fund by the Contractor.

   d. Prior to initiating any bypass pumping, the Contractor shall submit a contingency action plan indicating how the Contractor will maintain by-pass flow around the work area in the event of by-pass pumping system malfunction or equipment breakdown.

   e. The Contractor shall protect water resources wetlands and other natural resources.

   f. Contractor shall be responsible for any MDE fines incurred as a result of any sewage spills caused by or as a result of temporary by-pass operations.

   g. The Contractor shall be responsible to coordinate with the County at least one week in advance for the bypass pumping system monitoring tie-ins to the County SCADA system.

   h. The Contractor shall be responsible for continuously energizing the County’s SCADA system during the entire construction.

11400.03 EXECUTION
A. Field Quality Control and Maintenance

1. Test:
   a. The Contractor shall perform leakage and pressure tests of the new bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours’ notice prior to testing.
   b. All bypass pumping system(s) shall be tested and operated successfully for 24 continuous hours, prior to beginning the affect work.

2. Inspection:
   During the time the Contractor is utilizing the bypass operations at the project site, Contractor shall provide continuous watch over the bypass pumping system to ensure that the system is working correctly and shall keep a written log of the pump inspection results. Contractor shall ensure full fuel tanks for the bypass pumps. For the entire duration of each bypass operation, the Contractor shall have a worker on site 24 hours a day, 7 days a week to verify that the bypass system is functioning properly.

3. Maintenance Service:
   The Contractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on-site when pumps are operating.

4. Extra Materials:
   a. Spare parts for pumps and piping shall be kept on site as required.
   b. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

B. Preparation

1. Precautions
   a. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the County and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
   b. During all bypass pumping operation, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment.
C. Installation and Removal

1. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.

2. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

3. When working inside manholes or sewer lines, the Contractor shall comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

4. The installation of temporary bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the County.

END OF SECTION
SECTION 15100

GENERAL MECHANICAL REQUIREMENTS

15100.01 SCOPE

A. All work under Division 15 is subject to the General Provisions and Special Requirements for the entire Contract.

B. Provide all labor, materials, equipment and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange equipment and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with this Section and Section 01010. The Engineer reserves the right to make reasonable changes in location of equipment, piping, and ductwork, prior to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under this section with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures and sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in a first class, substantial, and workmanlike manner, in accordance with the full intent of the contract documents.

H. Permits and Fees

Obtain all permits and pay taxes, fees and other costs in connection with the work except as excluded in the General Conditions. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to the Owner prior to final acceptance of the work.

I. Fire Safe Materials

Unless otherwise indicated, materials shall conform to UL, NFPA or ASTM standards for
fire safety with smoke and fire hazard ratings not exceeding flame spread of 25 and smoke developed of 50. The materials, containers or shipping cartons shall bear certification with these requirements.

J. Referenced Standards, Codes and Specifications

Specifications, Codes and Standards listed below are included as part of this specification, latest edition:

- AABC - Associated Air Balance Council
- AMCA - Air Moving and Conditioning Association
- ASTM - American Society for Testing and Materials
- BOCA - Building Officials and Code Administrators
- IEEE - Institute of Electrical and Electronics Engineers
- MOSHA - Maryland Occupations Safety and Health Administration
- NEC - National Electrical Code
- NEMA - National Electrical Manufacturers Association
- NFPA - National Fire Protection Association
- OSHA - Occupational Safety and Health Administration
- UL - Underwriters Laboratories

K. Color Selection

Color of finishes shall be as selected by the Owner. Submit colors of factory-finished equipment for acceptance prior to ordering.

L. Guarantee

1. Guarantee obligation shall be as hereinbefore specified in the General Conditions of these specifications, with the following supplementary requirements.

2. Guarantee shall apply to all materials, equipment, and services and shall include readjustment and rebalancing of systems and equipment where required.

3. During the guarantee period, make appropriate revisions or corrections to operating
instructions, equipment manuals, and other as-built data.

15100.02 MATERIALS

A. Materials and Equipment

1. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the indicated type and quality.

2. Where proprietary name, model number and/or manufacturer identity material or equipment, furnish named item, or its equal, subject to approval by the Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

3. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items including items other that first named shall be equal or better in quality and performance to that of the specified items, and must be suitable for available space, required arrangement and application.

B. Supports, Hangers and Foundations

1. Provide supports, hangers, braces, attachments, and foundations required for the work. Support and set the work in a thoroughly workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval.

2. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes.

3. Concrete pads and foundations shall not be less than 4 inches high and in general shall extend 2 inches beyond equipment bases. Provide wire-mesh reinforcement; chamber exposed edges and corners; finish exposed surfaces smooth, connect as specified above.

C. Drive Guards

1. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

2. Fabricate guards of heavy gauge stainless steel or non-metallic, UV protected HDPE machine guards by Uniguard or equal. Provide openings for tachometers. Guards shall meet OSHA and MOSHA requirements.
D. Vibration Isolation

Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment or ductwork to building structure.

E. Provisions for Access

Furnish and install adequate access to all equipment, dampers, controls, and other devices requiring maintenance or manual operation.

F. Identification

1. Mark and permanently identify all systems and equipment in accordance with project nomenclature, include controls. Use plaques, stencils, nameplates, tags, marker, or other acceptable means. Securely mount or attach all signs, nameplates and tags with stainless steel screws. Adhesive style attachment is not acceptable.

2. The method of identification shall suit the particular item to be identified and all similar items shall be identified in a like manner. Lettering shall be uniform, neat, legible, and professional in quality. Characters shall be readable at a normal distance of operation.

3. Identification methods shall be:
   a. Plaques: For direct mounting on walls or large equipment; metal or laminated plastic; printed, engraved, or stenciled characters up to 2-inch minimum size.
   b. Stencils: For direct application on equipment; characters ½-inch minimum size.
   c. Tags: For attachment to controls and concealed equipment; stainless steel; engraved and filled characters ¼-inch minimum size.

4. Identification system shall be as manufactured by W.H. Brady Co., or equal.


6. Identification by means of marking pens or other temporary methods will not be acceptable.

15100.03 EXECUTION

A. Supervision and Coordination

1. Provide complete supervision, direction, scheduling and coordination of all work under
the Contract, including that of subcontractors.

2. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for work performed under Division 15.

3. Coordinate electrical work required under Division 15 with that Division 16.

4. Coordinate all work under Division 15 with work under all other Divisions.

B. Cutting and Patching

1. Accomplish all cutting and patching necessary for the installation of work under Division 15. Damage resulting from this work to other work already in place shall be repaired at Contractor’s expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

2. Do not cut structural members without approval.

C. Penetration of Waterproof Construction

Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

D. Cleaning, Painting and Finishes

1. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials; hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint.

2. Clean surfaces prior to application of insulation, adhesives, coatings, paint or other finishes.

3. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

4. Protect all finishes and restore any finishes damaged as a result of work to their original condition.

5. These requirements apply to all work whether exposed or concealed.

6. Remove all construction markings and writing from exposed equipment, ductwork, and
building surfaces. Do not paint manufacturer’s labels or tags.

E. Protection of Work

Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment. Cover temporary openings in equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Cover or otherwise protect all finishes.

F. Operation of Equipment

1. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufactures instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

2. Where specified, or otherwise required, provide the services of the manufacturer’s factory-trained servicemen or technicians to start up the equipment.

3. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Engineer. Where such authorization is granted, temporary use of equipment shall not limit or affect warranties or guarantee period of the work.

4. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

G. Testing, Balancing and Adjustment

1. Perform all specified or required tests to demonstrate that the work is installed and operating properly. Where formal tests are required, give adequate notice and perform preliminary tests to assure that work is complete and ready for final test.

2. Balance and adjust all systems, equipment, and controls to operate at the proper capacities in a safe, efficient and stable manner.

H. As-Built Drawings

1. During construction, maintain an accurate, up-to-date record of the installed locations of all work on a set of contract drawings.

2. Upon completion of the work, deliver to the Engineer, one complete set of contract drawings with all “as-built” information neatly recorded thereon in red ink.
I. Equipment by Others

1. The Contractor shall make all system connections required to equipment furnished and installed under other divisions, and by the Owner. Connections shall be complete in all respects to render the equipment functional to its fullest intent.

2. It shall be the responsibility of the supplier of the equipment to furnish complete instructions for connections. Failure to do so will not relieve the Contractor of any responsibility for improper equipment operation.

J. Lubrication

1. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year’s supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication.

2. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Zerk or equal accessible or extended grease fittings and drain plugs.

END OF SECTION
SECTION 15140

PIPE SUPPORTS

15140.01 GENERAL

A. Description

B. This section includes provisions for pipe hangers, brackets, supports, and spacing of expansion joints in piping systems. Pipe supports shall be furnished, complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

C. Submittals

1. Submit Contractor’s drawings in accordance with Section 01010 including the following:

2. Catalog cuts on all pipe support components to be used including detailed specifications.

3. Submit layout drawings in conjunction with Sections 15210 and 15400 showing the location of all pipe supports.

15140.02 MATERIALS

A. Materials

1. Pipe supports are identified by manufacturer’s name and catalog number. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have threading to permit the maximum adjustment available in the support item.

2. In certain locations, pipe supports and anchors have been shown on the drawings, but no attempt has been made to indicate every pipe support and anchor. It shall be the Contractor’s responsibility to provide a complete system of pipe supports and to anchor all piping, in accordance with this section.

B. Description

1. Pipe support types and applications shall comply with the following:

   a. Description or Size:

      i. Hangers:

         a. 2-1/2” and smaller pipe:
GENERAL MECHANICAL REQUIREMENTS

SECTION 15140

i. Split ring: Elcen Flg 90. Fee & Mason Fig 210.

ii. Unistrut J-Style. Grinnell Fig. 104

iii. Clevis Grinnell Fig 65, Fee & Mason Fig 104

b. 3” through 12” pipe:

i. Clevis Grinnell Fig 260, Fee & Mason Fig 239

ii. Concrete Inserts, steel:

12” and small pipe Channel 12 ga; galv. 1-5/8” X 1-5/8” Min 8 inches long. Anchor lugs on 4” centers, at least three lugs and caps, and filler strip. Grinnell Fig. 285. Fee & Mason Fig 186

iii. Floor Supports, steel or cast iron:

a. 6” and smaller pipe Grinnell Fig. 259, Fee & Mason Fig 295, or Standon Model 2589.

b. 8” through 24” pipe Grinnell Fig. 258, 264 Fee & Mason, or Standon Model 2589

15140.03 EXECUTION

A. Location

1. Unless otherwise indicated on the drawings, or directed by the Engineer, piping shall be supported approximately 1-1/2 inches out from the face of walls.

2. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be:
<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Pipe Support Max Spacing, Ft.</th>
<th>Max Run without Expansion Joint, Loop, Bend, Ft.</th>
<th>Expansion Joint Max Spacing, Ft.</th>
<th>Type of Expansion Joints</th>
</tr>
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<tr>
<td><strong>Ductile Iron</strong></td>
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<td></td>
<td>15</td>
<td>80</td>
<td>80</td>
<td>Mechanical Couplings</td>
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<td><strong>Steel</strong></td>
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<td>1-1/4” and Smaller</td>
<td>7</td>
<td>30</td>
<td>100</td>
<td>None required</td>
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<td>1-1/2 to 4”</td>
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<td>30</td>
<td>100</td>
<td>Mechanical Couplings</td>
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<td>80</td>
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<td><strong>Copper</strong></td>
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<td>1” and smaller</td>
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<td>None required</td>
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<td>7</td>
<td>50</td>
<td>100</td>
<td>None required</td>
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<td><strong>PVC</strong></td>
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<tr>
<td>1/8 and ¼”</td>
<td>Continuous Support</td>
<td>20</td>
<td>80</td>
<td>None required</td>
</tr>
<tr>
<td></td>
<td>(Note 1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>½ to 2”</td>
<td>4</td>
<td>20</td>
<td>60</td>
<td>None required</td>
</tr>
<tr>
<td>Over 2”</td>
<td>6</td>
<td>20</td>
<td>60</td>
<td>None required</td>
</tr>
<tr>
<td>Cast Iron Soil pipe</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>None required</td>
</tr>
</tbody>
</table>

Note 1. Hanger and bracket spacing may be increased to 10 feet where PVC pipe is provided by continuous support.

**B. Application**

1. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.
2. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer’s recommended loads.

3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows used as expansion joints.

4. Contact between dissimilar metals shall be prevented in supporting copper tubing. Those portions of pipe supports that contact the tubing shall be copper plated, rubber or vinyl coated, or stainless steel.

5. All piping shall be supported and anchored so that there is no movement or visible sagging between supports.

END OF SECTION
SECTION 15210

PIES, VALVES, FITTINGS AND SPECIALTIES

15210.01 GENERAL

A. Description

This section includes requirements for interior piping and fittings, buried and interior valves and specialty items used in conjunction with piping systems.

B. Related Work Specified Elsewhere:

1. Section 02250: Trench Excavation, Backfill and Compaction
2. Section 11310: Sewage Pumps
3. Section 11400: Temporary Bypass Pumping System

C. Submittals

The Contractor shall submit certificates of compliance for all materials furnished under this section in accordance with Section GP-6.05 of the General Provisions.

D. Quality Assurance

All materials shall be new and of the highest grade. The Contractor shall carefully inspect all materials for defects prior to installation, report deficiencies to the Engineer, and replace deficient materials as directed by the Engineer.

15210.02 MATERIALS

A. General

1. Pipe and Fittings

    All pipe fittings shall be of the types indicated on the Contract Drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings; copper piping shall be provided with bronze, wrought copper, or brass fittings.

B. Ductile Iron Piping

1. Ductile iron piping shall conform to the requirements of AWWA C 151. All fittings for ductile iron pipe shall be ductile iron, conforming to AWWA C1 10. Exposed ductile iron pipe and fittings shall have flanged ends. Ductile iron pipe shall be Class 53 minimum
and shall conform to the requirements of AWWA C 115.

a. All buried ductile pipe and fittings shall be double cement lined on the interior per AWWA C104 and bituminous coated on the exterior. All buried ductile iron pipe and fittings shall be wrapped with Polyethylene Encasement on the outside in accordance with ANSI/AWWA C105/ A21.5.

b. All interior pipe and flanged fittings shall be double cement lined on the interior per AWWA C104 and factory prime coated on the exterior, compatible with specified, field applied coating system.

2. All ductile iron pipe fittings shall be supported, anchored and/or buttressed as indicated in the specifications or stipulated on the Drawings.

3. Ductile iron wall castings shall have integral water stops and shall have ends as indicated on the Drawings.

C. PVC Pipe

1. PVC pipe and fittings shall be Schedule 80 with screwed or solvent welded joints. Fittings for threaded pipe shall be Schedule 80 with threads recessed and cut in accordance with ANSI B2.1. Fittings for solvent-welded pipe shall be Schedule 80-recessed type.

2. Flanged fittings or valves where shown or required, shall have companion flanges of the threaded type on the pipe side of these connections.

3. All pipes shall be threaded where required for installation of valves and connections to equipment. PVC unions shall be installed in the pipeline adjacent to all valves and equipment connections, and at reasonable intervals along the run of the pipe, to permit disassembly.

D. CPVC Pipe

1. Chlorinated polyvinylchloride (CPVC) pipe and fittings shall be schedule 80 with screwed or solvent welded joints. The pipe shall be manufactured from a Type IV, Grade 1, CPVC compound with a minimum cell classification of 23447 per ASTM D1784. The pipe shall be manufactured in strict compliance to ASTM F441, consistently meeting the Quality Assurance Test requirements of the standard with regard to material, workmanship, burst pressure, flattening and extrusion quality.

2. The pipe shall have a flame spread rating less than 25 and a smoke development rating less than 50 when tested. The pipe shall also be listed for surface burning characteristics.
in accordance with CAN/ULC-S 102-2-M 88.

3. Pipe and fittings shall be manufactured by Harvel Plastics, Inc., or equal.

E. Stainless Steel Pipe

1. Stainless steel pipe and fittings shall not have a lining and the outside shall not be painted.

2. Pipes 2-1/2 inch and smaller shall be ASTM A312, Type 304, schedule 40 seamless, unless otherwise noted. Joints shall be screwed type unless otherwise noted.

3. Fittings shall be screwed, stainless steel, conforming to ASTM A182, Grade F304 or barstock to ASTM A276 Type 304 with dimensions conforming to ANSI B16.3 for 150 lb SWP malleable iron screwed fittings.

F. Unions

1. Unions for use in galvanized steel pipe systems shall be galvanized malleable iron, screwed end, ground joint, brass seat unions, suitable for 150 psi service.

2. Unions for use in polyvinyl chloride (PVC) piping systems shall be Schedule 80, manufactured from polyvinyl material conforming to the requirements of ASTM D1784, with Buna-N or Viton O-rings.

3. Unions shall be furnished adjacent to valves and equipment connections, and at appropriate intervals along the run of pipe to permit disassembly.

G. Joints

1. Unless otherwise specified or indicated on the Drawings, joints for exposed ductile iron pipe and fittings shall be flanged. Pipe shall have screwed-on flanges conforming to AWWA C1 15. Fittings shall have integrally cast flanges in accordance with AWWA C1 10.

2. PVC solvent-welded piping joints shall conform to ASTM D2564 and ASTM F402.

3. Joints for galvanized steel pipe and fittings shall be threaded joints except where otherwise indicated on the Contract Drawings.

H. Wall Castings and Sleeves

1. Provide wall castings and sleeves in walls and floors for the passage through concrete and other materials of all pipes.
2. Wall and floor sleeves for pipe smaller than 4-inch shall be standard weight galvanized steel, conforming to ASTM Specification A-120. Sleeves in concrete shall have integral waterstops. Sleeves passing through floors shall extend approximately 1/2-inch above the finished floor. The space between pipes and sleeves shall be sealed with modular rubber mechanical seals or other method as approved by the Engineer. Low melting point asphaltic materials will not be permitted for caulking.

3. Generally, except where otherwise noted on the Drawings, all wall castings in concrete walls or floors for pipes 4-inch and larger shall be minimum ductile iron ANSI Class 125 of the shapes and sizes indicated, and shall be complete with water-stop flanges. The ductile iron wall coatings shall conform to ANSI A21.10.

4. Modular rubber mechanical seals shall consist of interlocking rubber links shaped to continuously fill the angular space between the pipe and the pipe sleeve. All metal modular rubber seal parts shall be stainless steel. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe. When the seal is in place, the bolts are tightened and a watertight seal is made. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe O.D. and sleeve I.D. involved. Seals shall be "Link Seal" as manufactured by Thunderline Corporation or equal.

I. Mechanical Couplings

1. Mechanical couplings shall be sleeve type with steel coupling body, rubber gaskets and steel follower glands secured to the coupling body with steel bolts. Couplings shall be designed specifically for use with ductile iron pipe. Couplings shall be designed for a working pressure of 150 psi.

2. Mechanical couplings shall be Style 38 as manufactured by Dresser Industries or equal.

3. Pipe ends at each side of mechanical couplings shall be tied together with at least 2 threaded rods extending to the nearest flanges or by utilizing two (2) piece pipe clamps. Piping restraint at mechanical couplings shall be as acceptable to the Engineer.

J. Plug Valves

1. Plug valves shall be the eccentric plug, non-lubricated type, with ductile iron body, welded nickel plug seat, resilient-type neoprene coated plug, stainless steel, sleeve- type bearings, and multiple stem packing. Valves shall have 100 percent port opening. All 4-inch and 6-inch exposed plug valves shall have lever operators unless otherwise shown on the contract drawings, quarter turn to full open position with extension pipe. Exposed plug valves of 8-inch and larger shall have geared operators and handwheels or operating nuts with extension stems couplings, bearing plate and wall brackets as shown on the
contract drawings. Geared operators shall be sized and designed for the full differential pressure rating of the valve.

2. Buried plug valves shall have mechanical joint ends, and operating nut. Exposed plug valves shall conform to ANSI B16.1, 125 PSI flanged ends. Plug valve bolt threads shall be coated prior to assembly with a compound to prevent seizing.

3. Plug valves shall be rated for 175 PSI operating pressure. The valve shall be rated "bubble tight" with the rated operating pressure applied on either side of the plug.

4. Plug valves shall be installed so that the plug isolates the valve body from flow in normally closed service or so the plug seats when closed against the normal direction of flow, or as directed by the Engineer. Where plug valves are installed horizontally the plugs shall open towards the top of the body.

5. All buried plug valves shall be furnished with a roadway box and operating stem extension to bring the operating nut within 12 inches of finished grade. Extension stems shall be securely attached to the valve operating nut and a two-inch square operating nut shall be welded to the top of the extension stem. Spacer discs or rods shall be installed in the valve box as required to center the extension stem. Extension stems shall be as recommended by the manufacturer of the valve with which it will be installed.

6. As part of the shop drawing submittals, the manufacturer shall provide the number of turns to fully open the valve from the closed position.

7. Plug valves shall be manufactured by DeZurik Unit of General Signal Corp., or equal.

8. Extension stems shall be provided for operation of valves where required or shown in the Contract Drawings. Extension stems shall be made from extra heavy duty galvanized steel, sized so to transmit full torque from the operating mechanism to the valve without binding, twisting or bending. Extension stems shall be complete with coupling for attachment to the valve stem for non-rising stems and a 2-inch operating nut.

9. Stem guide shall be high-strength cast iron and installed as necessary but at a minimum so that extension stems do not go unsupported for lengths more than eight feet.

K. Check Valves

1. Check valves 3-inch and larger shall be the heavy-duty clapper swing check type. It shall open smoothly at pump start and close quickly and quietly on pump shut down. When closed, the valve shall seat drop tight. Check valves shall meet or exceed the requirements of AWWA C508. Check valves shall be suitable for use in the horizontal or vertical position.
2. The body shall be heavy-duty, high strength cast iron and shall have a removable cover for inspection and removal of the clapper assembly. Check valves shall have integral ANSI B16.1 Class 125 flanged ends and a stainless steel or bronze replaceable body seat. The valve body shall be designed to provide full flow with the valve swung open 30%.

3. The disc shall be cast iron and faced with a renewable disc seat ring of BUNA-N rubber, held in place by a bronze or stainless steel follower ring and stainless steel screws. The disc nut shall be bronze or stainless steel with stainless steel cotter pin to prevent loosening.

4. The disc arm shall be ductile iron suspended from and keyed to a stainless steel shaft and supported on each end by heavy bronze bushings with o-ring seals or adjustable graphite packing.

5. The check valve shall be supplied with a steel external lever and adjustable weight to assist in valve closing.

6. Check valves 3-inches and larger shall be manufactured by GA Industries, Clow, M&H, or equal.

7. Check valves smaller than 3 inches shall be bronze, swing type, with screwed cap suitable for seat regrinding, Figure B-364 as manufactured by Stockham, or equal.

L. Pressure Gauge Taps and Shutoffs

1. Pressure gauge taps shall be provided on the suction and discharge line of each pump.

2. Fittings
   a. Quick Connect Stems: Shall be Type 316 stainless steel, full flow type, Y2-inch female NPT stem with protector cap. Swagelok "QF" series or equal. Quick connect stems shall be fully compatible with the quick connect body furnished with the pressure gauges. Both stem and body shall be of the same manufacturer.
   b. Ball Valves: Shall be Type 316 stainless steel body, stem and ball with Teflon seat and packing, spring return handle to the fully closed position, Marpac, PBM, Flow-Tek or equal.
   c. Service Saddles: Shall be bronze or nylon-coated iron with double stainless steel straps for use on pump discharge installations, Smith Blair or equal. Furnish bronze bushings as required for Y2-inch NPT connections.
   d. Nipple: Shall be Schedule 80, seamless, Type 316 stainless steel conforming to
ASTM A312-89 with threaded ends.

M. Pressure Gauges

1. Pressure gauges, unless otherwise specified shall be bourdon-tube type with measuring element of phosphor-bronze. Gauges shall be 4-1/2 inch diameter, glycerin filled, white dial with black numbers, and Y2-inch NPT connection on the underside. All gauges shall have an accuracy of plus or minus one percent of full-scale range. Gauges shall include a stainless steel diaphragm seal (glycerin filled) with bleed pet cock on lower half (wastewater side), and 316 S.S. quick connect fitting to match the quick connect stems in subsection 15210.02-M.2.a. of this Section.

2. Note: The gauge assembly should not be installed directly into the pump, but into a straight length of pipe. The nipple must not be installed in a tapped hole in the piping. Use either a welded-on "Thread-o-Let" connection (3000 psi rating standard) or a service saddle. The service saddle should have either a bronze or coated iron saddle with a double stainless strap.

3. Pump discharge pressure gauges, where shown on the Contract Drawings, shall have a dual scale reading in psi and feet of water with full scale not greater than 2 times or less than 1.25 times the pump design TDH.

4. Pump suction piping (except wet pit submersible pumps), where shown on the Contract Drawings shall have a compound pressure and vacuum gauge with scale indicating psi and feet of water from -7.5 psi to +7.5 psi.

5. A 2-1/2 inch dial, glycerine-filled pressure gauge shall be provided at each bubbler system compressor air receiver tank and shall have a pressure range of 0 to 160 psig.

N. Surge Relief Valve

1. The surge relief valve shall be of the spring relief type with hydraulically-damped cylinder. The valve body shall be angle design and constructed with a cast iron body and cover/yoke assembly to withstand severe shock conditions. The body shall be a 90 degree, long radius angle pattern to permit side or downward discharge. The valve exterior shall be coated with red phenolic primer paint.

2. A cover/yoke assembly shall provide an air gap between the surge valve and hydraulic cylinder. The valve stem shall be connected to the hydraulic cylinder by means of a self-aligning, universal connector to insure a smooth and positive opening, without binding, during shock opening of the valve.

3. The hydraulic cylinder shall be removable from the valve without dismantling or removing
the valve from the line.

4. Closing speed shall be externally adjustable by means of a color-coded, micrometer control valve.

5. The valve disc shall be normally closed against system operating pressure by means of a spring plus hydro-pneumatic accumulator. When the system pressure exceeds the factory valve setting, the surge relief valve shall open immediately to relieve the pressure surge and close slowly at a controlled rate as the system pressure returns to normal by means of the hydraulic cylinder.

6. The valve disc shall be cast iron or steel and have a renewable, resilient seat secured in place by an alloy bronze or stainless steel retaining ring and stainless steel screws. The body seat shall be alloy bronze or stainless steel.

7. The valve shall be APCO Series 3000 Angle surge relief as manufactured by the Valve & Primer Corporation.

15210.03 EXECUTION

A. Piping System Installation

1. The Contractor shall verify all dimensions of pipes, valves, fittings, and equipment so that pipe work will fit properly and conform to general arrangement shown on the Drawings. Pipe, valves, fittings and related accessories shall be carefully examined for defects before installing and no defective pieces shall be installed. Pieces shall be thoroughly cleaned before installation and shall be kept clean and dry.

2. Threads shall be standard, clean-cut and tapered. All pipe shall be reamed free from burrs and kept free of scale or dirt. Threaded joints shall be made up with lubricating oil and graphite or graphite pipe joint compound applied to male thread only. The use of red or white lead will not be permitted. Complete threaded joints shall not have more than two threads exposed when made tight. Threads shall comply with ANSI Specifications No. B-2.1.

3. All gaskets between flanged connections and fittings shall be rubber meeting the requirements of AWWA C 115.

4. Flange bolts, nuts and washers shall be stainless steel for metal pipe, with good sound well-fitting threads; the nuts shall be cold punched, hexagonal, trimmed and chamfered. Heads, nuts and threads shall be United States Standard sizes. Bolts shall be of such length as to project one-quarter inch beyond the nut when the flanged joint gasket is assembled. Bolt threads shall be coated prior to assembly with a compound to prevent
seizing.

5. Solvent-welded polyvinyl chloride (PVC) pipe joints shall be made with a solvent cement supplied or recommended by pipe manufacturer. Socket and plain ends shall be clean and dry; a thin application of solvent shall be applied to both socket and plain end, the plain end inserted to the socket shoulder and given one-half turn to ensure proper distribution of solvent. Following jointing operation, the joint shall be immobilized for not less than four hours, or as recommended by the manufacturer. Solvent welding operations shall be conducted in well-ventilated areas, remote from open flames, sparks, or other combustion hazards. Solvent welding operations shall be conducted in strict conformance with manufacturer's temperature recommendations.

6. During construction, the Contractor shall keep ends of pipes or conduits, and equipment connections, closed with caps, plugs, or wooden flange covers, so as to prevent entrance of dirt, building materials or other foreign matter.

7. Prior to drilling holes for anchors, supports, hangers, etc., in structural or building work, the Contractor shall secure permission from the Engineer.

8. Specialties shall be installed in strict accordance with the manufacturer's recommendations.

9. Provide an insulating union, coupling or flange connector for corrosion control wherever pipes of dissimilar metals join. Connectors shall include an approved type dielectric separator.

10. Wall castings and sleeves shall be provided in walls and floors for the passage of all pipes as specified and as shown on the Drawings. The boxing out of concrete for installation of any wall castings or sleeves will not be permitted. Pipe sleeves shall be provided where pipes and tubing pass through walls, floors, and partitions. Sleeves shall be placed during construction and at no time shall drilling or jackhammers be used. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/2-inch. Securely hold sleeves in proper position and location before and during construction. All sleeves shall be of sufficient length to pass through entire thickness of walls, partitions or slabs. Sleeves in floor slabs shall extend Y2-inch above the finished floor. Modular rubber seal-wall sleeve systems shall be in accordance with the seal manufacturer's printed instructions and as specified.

11. Polyvinyl Chloride (PVC) piping shall be installed in conformance with the requirements of ASTM D2855, ASTM F402, and the piping manufacturer's recommendations, subject to the approval of the Engineer.
12. Piping/flange alignments at pump casing connections shall meet the following standards in order to minimize piping/casing strain:

13. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted.

14. Mating flange faces shall be parallel to within a tolerance of no greater than 1/2 the gasket thickness unbolted.

15. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted.

16. Pipe supports must be adjustable.

B. Piping Modifications

Piping shall be modified or relocated where necessary to accommodate the work only with the approval of the Engineer.

C. Piping Tests

1. All tests shall be performed in the presence of the Engineer. All necessary labor, tools, equipment and materials, including gauges shall be supplied by the contractor. No additional compensation will be allowed for these tests and any defective items discovered during the performance of such tests shall be satisfactorily repaired or replaced at the discretion of and to the complete satisfaction of the Engineer.

2. Piping shall be adequately braced and supported during tests to prevent movement, displacement or damage upon application of test pressure. Equipment used in the testing shall be subject to the approval of the Engineer.

3. The Contractor shall not apply test pressures to existing piping systems. New piping systems shall be isolated and capped or plugged before tests are carried out. Where any section of new piping cannot be isolated for testing, the test shall be conducted in actual use conditions.

4. Some or all of the instruments and equipment connected to the piping systems may not be designed for the test pressures specified herein. All such instruments and equipment shall be disconnected, and open ends of pipelines shall be capped or plugged before tests are carried out.

5. All pressure gauges used in testing shall be calibrated, within six months prior to use, by an independent testing agency. A copy of the calibration report shall be submitted to the Engineer.
6. Interior Piping

a. Maintain the test pressures for at least two hours with no pressure drop. Test piping systems in accordance with the following schedule:

<table>
<thead>
<tr>
<th>System</th>
<th>Testing Medium</th>
<th>Testing Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposed Pressure, Piping 3 inches &amp; Larger</td>
<td>Water</td>
<td>150 psi</td>
</tr>
<tr>
<td>Exposed Pressure, Piping 3 inches &amp; Smaller</td>
<td>Water</td>
<td>150 psi</td>
</tr>
<tr>
<td>High Pressure or Gas Piping</td>
<td>Air</td>
<td>150 psi</td>
</tr>
<tr>
<td>Low Pressure or Gas Piping</td>
<td>Air</td>
<td>25 psi</td>
</tr>
</tbody>
</table>

b. Piping not passing pressure tests shall be repaired or replaced and retested as specified to the satisfaction of the Engineer.

END OF SECTION
SECTION 15400

PLUMBING

15400.01 GENERAL

A. Description

1. This division of the Specifications covers water and drain system plumbing and includes all piping, meters, valves, appurtenances, permits, permit costs, connection fees and includes the coordination of the plumbing with all other trades. All piping, valves, and equipment shall be new, and shall be installed completely in every detail.

2. In general, Drawings for the work are diagrammatic and show the location, type and size of piping, plumbing fixtures and accessory equipment. The Contractor shall furnish all fittings necessary for the proper installation of the work. The Contractor shall verify all necessary dimensions before installing any of the work, and shall check his layouts to allow clearance required for other work as shown on the Drawings.

B. Submittals

1. Submit shop drawings for the yard hydrants, service valves, hose bibs and backflow preventers in accordance with Section 5.04 of the General Provisions.

2. Submit operating and maintenance data for the backflow preventer and box hydrant.

3. Submit certificate of compliance for copper pipe, soil pipe and hose.

4. Submit certification that backflow prevention (BFP) device is inspected, tested and certified by person certified to test BFP; device to be tagged and dated.

C. Permits, Licenses and Inspections

1. The Contractor shall obtain and pay for all permits required by Anne Arundel County.

2. All work shall conform to all applicable local codes.

3. Upon completion of the entire system covered by these Specifications, a certificate of approval from the different departments having jurisdiction shall be obtained and then delivered to the Engineer. This certificate will in no way relieve the contractor from the terms of his warranty.
15400.02 MATERIALS

A. General

All materials shall conform, as applicable, to the following designated standards with latest addenda and errata. Materials not designated herein shall comply with the Standard Specifications and Details.

- Cast iron soil pipe and fittings: A40.1 (ANSI)
- Cast iron screwed fittings: B 16.4 (ANSI)
- Cast iron drainage fittings: B 16.12 (ANSI)
- Copper tubing types K, L, M: H23.1 (ANSI)
- Solder-type copper fittings: B16.22 (ANSI)

B. Piping

1. Water piping below grade shall be type K copper tube. Water piping above grade shall be type M copper tube. Water pipe shall comply with ASTM B88.

2. Soil pipe below grade shall be standard weight cast iron bell and spigot type. Soil waste and vent pipe above grade shall be standard weight cast iron, or Schedule 40 galvanized steel with black drainage pattern cast iron fittings or drainage weight copper, or plastic drainage pipe and fittings.

C. Joints

Joints for above grade copper piping shall be solder-type or compression pattern. Joints for buried copper piping shall be compression pattern.

Soil pipe joints shall be rubber gasket.

D. Valves and Specialties

Gate valves shall be bronze, non-rising stem, solid wedge, figure B-115 as manufactured by Stockham, or equal.

Backflow preventer shall be reduced pressure principle type, Series 909 as manufactured by Watts, or equal, installed with double check valves on water supply line.

Hose bibs shall be 3/4-inch bronze gate valves with hose outlet male threads conforming to ANSI B2.4. Hose bibs shall be Jenkins Brothers, Figure 372, or equal. NOTE: Do not install
hose bibs on interior walls of control room or generator room.

E. Hose

Hose shall be fifty foot length, industrial quality with single-ply braided reinforcement rated for working pressure of 100 psi, minimum. Hose shall be nominal 3/4-inch inside diameter and shall be fitted with standard 3/4-inch brass threaded hose couplings. An adjustable spray pattern brass nozzle with standard 3/4-inch threads for connection to the hose shall also be furnished.

F. Yard Hydrant

Yard hydrant shall be non-freeze post type with ¾-inch IPS pipe connection and 3/4-inch threaded hose connection. Yard hydrant shall have cast bronze casing, neoprene plunger, removable bronze operating parts, aluminum protective shield, and shall be 30 inches in height above finished grade. The yard hydrant shall be JOSAM Series 71450, Zurn Model Z-1385, or equal, equipped with vacuum breaker and four foot burial depth.

G. Wall Hydrant

Wall hydrants shall be a non-freeze wall hydrant, cast bronze with stain finish Nikalloy face with ¾-inch H.P.T. outlet, backflow preventer, pressure-relief valve and bronze operating parts. The wall hydrant shall be Josam HYDRASAN II 71200 or equal.

H. Mud Valve

1. Mud valves shall be of the iron body, bronze-mounted type with rising stems, flanged ends. Provide an extension stem with 2-inch square operating nut and extension stem support as required.

2. The frame, yoke and disc shall be of cast iron conforming to ASTM A 126 Class B.

3. The stem, stem nut and seats shall be bronze. The stem shall be machined with accurately cut, modified ACME threads.

4. The gate seat shall be rolled into a dovetailed groove under pressure to make one inseparable unit. The body seat ring shall be threaded and screwed into place in the frame. Both gate and body seat ring surfaces shall be machined to a smooth finish.

5. Mud valves shall be manufactured by M&H, Trumbull or equal.

I. Sump Pump

1. Furnish and install submersible sump pumps where shown on the contract drawings.
2. The sump pump shall be driven by a continuous duty, single-phase, 120-volt, 60 Hz motor with Class F insulation and thermal overload protection. The motor shall be provided with thrust and radial bearings to carry all loads which may be imposed upon it under all operating conditions. Furnish with a carbon/ ceramic mechanical seal. The motor shall be UL approved for sump pump application and shall be provided with sufficient cord length to plug into the adjacent 120VAC receptacle. Pump shall pass 3/4-inch solids, deliver 30 gallons per minute against 20 feet head and shall be driven by a 1/2 horsepower motor suitable for the service and available current characteristics and designed for submersible operation.

3. Provide an adjustable, piggy-back mounted, float switch for automatically controlling the pump.

4. Provide sump pumps consisting of gray Class 30, ASTM A-48 cast iron casing and motor housing, heavy duty stainless steel shaft, and cast iron or bronze, non-clog impeller capable of passing up to ½ inch diameter solids. Impeller shall be threaded or keyed and bolted to the shaft.

5. The capacity of the pump shall be 30 GPM at 20 feet of head.

6. The discharge shall be 1-1/2 inch N.P.T. unless otherwise indicated on the drawings. Each sump pump shall have a 1-1/2 inch diameter discharge line with double check valves and isolation ball valve.

7. Sump pumps shall be Goulds, Hydromatic, or equal.

15400.03 EXECUTION

A. Workmanship

1. Copper pipe at solder joints shall be cut squarely and mechanically cleaned. Tube ends shall be reamed. Joint shall be made with a non-corrosive flux and 50-50 solder. No ferrous metal pipe will be permitted.

2. Threaded pipe shall be reamed and pipe compound shall be applied to male thread only.

3. Pipe below ground shall be laid on undisturbed earth and bell holes shall be excavated for piping. Bolts, nuts, etc. on pipe below grade shall be given two coats of non- corrosive bituminous compound.

4. Where pipe passes through walls or floors, provide sleeves and seals as specified in Section 15210. All piping shall be properly supported with compatible non-corrosive hangers.
5. Pipe shall be kept closed and free of dirt during construction.

6. Unions shall be installed at all equipment and valves.

7. Contractor shall determine exact location of utilities and shall check elevations before installing pipe.

8. All cutting of walls, floors, etc., for the passage and accommodation of pipes and all closing up of superfluous openings that may be caused by any work under this Contract, and the removal of all debris caused by said work, shall be performed by the Contractor. No cutting of any walls or floors shall be done until the condition of cutting has been approved by the Engineer.

END OF SECTION
SECTION 15600

HEATING, VENTILATION AND AIR CONDITIONING

15600.01 GENERAL

B. General Requirements

1. Provide all labor, materials, equipment and services necessary for and incidental to the complete installation and operation of all mechanical systems.

2. All work under Section 15600 is subject to the General Conditions and Special Provisions for the entire Contract.

3. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Engineer.

4. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

5. Perform the work in first class, substantial and workmanlike manner.

6. Coordinate the work of all trades.

7. Be responsible for all construction means, methods, techniques, procedures and sequences used in the work. Furnish and use all tools, equipment and materials necessary to properly perform the work.

C. Arrange piping, ductwork, equipment and other work generally as shown on Contract Drawings, providing proper clearances and access. Carefully examine all contract drawings and properly fit work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawing for acceptance. The right is reserved for the Engineer to make reasonable changes in location of equipment, piping, or ductwork up to time of rough-in or fabrication.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Provide all such items as may be required to fit the work to the conditions.

E. Permits and Fees

The contractor shall be solely responsible for acquisition and payment for all required permits and compliance with applicable codes.
F. Examination of Site

The contractor shall examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances.

G. Materials and Equipment

1. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the indicated type and quality.

2. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equivalent, subject to its acceptance.

3. The suitability of the named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than the first named, shall be equal or better in quality and performance to that of the specified items, and must be suitable for available space, required arrangement, and proposed application. Submit any and all data necessary to determine suitability of proposed items.

4. Substitutions will not be permitted for specific items of material or equipment where noted.

H. Fire-Safe Materials

Unless otherwise indicated, materials shall conform to UL, NFPA, or ASTM Standards for fire safety with fire and smoke hazard ratings not exceeding flame spread of 25 and smoke developed of 50. The materials, containers, or shipping cartons shall bear certification that the product complies with these requirements.

I. Referenced Standards, Codes and Specifications

Material, equipment, installation and procedure shall conform to applicable requirements of current referenced standards, codes and specifications.

<table>
<thead>
<tr>
<th>Abbreviations</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMCA</td>
<td>Air Moving and Conditioning Association</td>
</tr>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASHRAE</td>
<td>American Society of Hearing, Refrigerating and Air Conditioning Engineers</td>
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</tbody>
</table>
J. Submittals, Review and Acceptance

The contractor shall make submittals to the Engineer for review in accordance with Section 5.04 of the "General Provisions".

K. Shop Drawings

The contractor shall make submittals to the Engineer for review in accordance with Section 5.04 of the "General Provisions".

L. Supervision and Coordination

1. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors, using full attention and the best skill. Be responsible for all work and make all subcontractors, suppliers, and manufacturers fully aware of all requirements of the Contract.

2. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, ductwork, and all other work specified.

3. Coordinate required electrical work.

M. Cutting and Patching

1. Accomplish all cutting and patching necessary for the installation of work specified. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

2. Do not cut structural members without approval.

N. Penetration of Waterproof Construction

1. Coordinate the work to minimize penetration of waterproof construction, including roofs,
exterior walls, and interior waterproof construction. Where such penetrations are necessary, provide all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

2. Where sleeves are installed in waterproof membrane construction, provide clamping collars and flash membrane to fitting.

O. Electrical Requirements

1. The available electrical service shall be 120/208 volt, 3 phase, 60 Hertz, 4 wire, unless otherwise indicated on the drawings.

2. Control and interlock wiring for the equipment furnished will be provided under Section 16155, unless otherwise indicated in Section 15600 of these specifications.

P. Electric Motors

1. Motors shall be quiet operating, continuous duty high efficiency type suitable for the specific application. Select motors in accordance with nameplate ratings for voltage, horsepower, and ambient temperature. Size motors so that operating loads do not exceed nominal horsepower ratings, exclusive of any service factors.

2. Motors shall conform to applicable NEMA and IEEE Standards.

3. Unless otherwise indicated motors 3/4 horsepower and larger shall be suitable for operation on 208 volt, 3 phase power supply.

4. Unless otherwise indicated motors smaller than 3/4 horsepower shall be suitable for operation on 120 volt, single-phase power supply.

5. Motor enclosures shall be open-drip proof, unless otherwise indicated.

6. Motors shall be constant-speed, 1800 rpm maximum.

Q. Drive Guards

1. Provide safety guards on all exposed motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

2. Fabricate guards of heavy gauge stainless steel or non-metallic, UV protected HDPE machine guards by Uniguard or equal. Provide openings for tachometers.
R. Supports, Hangers and Foundations

1. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure.

2. Supports, hangers, braces, and attachments shall be standard stainless steel, aluminum or FRP manufactured items or fabricated structural shapes.

3. Provide vibration isolators, flexible connections, supports, anchors, and foundations to prevent the transmission of vibration from equipment to the building structure.

S. Provisions for Access

1. Provide adequate access to all equipment, valves, dampers, controls, and other devices requiring maintenance or manual operation.

T. Cleaning, Painting and Finishes

1. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work to the maximum extent feasible. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. See "Painting", Section 09900.

2. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes. See "Painting", Section 09900.

3. Provide factory-applied finishes where specified. Unless otherwise indicated, factory-applied paints shall be baked enamel with proper pretreatment.

4. Protect all finishes and restore damaged finishes to their original conditions. See "Painting", Section 09900.

5. The preceding requirements apply to all work whether exposed or concealed.

6. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces.

U. Protection of Work

1. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

2. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of
water, dirt, debris, or other foreign matter.

3. Cover or otherwise protect all finishes.

V. Operation of Equipment

1. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is operated during construction and protect the equipment.

2. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

3. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Engineer. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guarantees on the work.

4. Upon completion of work, clean and restore all equipment to new condition.

W. Testing, Balancing and Adjustment

1. Perform all required tests to demonstrate that the work is installed and operating properly. Where formal tests are required, give adequate notices and perform preliminary tests to assure that work is complete and ready for final test.

2. Balance and adjust all systems, equipment, and controls to operate at the proper capacities in a safe, efficient and stable manner.

X. Guarantee

1. In addition to and in conjunction with the guarantee requirements specified herein before, provide complete periodic service and maintenance of all work during the guarantee period, without additional cost to the Owner.

2. Service and preventative maintenance shall be performed as scheduled in the equipment manufacturer’s manual and agreed upon in advance by the County. The work shall include necessary cleaning, lubrication, adjustment, repair, replacement, renewal, and preventive maintenance as recommended by the equipment manufacturers or otherwise required by the equipment. Include labor, materials, and services, complete, including belts, air filters, packings, lubricants, and other materials.
Y. Provide complete and prompt emergency service on a 24 hour basis with a minimum four hour response time.

15600.02 MATERIALS

A. Ductwork

Duct systems shall be as follows:

1. Wet Well and Dry Well:
   a. General exhaust and ventilation: Schedule 80 F.R.P., PVC pipe or stainless steel or aluminum duct sheet.
   b. The fabrication and installation of all duct systems together with related equipment shall comply with the standards of the National Fire Protection Association, as set forth in NFPA Standard No. 90A, as well as with the requirements of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and the latest edition of the ASHRAE Guide.
   c. Low pressure aluminum ductwork shall be sheet aluminum conforming to Commercial Designation 3003 Temper H14 and Duct Sheet. Duct gauges, jointing and reinforcement shall conform to Section 1 of the Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Contractors' Association.
   d. All sheet aluminum ductwork shall be erected in a first-class and workmanlike manner, rigidly and permanently secured in place. Suitable hangers shall be provided, securely attached to building construction by means of bolts, clips or inserts. Hangers shall be aluminum structural shapes, flat bars, formed straphangers; the use of wire will not be permitted. Hangers shall not pass through or be inside duct. Where ducts pass through walls, all space around the ducts at such locations shall be gasketed and watertight.
   e. Flexible connections of neoprene NFPA approved non-flammable sheet material shall be provided in the duct system at all fan inlet and outlet connections and where indicated on the Drawings.
   f. Duct turning vanes shall be provided in all rectangular duct turns where the centerline radius is less than 1 1/2 times the width of the duct. Turning vanes shall be the air-foil type with extended trailing edges.
B. Ventilation Blowers

1. Blowers for ventilation of wet wells and dry wells shall be general-purpose nonmetallic fans of the capacities scheduled on the Contract Drawings. Fans shall be tested and rated in accordance with the AMCA Standard Test Code and shall bear the AMCA Certified Rating Seal.

2. Blowers shall be direct drive, arrangement 4 where if available for the blower sizes listed in the schedules on the contract drawings. When belt drives must be provided, bearings shall be constructed of the heavy-duty, self-aligning ball bearing type. A complete weather cover shall protect the shaft, bearings, sheaves, belts and motors and shall be FRP, aluminum or stainless steel attached with stainless steel fasteners.

3. Fan housings shall be FRP construction and UV stabilized. Fan shall be of corrosion resistant polyester resin with flame retardant additives to reduce the flame spread rate below 25 for a Class I flame spread rating. Fan wheels shall be radial vane or backwardly curved design and shall be of fiberglass material. Fan housings shall be provided with a $\frac{1}{2}''$ (min) NPT bottom drain with plug at the lowest point of each housing. Fan wheels shall be dynamically balanced.

4. The support pedestal base shall be constructed of heavy gauge steel and shall have (1) coat primer and (2) coats epoxy. All fasteners and anchors shall be stainless steel.

5. Provide grease-lubricated ball bearings with a minimum L-10 life of 50,000 hours.

6. Provide TEFC motors which will supply the required torque at any point on the blower operating curve without overloading. The motors shall have a 1.15 Service Factor, Class F insulation and Mill and Chemical Duty rating. Motors shall conform to NEMA MG1.

7. Furnish factory supplied rubber vibration mounting and rails. Provide the fans with suitable flexible connections for connecting to ductwork.

8. Fan inlets shall be equipped with removable stainless steel bird screen.

9. Fans shall be controlled as indicated diagrammatical on the contract electrical drawings.

10. PVC or aluminum rain hoods shall be provided on the inlet for the wet well blower.

11. Blower/Fan assemblies specified herein shall be as manufactured by M. K. Plastics of Mooers, New York, Hartzell Fan, Inc. of Piqua, Ohio, Ceilcote Air Pollution Control, or equal.
C. Unit Heaters – Electric

1. Propeller type unit heaters equal, with heating and air delivery capacities and electrical characteristics as indicated on the drawings. Heating coil shall consist of metal sheath fintube electric heating elements. The rust resistant fin tube elements shall be attached to junction box with leak-proof threaded fittings for maximum corrosion resistance.

2. Automatic reset thermal overheat protection shall be wired for instantaneous pilot operation of control contactor.

3. Unit heater motor shall be totally enclosed continuous duty with permanently lubricated ball bearings for long life. Motor shall be resistant to moisture and corrosion, and shall be provided with integral overloads. Each unit shall be equipped with a combination fan guard/motor support resiliently mounted at four points to absorb motor vibration.

4. Unit fans shall be aluminum directly connected to fan motor, dynamically balanced and designed specifically for unit heater application. All metal surfaces of casing shall be phosphate coated to resist corrosion and finished in baked enamel.

5. Heaters shall be controlled by a remote wall-mounted thermostat and as indicated diagrammatically on the Drawings.

6. Heaters shall be capable of operation on voltages indicated on the Drawings, with capacities as scheduled on the Drawings.

7. Unit heaters shall be provided with a NEMA 4X molded fiberglass junction box. Junction box shall house built-in controls which shall include two power contactors (primary and backup), motor contactor and fused transformer for 120V control circuit.

8. Unit shall be provided with a stainless steel swivel-mounting bracket.

9. Unit shall be provided with a built-in overload protection provided by an epoxy sealed automatic and manual (back up) reset thermal cutout.

10. Unit shall be provided with an epoxy sealed thermal fan delay allowing the fan motor to continue to operate after heating thermostat has been satisfied to maximize transfer of generated heat to space being heated and extend operating life of heating element.

11. All hardware shall be stainless steel.

12. Unit shall be provided with adjustable louvered outlet grille to direct air flow up or down. Grille shall be painted with one coat of zinc chromate primer and two coats of corrosion resistant paint.
13. Unit shall be provided with heavy-gage rear wire grille to protect against accidental contact with the fan. Finish shall be the same as the grille.

14. Unit shall be provided with a pilot light to indicate power on.

15. Unit shall be suitable for water contact associated with periodic water wash downs.

16. Heater shall be controlled with integral thermostat.

17. Electric Unit Heaters shall be as manufactured by Chromalox Model HDH, Indeeco TRIAD or Ruffneck CR1 Triton Series washdown and corrosion resistant heaters.

D. Thermostats (Electric)

1. Thermostats shall have fully field adjustable temperature range with mounting box, and standard cover. Unit shall contain no moving parts except integral set point adjustment and shall have a thermistor-sensing element. Units shall have "Marine Finish" suitable for use in corrosive and wet areas. Thermostats shall have key adjustment and limit stops and NEMA 4 enclosures.

2. All thermostats shall be protected by a heavy-duty cast and die formed guard. Guards shall be securely fastened to the building construction independent of the thermostat. Guards fastened directly to the thermostat are not acceptable. Plastic guards are not acceptable. All room thermostats shall be mounted 5 feet 3 inches from the finished floor except where directed otherwise.

3. Where identified on plans, provide a dial timer with preset thermostat such that the thermostat is bypasses for a specified period of time and then resumes standard thermostat setting.

4. Heating thermostats shall have a temperature range of 40 degrees F. to 90 degrees F., Penn TY26, Honeywell, or equal.

5. Ventilating thermostats shall have a temperature range of 60 degrees F. to 90 degrees F., Penn TY26, Honeywell, or equal.

E. Dehumidifier

1. Provide and install dehumidifiers where indicated, Westinghouse ED203D, Dayton, or equal, having a capacity of 20 pints per 24 hours, 115 volts, 60 Hertz, 1 phase with cord and plug, complete with humidistat and discharge pipe or tubing to sump pump pit.
15600.03 EXECUTION

Install as shown on Contract Drawings, in accordance with these Specifications and Manufacturer’s recommendations.

END OF SECTION
SECTION 15990
VIBRATION, TESTING, ADJUSTING AND BALANCING

15990.01 GENERAL

A. Section Includes

Vibration design and installation requirements for rotating equipment.

B. Related Sections

Section 11310 – Sewage Pumps.

C. System Description

Vibration requirements for rotating equipment furnished and installed in these specifications to assure that said rotating equipment will operate within vibration limits specified in Appendix F of these standards.

D. Design Vibration Requirements

1. Provide adequate pipe supports so that equipment will not carry the weight of the piping so as not to stress the machinery casing, put a strain on the shaft and bearings and set up a vibration which is difficult to correct.

2. The machine base of the rotating equipment shall be mounted on the sub-base in a manner that is level in both directions according to the machined surfaces on the base. If sub-base is cast-in-place concrete, coordinate drawings to show details of steel reinforcement. The base is to be supported firmly by hold-down bolts all the way around the base and grouted when necessary.

E. Pump Requirements:

1. Proper sump pit design and suction line design per Hydraulic Institute Standards to avoid pre-rotation, vortexing and cavitation-related vibration problems. As part of this requirement, perform a net positive suction head available analysis (NPSHA) and include this information in the pump specification. The NPSHA shall be calculated for expected design flows and shall exceed the pump manufacturer’s recommendations with a added margin of safety of not less than 2 feet.

2. Avoid applications where centrifugal pumps operate for extended periods of time in an adverse area of their performance curve. Example includes pumps operating at low flows and high head or near shutoff head. If such operation is necessary, pumps with heavy-
duty shafts and bearings are to be specified. Excessive hydraulic radial loads developed in the volute casing and acting on the impeller from operation in adverse hydraulic conditions cause excessive shaft deflection, vibration, rapid bearing and mechanical seal/packing wear and shaft fatigue.

15990.02 MATERIALS

A. Manufacturer’s Vibration Requirements

1. Mounting feet or surfaces of rotating equipment shall be machined.

2. Base Structure: Cast iron or welded steel construction with ribs or bracing to prevent distortion and machine surfaces where equipment is to be mounted. Tolerance shall be +/- 0.002 inches between mounting pads. Base structure shall have mounting holes around perimeter. Center distance between these holes shall not be more than 30 inches.

3. Hollow Bases: Holes sufficiently large in top of base for filling and venting grout, throughout the entire base. If cross-members are provided in the base, provide grout vent holes for each base segment.

B. Dynamic balancing and unbalance vibration of the rotating element (or rotor) shall be as follows:

1. Pump impellers shall be balanced in accordance with ISO 1940/1 – 1986E balance quality grade G2.5. If the manufacturer’s tolerance is more stringent, then that balance quality shall apply.

2. Motor rotors shall be balanced in accordance with NEMA MG-1, Part 7 standards to a Special Balance or Ultra Standard tolerance to give an amplitude of vibration of no more than 0.08 inches per second (peak) unfiltered vibration velocity on the bearing housings. If the motor manufacturer’s tolerances are more stringent, then they shall apply.

C. Shaft Alignment Requirements: On coupled rotating equipment installation where driver and driven units are supplied as a factory mounted unit, shafts shall be aligned in angular and offset positions and within tolerances as specified in this section with all hold-down bolts/nuts tight.

15990.03 EXECUTION

A. Installer’s Vibration Requirements

1. Sub-Base

   a. Sub-base that supports the equipment base and made of concrete shall be reinforced
with steel reinforcements of the proper design as indicated.

b. The sub-base shall be level in both directions. Particular care shall be taken at hold-down bolt locations so that these areas are flat and level.

2. Machine Base

a. Machine bases of rotation equipment shall be mounted on sub-bases in a manner that they are level in both directions according to machined surfaces on base.

b. Leveling of machine bases on sub-bases and alignment of shafts between driver and driven unit shall be accomplished by use of stainless steel blocks and stainless steel precision cut and shims.

c. Blocks and shims shall be generously sized to provide solid support at each anchor bolt location.

d. Provide blocks and shims at each anchor bolt. Blocks and shims shall be square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.

3. Piping/flange alignment at machinery casing connections shall meet the following standards in order to minimize piping strain on the equipment:

a. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted.

b. Mating flange faces shall be parallel to within the tolerance of no greater than one half the gasket thickness unbolted or 1/8", whichever is less.

c. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted, or relaxed expansion joint length unbolted; nor less than the relaxed expansion joint length by more than 1/16".

4. Machinery Shaft Alignment: All rotating motor-driven equipment shafts with couplings shall be aligned as installed on-site using a computer-aided optical laser. The transducer system, which houses the Class 1 laser diode and a position detector, and the prism shall be installed on the respective shafts, then adjusted such that the laser beam is reflected back into the position detector. As the shafts are rotated through 180 degrees, any parallel offset or angularity shall deflect the reflected beam from its original point of incidence in the position detector. The position detector measurements shall automatically enter the computer, which shall calculate misalignment from the beam deflection, and then display shaft misalignment at the coupling and corrective measures to the nearest 0.0005 inches at the machine feet.
a. Preliminary and final alignments shall be performed. Preliminary alignment shall occur before grouting of the base, connection the piping and cabling connections are performed. During preliminary alignment, soft foot function shall measure machine feet sitting unevenly on the foundation and determine the necessary corrections. Measurement of the amounts and directions of misalignment, calculations of corrective moves, and initial alignment shall be performed.

b. Following the completion of all connections and grouting, the final alignment shall be performed.

c. The computer shall automatically calculate alignment specifications into the corrections such that when thermal growth is present, the machines will be positioned to grow into optimum alignment at operating temperatures. All data collected will be permanently recorded in a report and included in the final O&M manual for the equipment.

d. Shims used to adjust alignment shall be factory precut stainless steel sized for the appropriate motor horsepower.

e. Accuracy of the optical laser alignment system shall be traceable to the National Institute of Standards and Technology. Allowable equipment tolerances are as set forth elsewhere in this Section.

f. Coupling manufacturer alignment tolerances shall not be used for shaft alignment tolerances. The tolerances specified herein shall apply to both vertical and horizontal alignments measured at or calculated to the coupling centerline. In cases where the equipment manufacturer requires more stringent shaft alignment standards, the manufacturer's standards shall apply.

g. If the equipment comes as a factory mounted/aligned unit the shaft alignment shall be rechecked as installed on site and any misalignment corrected in accordance with these specifications and tolerance herein.

5. Prior to final shaft alignment, the following criteria must be met:

a. Machinery foundation must be installed as designed with the base parallel with respect to the machine's shaft on horizontally mounted machines.

b. Machinery must be free of piping strain. To check for piping strain, piping flanges should be loosened up separately with flange movement observed continuously. Should movement exceed 1/8- inch, piping strain is considered excessive and shall be corrected by adding or adjusting pipe supports, hangers, expansion joints, etc., per requirements of this Specification.
c. Machinery must be resting firmly on the mounting bases with equal loading on each support.

d. Horizontally mounted machinery (coupled) over 125 horsepower shall be provided with fine-thread jackbolts for horizontal alignment adjustments. Machine foothold down bolts shall be loosened before horizontal position adjustments are made with the jackbolts.

e. Machinery supports and baseplate pads shall be free of burrs, rust, scale and other obstructions.

f. Stainless steel pre-cut shims shall be used to provide a firm, solid, adjustable link between machine and baseplate.

g. Machinery must be free of soft foot. To check for soft foot, the machinery must be firmly bolted to the baseplate. Each support foot is checked with the dial indicator and/or feeler gauges, loosening hold-down bolts one at a time. If movement exceeds 0.002 inches, soft foot is indicated. Shim and torque uniformly to minimize soft foot.

h. All jackbolts shall be backed-off (1) turn after the alignment procedure is complete.

B. Shaft Alignment Tolerances

Alignment Tolerances (in inches)

<table>
<thead>
<tr>
<th>RPM</th>
<th>Offset</th>
<th>(Inches per Inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-1000</td>
<td>+/- 0.0040</td>
<td>+/- 0.001000</td>
</tr>
<tr>
<td>1001-2000</td>
<td>+/- 0.0030</td>
<td>+/- 0.000500</td>
</tr>
</tbody>
</table>

C. After erection the contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibration, overheating, or signs of distress at specified capacity. The engineer shall be notified in advance of all tests, and all tests shall be conducted to his entire satisfaction. All tests shall be made by the manufacturers’ representative and the results recorded and submitted to the County. Vibration testing and acceptance shall be done in accordance with the Performance Testing in Appendix D of these design standards.

D. Manufacturer's certificates that the installation of the equipment is in accordance with the manufacturer's recommendations shall be secured by the contractor and submitted to the engineer.
E. Certification that the equipment shafts are aligned to the alignment tolerances specified.

F. Certification that equipment rotors have been dynamically balanced within the tolerances specified.

END OF SECTION
SECTION 15991

HVAC SYSTEM ADJUSTING AND BALANCING

15991.01 GENERAL

A. Description

This Section includes requirements for adjusting and balancing of ventilation systems.

B. Quality Assurance

1. Equipment furnished under this Section shall be furnished by manufacturers who meet the quality, workmanship, and experience requirements as specified in the General Provisions Section of this Contract.

2. Adjusting and Balancing Agency's Qualifications: Firm certified by National Environmental Balancing Bureau (NEBB) in those disciplines similar to those required for this project. Firm shall not be the installer of the system being adjusted and balanced and shall otherwise be independent of the project. Firm shall be a member in good standing with NEBB for a minimum of five (5) years.

3. Comply with recommended procedures for examination, preparation, and performance of adjusting and balancing, as outlined in the referenced NEBB standard, for mechanical air and liquid distribution systems and their associated equipment.

4. Comply with ASHRAE recommendations pertaining to measurements, instruments, and adjusting and balancing; except as otherwise indicated.

C. Submittals

1. Submittals shall be developed and submitted in accordance with the requirements of the General Provisions and shall include, but not be limited to, the following:

   a. Submit name of the adjusting and balancing (AB) agency for approval within 30 days after award of Contract. Submittal shall also include certification by the adjusting and balancing agency-affirming membership in good standing with NEBB or AABC for the time frame specified herein.

   b. Adjusting and Balancing Reports

      i. Submit report(s) on NEBB or AABC forms. Submit draft copies of report for review prior to performance of adjusting and balancing Work. Include adjusting and balancing instrument calibration history with draft report.
ii Submit certified adjusting and balancing reports bearing the seal and signature of the Adjusting and Balancing Engineer. The reports shall be certified proof that the systems have been adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the adjusting and balancing procedures; and are an accurate record of final quantities measured to establish the normal operating values of the system.

iii Provide reports in soft cover, letter size, 3-ring binder, complete with index page and indexing tabs, with cover identification on front and spine. Include system schematic drawings and/or reduced drawings with air outlets and inlets, balancing dampers and fittings, and equipment identified to correspond with report forms. Include calibration histories of test instruments used.

iv Report shall be divided by system type and subdivided within each type by individual systems (e.g., Exhaust Air System, Air Handling Unit Distribution System, etc.).

2. Submit detailed procedures, agenda, sample report forms indicating all adjusting, balancing and equipment data required, system schematics, and samples of patching plugs, stamped brass tags, and caulking sealant for approval prior to commencing system(s) balance.

3. Submit detailed drawings for non-ducted equipment balancing, including temporary ductwork size and details of temporary ductwork support, connection to equipment, as well as repair to equipment at the point of connection.

D. Sequencing and Scheduling

1. Sequence Work to commence after completion of system installation and before conditional acceptance of project.

2. Provide written notification to the Engineer a minimum of five (5) working days prior to the performance of adjusting and balancing Work. Perform adjusting and balancing work in the presence of the Owner's designated Representative.

E. Warranty

1. Adjusting and balancing results shall be warranted to maintain setting and adjustment and to perform as stated in the test report for 90 days from the date of final adjustments.

2. Balancing Contractor shall be subject to recall to the site to verify results before approval of balancing test report.
15991.02 MATERIALS

A. Qualifications

Adjusting and balancing shall be performed by a company specializing in the adjusting and balancing of heating, ventilating and air conditioning systems specified in this Section having a minimum of five (5) years’ experience and shall be certified by AABC or NEBB. The adjusting and balancing contractor shall not be the installer of the system and shall otherwise be independent of the project. Individuals qualified for that work by the AABC or the NEBB shall perform system balancing. Proof of such qualifications, outlines of proposed balancing procedures, and data sheets for the specific instrument to be used, listing their most recent calibration dates shall be submitted for approval. The balancing procedures used shall meet the recommendations of the ASHRAE as published in the 2011 ASHRAE Handbook-HVAC Applications under the chapter headed Testing, Adjusting and Balancing, and shall be witnessed by the Engineer.

B. Detailed Material Requirements

1. Adjusting and balancing instruments and equipment

   a. Adjusting and balancing instruments and equipment used shall be selected to provide the precision stated in this specification and capacity requirement as indicated on the Contract Drawings for the system(s) being tested. Selection shall follow the guidelines on NEBB; preference shall be given to instruments, which are required for NEBB certification.

   b. Adjusting and balancing instruments and equipment used shall be company owned and remain the property of the company. Use adjusting and balancing instruments that are in first class operating condition with individual calibration histories to guarantee accuracy. Include instrument calibration histories in the test report.

2. Patching Materials

   a. Circular Plastic Plug: With retainer, size to fit tightly into drilled hole.

   b. Sheet Metal: Material and gage shall match ductwork or housing, cut to allow minimum of one inch lap all around.

   c. Caulking Sealant: Silicone rubber; Dow Corning "732" or equal.

15991.03 EXECUTION
A. General

1. Adjusting and balancing Work shall follow recommended procedures for examination, preparation, and performance of adjusting and balancing, as outlined in the referenced NEBB standard.

2. Prior to commencing any final adjusting or balancing Work, the Contractor shall verify that ductwork and accessories for each system has been completely installed and is ready for operation. Contractor shall verify the following:
   a. Electrical service has been installed to motors and controls.
   b. Motor overloads have been installed.
   c. Fans have been inspected for correct rotation.
   d. Access doors, test holes and duct drains have been closed and plugged.
   e. Mating flanges shall be within 1/16” tolerance unbolted.
   f. Flange face separation shall be no greater than 1/16” beyond normal gasket thickness.

B. The Contractor shall notify the Engineer five (5) full working days prior to beginning adjusting and balancing.

C. After adjusting and balancing is complete the Contractor shall leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical boxes and panels, and restoring thermostats to specified settings.

D. Where HVAC equipment is non-ducted, the Contractor shall provide temporary ductwork as required in order to measure airflow and static pressure. Temporary ductwork shall be removed after airflow measurement and balancing is complete.

E. Examination

1. Examine installed Work and conditions under which adjusting and balancing is to be done to ensure that work has been completed, cleaned, and is operable.

2. Report any defects or deficiencies noted during examination to Engineer. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

F. Installation Tolerances

1. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or
minus 10 percent for return and exhaust systems from scheduled values.

G. Air System Procedures

1. Adjust air handling and distribution system to provide required or design supply, return, and exhaust air quantities as identified herein.

2. Sound pressure level measurements shall be taken at each fan location. Measurements shall be taken at distances of five feet, ten feet, and twenty feet from the fan with the fan operating, and with the fan not operating. Measurements shall be taken at four separate points at each distance. Measurements shall be taken on each side of the wall of a wall-mounted fan, and on the interior and exterior of the roof for the up-blast fan. Measurements shall be taken in the presence of the Engineer.

H. Report Preparation

1. Prepare report of test results, including instrumentation calibration histories, in format recommended by referenced NEBB standard.

2. Submit draft of report for approval.

I. Final Compliance Procedures

1. The following items of the Work are to be carried out only after acceptance of the adjusting and balancing report.
   
a. Final Inspection
   
i. Recheck random selections of data recorded in report. Take measurements to verify balance has not been disrupted or that such disruption has been rectified.

   ii. Verify that systems are in proper working order, belt guards have been replaced, access doors have been closed, doors to electrical boxes and panels have been closed, and thermostats have been restored to specified settings.

b. Marking of System Settings

   i. Mark equipment and control device settings to show final settings at completion of adjusting and balancing Work.

   ii. After final check of the systems has been performed, the Contractor shall provide stamped brass tags at each volume control damper and fan indicating the following information:
a. Flow (CFM).

b. Velocity (FPM).

c. Date readings were taken.

c. Patching

i Patch holes drilled in ductwork and equipment housings for adjusting and balancing purposes using plastic plugs with retainers.

ii Patch non-circular and larger holes using sheet metal of like material and gage. Secure patch to duct or housing using aluminum or stainless steel pop rivets. Seal patch using silicone rubber caulking. Degrease, prepare, and prime paint patch.

END OF SECTION
SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

16010.01 GENERAL

A. Description

1. This section includes materials, installation, and testing of the electrical system.

2. All work under this section is subject to the General Conditions and Special Provisions for the entire Contract.

3. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawings for acceptance.

B. Regulatory Agencies and Standards

1. Regulatory Agencies: Installations, materials, equipment, and workmanship shall conform to the provisions of the following agencies and codes:


   b. Occupational Safety and Health Act (OSHA).

   c. Local authorities having lawful jurisdiction pertaining to the work required.

   d. NFPA 820-2012 or latest version thereof.

   e. Underwriter’s Laboratories, Inc. (UL): Materials, appliances, equipment, and devices shall conform to the applicable UL standards. The label of, or listing by, UL is required wherever applicable.

2. Standards: Where referenced in these specifications or on the drawings, the publications and standards of the following organizations apply:


   b. National Electrical Manufacturers Association (NEMA).


e. Institute of Electrical and Electronics Engineers (IEEE).

f. Insulated Cable Engineers Association (ICEA).

C. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit operation and maintenance data for all items in accordance with the General Provision 5.04.08.

3. As-built drawings shall be in accordance with Section 5.04.7 of the “General Provisions”.

**16010.02 MATERIALS**

A. Materials

1. General

   a. Similar materials and equipment shall be the product of a single manufacturer.

   b. Provide only the products which are new, undamaged, and in the original cartons or containers.

   c. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer’s current design.

   d. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish the named item or equivalent thereof, subject to acceptance by the Engineer.

   e. Substituted items or items other than those named shall be equal or better in quality and performance and must be suitable for the available space, required arrangement and application. Submit any and all data and samples necessary to determine the suitability of substituted items. Data and samples shall be as required by the engineer.

   f. Substitution will not be permitted for specific items of material/equipment where specifically indicated.

   g. Materials and equipment shall be suitable for storage, installation, and operation in an ambient of 0°C to 40°C except where more stringent conditions are stated in individual equipment specifications.
h. Electrical equipment and panels shall be factory finished with manufacturer’s standard primer and enamel topcoats, unless stated otherwise in the individual equipment specifications. Provide 1 pint of the equipment manufacturer’s touchup paint per 500 square feet of painted surface for repair of damaged enamel topcoats.

i. Provide all supports, hangers, braces, attachments and foundations required for the work. Supports, hangers, braces and attachments shall be standard manufactured items of fiberglass-reinforced plastic (FRP) or stainless steel shapes and assemblies, ensuring no-rust construction.

j. Concrete equipment pads and foundations shall be not less than 4 inches high unless otherwise noted, and in general shall extend at least 4-inches beyond the equipment base unless otherwise noted. Provide wire-mesh reinforcement, chamfer exposed edges and corners and finish all exposed surfaces smooth. Concrete shall be minimum 3,000 psi test at 28 days.

k. All electrical panels, boxes, transformers, etc. which are wall-mounted both interior and exterior shall be installed on racks mounted on the walls to provide an air space behind the equipment. The rack shall consist of Kindorf channel, maximum ¾-inch depth or equal. Kindorf channel shall be FRP Aikenstrut or equal. All electrical equipment mounted on railings or similar structures shall be complete with framework backboards to provide air space behind. The framework shall be securely fastened to the railing or structure with corrosion resistance hardware. All supports in damp or corrosive areas shall be PVC coated. Typical mounting methods shall be approved by the Engineer prior to installation.

l. All conduit penetration through floor slabs or other fire rated walls shall be complete with fire seals as manufactured by O.Z. Gedney “FIRE-STOP” or equal. U.L. approved silicone foam system shall be acceptable where approved by the Engineer.

m. Indicator lights for VFD’s, motor starters, control panels, and other enclosures shall be as specified in other sections and where shown in the drawings. Unless otherwise shown, indicator light colors shall follow the standards below:

Power Available – WHITE

Run/ Start/ Unsafe – RED

Off/ Stop/Safe – GREEN

Failure/Alarm/Trip – AMBER

2. Hazardous Locations
a. Conform with NEC Articles 501 and 502 for areas identified as “Hazardous Areas” on the drawings. All areas shall be classified based on NFPA 820-2012 or the latest version thereof.

b. Provide threaded cast boxes and fitting for junction boxes and pull boxes in Class I and Class II areas. Boxes and fittings shall conform with Class I, Groups A, B, C, and D and Class II, Groups E, F, and G requirements.

c. Fixture hangars for pendant mounted fixtures shall conform with Class I, Division I and Class II, Division I requirements.

d. Provide conduit seals in Class I, Division I location within 18-inches of each conduit entering an enclosure containing electrical devices except for hermetically sealed switches and receptacles. Provide a conduit seal for each conduit leaving the hazardous location.

e. Flexible connections to motors and other vibrating equipment in Class I, Division I locations shall be made with flexible fittings approved for Class I locations.

3. Cabinets for Pump Station Electrical Equipment

a. In general, cabinets for electrical equipment shall be NEMA Type 1 for indoor applications and NEMA Type 4X, stainless steel for outdoor applications, unless otherwise noted in the specifications or on the drawings.

16010.03 EXECUTION

A. Storage and Protection of Equipment

1. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

2. Convenient electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.
3. VFD’s, motor controllers, control panels, panelboards, breakers, lighting, and supervisory equipment, when delivered to the construction site shall be warehoused and protected.

4. All equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover.

5. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and, in addition, shall be provided with auxiliary heat to prevent damage caused by condensation. The gear shall also be protected against damage caused by installation of any building systems and equipment; or damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

6. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

7. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

8. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

B. Installation

1. The drawings indicate connections for typical equipment only. If the equipment furnished is different from what is shown, provide the modifications necessary for a safe and properly operating installation in accordance with the equipment manufacturer's recommendations.

2. The drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. Field inspection shall determine exact locations based on physical size and arrangement of equipment, finished elevations, and obstructions.

3. Work or equipment not indicated or specified which is necessary for the complete and proper operation of the electrical systems shall be accomplished without additional cost to the County.

4. Review demolition methods with County's Representative prior to cutting or removing
existing architectural and/or structural items or equipment. Repair damage to match existing, and maintain the fire rating of the existing items affected by the work.

5. The Contractor shall do all excavating and backfilling necessary to install underground electrical work included in this section of the work. He shall establish all lines and grades required for the proper location of the work and shall be responsible for the correctness thereof. Excavation and back fill shall be performed in accordance with the requirements specified in other sections of these specifications.

6. The Contractor shall carefully coordinate the installation of all subterranean electrical work with other utility systems both new and existing. Locations of pole bases, manholes, handholes and duct banks are shown as approximate. All such items shall be staked and utility crossings identified prior to installation. The actual staked layout shall be reviewed with the Engineer prior to the installation.

7. Arrange conduit, wiring, equipment, and other work generally as shown providing proper clearances and access.

8. The following mounting heights of the various electrical outlets and devices are to bottom of box or nearest course-line in masonry wall.

   a. Switches 4' - 0" AFF
   b. Receptacle 1' - 6" AFF (unless otherwise noted)
   c. Disconnect Switches 4' - 6" AFF (unless otherwise noted)

9. In general, the mounting heights listed above are applicable; however, field conditions may dictate changes. Where these special conditions occur, final mounting height shall be brought to the attention of the Engineer and his decision shall be given.

10. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction. Where such penetrations are necessary, provide all necessary curbs, sleeves, shields, flashings, fittings and caulking to make the penetrations absolutely watertight.

11. Provide all cutting and patching necessary for the installation of the electrical work. Any damage done to the work already in place by reason of this work shall be repaired at the Contractor's expense by a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

12. Do not cut structural members without approval by Structural Engineer.
13. Clean all surfaces prior to application of adhesives, coatings, paint, or other finishes.

14. Protect all finishes and restore any damaged finishes to their original condition.

15. Remove all construction markings and writing from exposed equipment, conduit and building surfaces.

C. Operation of Equipment

1. Adjust and test all equipment and systems in accordance with the manufacturer's instructions prior to initial operation. Do not operate equipment unless proper safety devices and controls are operational. Provide all maintenance and service for equipment which is operated during construction and protect the equipment.

2. Where specified or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start-up the equipment.

D. Testing and Adjustment

1. The Contractor shall note that certain of the other sections and Appendices of these specifications require tests of various equipment. He shall make himself familiar with these requirements and where electrical controls are involved in any of these tests, he shall become a party to the test and furnish, as part of this contract, any services or materials needed to make any electrical performance tests required.

2. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

3. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

4. Provide circuits that are free from ground faults, short circuits and open circuits.

5. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

6. All loads shall be balanced evenly across phases. Balances shall be accomplished with an ammeter and all loads energized.

E. Identification and Signs

1. Mark each individual panelboard, VFD, motor controller, disconnect switch, timer, relay, and contactor to identify each item with its respective service or function. Provide
nameplates with engraved lettering not less the 1/4-inch high. Use black-on-white laminated plastic, attached with rivets or stainless steel sheet metal screws. Do not use embossed plastic adhesive tape.

2. Panelboard indices shall be completed and accurately typed with appropriate circuit identification. Identification by means of marking pens, embossed plastic tape markers or other temporary methods will not be acceptable.

3. All circuits in handholes and junction boxes shall be identified as to point of origin and termination. Tagging of such circuits shall be permanent. Paper or tape tags are not acceptable.

F. Infrared Survey/Testing

1. General
   a. Conduct an infrared survey of major electrical and rotating equipment in accordance with these Specifications and Appendices. Readings shall be done with the equipment operating under loaded conditions. Motor starters shall be loaded at the full load ampere rating of the motor. All other equipment, unless indicated otherwise, shall be loaded at 80% of the overcurrent protective device rating ahead of the equipment. All equipment shall be loaded for a minimum of 30 minutes before scanning. A Load Bank, provided by the Contractor, shall be used when the connected equipment cannot provide the required load.

2. Equipment to be Tested
   b. Bus Bars, Bus Splices, Bus Connectors.
   c. Main Breakers.
   d. Motor Connections at Motor.
   e. Lighting Panels, Transformers and other ancillary equipment (under normal station load).
   f. Connections at Generator and Automatic Transfer Switch.

3. Infrared Scanning of Electrical Equipment
   a. Visual Inspection
i Inspect for physical, electrical and mechanical condition and bus alignment.

b. Infrared Inspection

i Perform a qualitative (Level I) infrared inspection on the equipment listed in Section 2 above. The infrared-scanning device used shall meet the requirements contained in Part d below.

ii Provide a report indicating the following.

a. Location, equipment, date.

b. Problem area (location of “hot spot”).

c. Indicate temperature of “hot spot” and ambient temperature.

d. Indicate cause of heat rise, if known.

e. Indicate phase unbalance, if present.

f. List of areas scanned.

c. Test parameters

i Infrared scanning equipment shall detect 1 degree C rise between subject area and reference at 30 degrees C.

ii Equipment shall detect emitted radiation and convert detected radiation to visual signal.

iii Both identifying photographs and thermographic photos shall be provided of the deficient areas. The thermographic photos shall be as seen on the imaging system. The thermographs and identifying photos shall be contained in the report to provide a baseline inventory of the electrical system immediately preceding conditional acceptance.

d. Test Results/Tolerances

i Operating temperature shall not exceed the manufacturers or listing agency’s rating for the equipment or attached conductors. The following temperature tolerances are for equipment temperature ratings of 75 degrees C or above.

• The following tolerances are applied to temperature gradients/differences between phases on balanced three phase loads:
b. Temperature gradients between phases of 5 degrees C to 10 degrees C: Contractor to correct problem.

c. Temperature gradients between phases of 11 degrees C and above: Contractor to correct problem.

ii The following absolute temperature tolerances are applied to all components:

a. Temperature of 70 degrees C or more: Contractor to correct problem.

b. Temperature of 60 degrees C to 70 degrees C: Contractor to correct problem.

c. Temperature of 50 degrees C to 60 degrees C: Contractor to correct problem.

4. Training and Instruction Period

The Contractor shall note that certain of the other sections of these specifications require training on various equipment and systems. He shall make himself familiar with these requirements and where electrical controls are involved, he shall furnish, as part of this contract, any services or materials needed to provide the training required.

END OF SECTION
SECTION 16051
MISCELLANEOUS ELECTRICAL DEVICES

16051.01 GENERAL

A. Description

This section includes materials and installation of miscellaneous electrical devices and equipment, such as disconnect switches, and limit switches.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit ratings and characteristics including voltage ratings, continuous current ratings, conduit entry restrictions, and enclosure type and dimensions.

16051.02 MATERIALS

A. Materials

1. Disconnect Switches

Provide non-fusible or fusible disconnect switches with ampere rating and number of poles as indicated in the drawings. Switches shall be NEMA heavy-duty Type HD. Provide switches in NEMA Type 4X stainless steel enclosures, unless otherwise noted. Switches installed within the Pump Station building shall be NEMA Type 1 enclosures. Mechanisms shall have quick-make and quick-break operating handles and provisions for padlocking in the “OFF” position. The switch shall have an interlock to prevent unauthorized opening of the hinged cover when the switch is in the “ON” position and an interlock to prevent closing the switch mechanism with the hinged cover open. Fusible switches shall be equipped with rejection feature. Switch contacts shall be silver or tinned plated. On the front of the enclosure, attach a nameplate that identifies the load per Section 16010. Disconnect switches shall be Square D, or equal.

2. Limit Switches

a. Provide heavy-duty, precision turret head type limit switches with one normally open and one normally closed contact along with an adjustable lever arm with oil-impregnated sintered iron roller.

b. The switches shall be interfaced with the RTU, or as shown on the drawings. For door switches, mount switch on inside doorframe such that when opened, the normally
open switch contacts shall close and, when closed, the normally open switch contacts shall open.

c. Provide a Square D, Class 9006, Type C switch or equal.

d. For switches in hazardous locations provide intrinsically safe relays, and switches rated for the installation.

B. Emergency Stop/Personnel Alarm Pushbuttons

Provide maintained, mushroom style E-stop switches and Personnel emergency pushbuttons where shown on the contract drawings. Switches shall be 2-position, non-illuminated, maintained pull/maintained push. Pushbuttons shall be heavy-duty, corrosion resistant NEMA 4X with red mushroom head. Switches located in classified areas shall be rated accordingly. Switches shall be Square-D Class 9001 Type K, or equal.

16051.03 EXECUTION

A. Execution

1. Disconnecting Switches

   a. Provide standoff brackets providing a minimum of 1-1/2-inch air space between the switch and the mounting surface. Provide 304 stainless steel brackets and concrete anchors in non-air-conditioned rooms and in exterior locations.

2. Limit Switches

   a. Mount the limit switches as shown on the Drawings, and as recommended by the Manufacturer.

   b. Provide and install all wire and conduit for installation.

3. Preliminary Inspection/Test

   a. Operate each disconnect switch three times, under load, and verify that all phases of the load are disconnected each time.

   b. Operate each device contacting limit switch to verify limit switch contacts are energized for accurate response to the motion.

   c. Operate each emergency pushbutton switch three times, under load, and verify that equipment is de-energized and/or alarms are properly generated each time.
4. Conditional Acceptance Inspection/Test

   a. Repeat Preliminary Inspection/Test as directed by the County and/or the Owner’s Representative.

END OF SECTION
SECTION 16060

ELECTRICAL DEMOLITION

16060.01 GENERAL

A. Section Includes

1. Electrical demolition.
2. Salvaged equipment.
3. Relocated equipment.
4. Equipment and wiring abandoned-in-place.

B. Work Involved

1. Safely disconnect from service, demolish, remove, and dispose of, the existing equipment/devices/materials and similar items as indicated in the Contract Documents and/or as may be necessary for the proper completion of the work.

2. Safely disconnect from service, remove, and salvage the selected existing equipment/devices/materials and similar items as indicated in the Contract Documents and/or as directed by the Owner.

3. Safely disconnect from service, remove, store on-site, and relocate the existing equipment/devices/materials and similar items as indicated in the Contract Documents and/or as may be necessary for the proper completion of the work.

4. Safely disconnect from service and appropriately tag the existing equipment/devices/materials and similar items to be abandoned-in-place as indicated in the Contract Documents and/or as may be necessary for the proper completion of the work.

5. Repair or replace all damage caused by the demolition, removal, salvage, and/or relocation work.

6. Prior to the commencement of demolition, removal, salvage, and/or relocation work, the Contractor shall compile a list of equipment and material to be demolished and removed, salvaged, and/or relocated and shall deliver this list to the Owner for acceptance. All demolished equipment and material shall become the property of the Contractor and shall be removed and properly disposed of. All salvaged equipment or material shall be removed and then delivered by the Contractor to the Owner. Items shall be delivered in
the same condition as when removed and shall be unloaded and placed as directed by the Owner. The Contractor shall prepare a receipt and obtain the Owner's signature on same for all salvaged equipment or material. All relocated equipment and material shall be safely removed, protected from damage, stored and reinstalled complete and in proper operating order.

C. Quality Assurance

1. All demolition, salvage, and abandonment work shall be done in strict compliance with the requirements of the National Electrical Code.

2. All relocation work shall be done in strict compliance with the requirements of the National Electrical Code and in accordance with the instructions/recommendations of the equipment manufacturers.

3. The Contractor may refer to existing drawings for general information only. The information on these drawings shall not relieve the Contractor of any responsibilities under the contract, or the obligation to visit the site and ascertain the existing conditions affecting the work during the bidding process.

D. Project Conditions

1. The Contractor shall verify field conditions and circuiting arrangements are as shown on drawings.

2. Verify that wiring and equipment indicated for demolition, salvage, or relocation serve only those facilities included in the scope of work.

3. Demolition work shown on drawings is based on casual field observations and existing documents. Report discrepancies to the Owner before disturbing existing installations.

4. It shall be the responsibility of the Contractor to obtain or verify the existing circuit numbers/circuiting for all of the existing equipment/devices that shall be demolished and/or relocated prior to commencing work on these items. The Contractor shall also be responsible for safely remove from service and/or relocating/reinstalling all existing equipment/devices/materials and similar items indicated on the drawings and/or as may be necessary for the proper completion of the work.

5. Commencement of demolition/salvage/relocation work shall mean that the Contractor accepts the existing conditions.

16060.02 MATERIALS
A. Materials and Equipment

1. In general, all demolished equipment/devices/materials shall become the property of the Contractor and shall be removed from the site.

2. All materials and equipment for repairs, patching, or replacement, shall be new and free of defects.

3. All materials and equipment used for relocation and reinstallation of existing equipment shall be new and free of defects.

16060.03 EXECUTION

A. Preparation

1. Safely disconnect electrical systems in areas of demolition/relocation work.

2. Provide temporary demolition and/or connections to maintain any Owner selected existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3. Existing Electrical Systems and Equipment: Obtain permission from the Owner and all other concerned parties at least five (5) working days before completely disabling systems. Make temporary connections to maintain service in any Owner selected areas adjacent to work area.

4. Existing Pump Systems and Equipment: Obtain permission from the Owner and all other concerned parties at least five (5) working days before completely disabling systems. Make temporary connections to maintain service in any Owner selected areas adjacent to work area.

B. Demolition - General

1. Remove and/or relocate existing installations to accommodate new construction.

2. Disconnect and remove items as indicated on the drawings and/or as specified and/or as required for proper completion of the work.

3. Repair adjacent construction and finishes damaged during demolition work.

4. Maintain access to existing electrical installations which remain active.

5. Remove wiring to source of supply.

6. Cut unused concrete embedded conduit flush with surface and fill/patch with grout.
C. Demolition of Existing Electrical Equipment

1. Safely de-energize and disconnect all electrical power and control wiring to Equipment (at both source and usage locations) prior to its decommissioning, relocation, and/or demolition.

2. Label any/all decommissioned equipment wiring with a “white” tag indicating its feeder/circuit number, phase indication, and/or control terminal number prior to disconnection.

3. Tag all decommissioned equipment wiring with “yellow” warning labels, “Decommissioned Wiring – Do Not Reconnect, Without Permission of the County DPW”.

4. Without intending to limit or restrict the types or quantity of demolished equipment and solely for the convenience of the Contractor, the demolished items shall include, but shall not be limited to, the following:
   
   a. All electrical equipment and wiring indicated on the drawings.

D. Salvaged Equipment

1. Without intending to limit or restrict the types or quantity of salvaged equipment and solely for the convenience of the Contractor, the salvaged items shall include the following:
   
   a. Selected electrical distribution equipment.

   b. Selected lighting fixtures.

2. The Owner has not determined a specific list of electrical equipment/items to be salvaged. However, the Owner reserves the right to make a selection of any/all items at the time the Contractor furnishes the demolition items list. Any/all salvaged equipment/items will be delivered to the Owner at a designated place.

E. Repairs and Replacement

1. Existing surfaces remaining after removals shall be left in a condition suitable for the application of the new work. Where removals leave holes and/or damaged surfaces that will be exposed in the finished work, these holes and/or damaged surfaces shall be patched and repaired.

2. All repair and/or replacement work shall be performed in a neat and workmanlike manner by craftsmen skilled in the trades involved and shall be accomplished in accordance with the best practice of the trade.

F. Cleaning
1. Clean all existing electrical materials and equipment which remain or are reused.

END OF SECTION
SECTION 16110

RACEWAYS, BOXES AND FITTINGS

16110.01 GENERAL

A. Description

This section describes materials and installation of raceway systems, whether concealed or exposed, above or below grade. Minimum size conduit shall be ¾”.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for all conduits, fittings, boxes, conduit bodies, mounting hardware, and related accessories.

3. Submit conduit layout for each building, facility, vault, and for the site.

16110.02 MATERIALS

A. Rigid Steel Conduit and Fittings

1. Use rigid, thick wall, hot-dipped galvanized inside and out, with galvanized threads conforming to ANSI C80.1 and UL-6. Do not use electro-galvanizing.

2. Use insulated metallic bushings. Sizes 1 inch and smaller may be non-metallic type.

3. Use hot-dipped galvanized threaded fittings which are compatible with the conduit.

4. Use cast aluminum or hot-dipped galvanized cast-iron conduit bodies, equipped with threaded covers or gasketed sheet metal covers secured with at least two captive screws.

B. Rigid Non-Metallic Conduit and Fittings

Polyvinyl chloride (PVC) Schedule 40, 90 C rise rating. Conduit shall conform to NEMA TC-2 and UL-651.

C. PVC-Coated Conduit and Fittings

PVC-coated conduit and fittings shall be rigid steel with a .040-inch-minimum thickness of exterior PVC coating. Conduit shall have minimum 2-mil urethane coating on interior. Conduit and fittings shall be UL listed and shall conform to ANSI C80.1 and to UL-6.
Conduit and fittings shall be PermeCote Supreme or equivalent product of Occidental, or Robroy.

D. Liquid-Tight Flexible Conduit and Connectors

1. Use single strip steel, hot-dipped galvanized on all four sides prior to conduit fabrication. Conduit shall have overall PVC plastic jacket. Conduit sizes 1-1/4 inches and smaller shall include an integral copper bonding conductor wound spirally in the space between each convolution on the inside of the conduit. Conform to UL-360.

2. Use compression type bushings with steel or malleable iron body and insulated throat and sealing O-ring.

3. All fittings shall be PVC coated.

E. Outlet, Junction and Pull Boxes

1. Provide boxes for installation of electrical work, in compliance with codes and regulations.

2. Provide stainless steel boxes, nominal size 4 inches square by 1-1/2 inches in flush-mounted or concealed locations unless otherwise indicated. Boxes for use in concrete shall have square corner tile type covers with ribs or extensions for casting in concrete.

3. Construct pull boxes in flush-mounted or concealed locations that are larger than 4 inches square by 1-1/2 inches of stainless steel.

4. Use PVC coated threaded-hub ferrous boxes for surface-mounted or exposed locations. PVC coated cast conduit fittings may be used instead of boxes except where boxes contain devices.

5. Where threaded-hub cast boxes and fittings are not practical, provide NEMA 4X pull boxes constructed of Type 304 stainless steel. Install cover with neoprene gaskets and Type 304 stainless steel bolts. Attach conduit with “Myers” hubs.

6. Provide junction boxes in all exterior areas above wet well suitable for Class 1, Division 1 outdoor locations.

F. Electric Handholes/Manholes

1. Handholes and manholes shall be electrical-type utility boxes manufactured by Quickset, Brooks Products, or equal. Provide cast-iron covers with lifting hooks in all areas. Set the handhole and manhole on a crushed rock base 6 inches thick with horizontal dimensions same as bottom of handhole plus 6 inches all around. Crushed rock shall be 3/4-inch
maximum size.

2. Provide raceway entrances on all four sides. For raceways installed under this contract, knockout panels or precast individual raceway openings may be sued. On sides where no raceways are installed under this contract, provide 12-inch-high by 12-inch-wide (minimum) knockout panels for future raceway installation.

3. Utilize frames and covers made of cast iron, suitable for street loading. On the upper side of each cover, cast in integral letters not less than 2-inches high appropriate titles ELECTRIC HV (for above 600 volts), ELECTRIC LV (for 600 volts and below) or CONTROL. Field stamp covers with handhole numbers indicated on the drawings.

4. Concrete pull boxes and handholes shall be precast with pull-in irons, hot-dipped galvanized traffic cover with hot-dipped galvanized frame, and two galvanized cable racks with porcelain blocks on each of the two longest sides. Design for AASHTO H-20 loading. Provide bead weld on cover of pull box to indicate services within pull box (electrical, telephone, fire alarm, or signal). After cables have been pulled and inspected, seal box between cover and frame with a mastic compound similar to Parmagum, Dukaseal, or equal.

5. Manufacturers: Brooks Products, Inc.; Penn-Cast Products, Inc.; Concrete Conduit Company; Associated Concrete Products, Inc.; or equal.

6. Polymer concrete manholes and handholes can be used in place of precast manholes and handholes. Structures must be UL listed as an underground enclosure. All other design considerations shall be met including AASHTO H-20 loading and design. Provide and install Quazite by Strongwell, or equal.

16110.03 EXECUTION

A. Conduit Usage

1. Install the following types of raceway in the locations listed, unless otherwise indicated on the drawings.

   a. Exterior, Exposed:

      i. PVC-coated conduit.

   b. Interior, Exposed:

      i. PVC-coated conduit.

   c. Embedded in Concrete or Masonry:
i. PVC-coated conduit.

d. Underground Dirt Burial, or Below Concrete Slabs:
   i. PVC-coated conduit.

e. Underground Concrete Encased:
   i. Provide rigid non-metallic conduit. Provide rigid steel conduit with long radius elbows for bends exceeding 45 degrees (see requirement for conduit stub-ups).
   ii. Rigid steel conduit (see requirement for conduit stub-ups).

f. Final Connections to Motors or Vibrating Equipment: Liquid-tight flexible conduit unless otherwise shown on the drawings.

g. Connections to Suspended Lighting Fixtures: Liquid-tight flexible conduit.

h. Conduit Stub-ups: Provide PVC-coating conduit for stub-ups.
   i. All fittings for conduit or enclosures which are connected to PVC coated conduit or fittings shall be PVC coated.

j. The Contractor shall replace all PVC coated conduit and fittings which have damaged, nicked, or scared PVC coating, at no cost to the County. A repair system will not be acceptable.

B. Installation

1. Provide 30 inch-minimum cover for direct burial underground conduit.

2. Liquid tight conduit shall be a maximum of 18 inches in length.

3. Repair or replace conduit damaged during or after installation. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.

4. Support conduit and cable tray at intervals and at locations as required by the NEC. Do not use perforated strap or plumbers tape for conduit supports.

5. Conduit on Concrete or Masonry: Use PVC coated one hole aluminum iron clamps with pipe spacers (clamp backs) or Type 304 stainless steel, preformed channel. Anchor with 304 stainless steel preset inserts. Use preset inserts in pre-stressed concrete.

6. Suspended Conduit: Use fiberglass or PVC, factory made, split hinged pipe rings with Type 316 SST threaded suspension rods sized for the weight to be carried (minimum 3/8”
diameter); Kin-Line, Grinnell, Elcen, or equal. For grouped conduits or cable tray, construct racks with the fiberglass threaded rods and stainless steel or fiberglass channel cross members. Construct channel to limit deflection to 1/200 of span. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing. All PVC coated conduits shall be terminated using Myers Hubs in any non-threaded entries.

7. Supports at Structural Steel Members: Use Type 304 stainless steel or PVC coated beam clamps in exposed locations.

8. Wherever conduit may be affected by dissimilar movements of the supporting structures or medium, provide flexible or expansion devices.

9. Dry pack with non-shrink grout around raceways that penetrate concrete walls, floors, or ceilings above ground. Use "Link Seal" around all conduits in penetrations located below grade.

10. Conduit runs are shown schematically. Supports, pull boxes, junction boxes, and other ancillary equipment are not usually shown. Provide pull boxes and junction boxes where shown. In addition, provide pull boxes and junction boxes to permit pulling of wires without damage to the conductors or insulation.

11. Install exposed conduits parallel to or at right angles to the lines of the building. Make right angle bends in exposed conduit runs with standard elbows, threaded conduit fittings, or conduit bent to radii not less than those of standard elbows.

12. Route exposed conduit to preserve headroom, access space, and work space.

13. Provide expansion fittings for raceways crossing expansion joints in structures or concrete slabs.

14. Treat threaded joints of rigid steel conduit with T&B “Kopr-Shield” before installing fittings.

15. Terminate rigid steel conduits with locknuts and bushings. Install conduit squarely and provide one locknut outside the box and a bushing inside the box. Install locknuts with dished side against the box.

16. When terminating in threaded hubs, screw the conduit or fitting tight into the hub so that the end bears against the fire protection shoulder. When chase nipples are used, install the raceway and coupling square to the box and tighten the chase nipple with no exposed threads.
17. Coat all aluminum surfaces which are in contact with concrete or masonry per Section 09900 before installation.

C. Testing

1. None required.

END OF SECTION
SECTION 16120
WIRE AND CABLES

16120.01 GENERAL

A. Description

This section describes materials and installation of wires and cables.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for each conductor type. Indicate insulation material, conductor material, voltage rating, manufacturer and other data pertinent to the specific cable, such as type shielding, number of pairs, and applicable standards.

16120.02 MATERIALS

A. Materials

1. Low-Voltage Building Wire
   a. Conductor material shall be copper.
   b. Low-voltage building wire for use at 600 volts or less shall be 600-volt insulated, Type XHHW (for all underground locations) or THWN, and rated for continuous operation at 75C.
   c. No. 12 AWG minimum conductor size for power and lighting circuits.
   d. No. 14 AWG minimum conductor size for control circuits.
   e. All conductors shall be stranded.

2. Instrument Cable
   a. Reference Spec 16946.
   b. Multiple-pair cables shall have number of pairs specified with each pair being two, No.18 AWG stranded, tinned-copper conductors individually insulated with PVC rated at 300 volts. Conductor pairs shall have insulation pigmented black and white with white conductor numerically printed for group identification. Each pair and its 20 AWG stranded tinned-copper drain wire shall be twisted together and shielded.
with an aluminum-polyester tape overlapped for 100% shielding. Provide a cable shield of 2.35-mil aluminum-polyester tape overlapped to provide 100% shielding and an 18 AWG copper drain wire. Provide a flame-retardant PVC jacket per UL 13, 105C temperature rating.

3. Support Grips

a. Provide a flexible wire mesh holding device to fit around an electrical cable for support of cable as shown on the drawings, or as required to support pump cables. The support grip shall support vertical runs of up to 99 feet with loads up to 600 pounds. Provide a single eye for attaching support grip as shown on the drawings. Support grip shall be Hubell, Kellems, or equal.

B. Control Wiring

1. Field control wire, type, and color shall be the same as specified in Section 16946.

16120.03 EXECUTION

A. Wire Installation

1. Install wiring and cable in conduit unless otherwise noted.

2. To reduce pulling tension in long runs, coat cables with pulling compound recommended by the cable manufacturer before being pulled into conduits.

3. Remove debris and moisture from the conduits, boxes, and cabinets prior to cable installation.

4. Group conductors No. 1/0 and smaller in panelboards, cabinets, pull boxes, and switchboard wireways; tie with plastic ties; and fan out to terminals. Lace conductors No. 2/0 and larger with marline.

B. Identification

1. Color coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>208/120 Volts</th>
<th>480/277 Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>Ground</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>
a. Conductors No. 10 AWG and smaller shall have factory color coding with solid color insulation. Do not use onsite coloring of ends of conductors or apply colored plastic adhesives in lieu of factory color coding.

b. Conductors No. 8 AWG and larger shall have factory color coding with solid color insulation or shall have black insulation with onsite application of colored plastic adhesives at ends of conductors and at each splice.

d. Tagging of Conductors: Tag control wires and instrument cables in panels, pull boxes, wireways, and at each control device with adhesive type of marker: Brady, Thomas and Betts, or equal. Tag control wires and instrument cables with same wire numbers as on the shop drawing submittals. Tag power wires in pull boxes and wireways where there is more than one circuit. Tag power conductors with motor control center or panelboard number and circuit numbers.

2. Low-Voltage Wire Splices

   a. Stranded Conductors No. 8 and Larger: Use T & B “Locktite” connectors, Burndy Versitaps and heavy-duty connectors, O.Z. solderless connectors, or equal.

   b. Stranded Conductors No. 10 and Smaller: Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors.

   c. Retighten bolt-type connectors 24 to 48 hours after initial installation and before taping.

       Tape connections made with noninsulated-type connectors with rubber-type tape, one and one-half times the thickness of the conductor insulation, then cover with Scotch 33 tape.

3. Splices and Terminations

   a. Do not splice cables unless specifically indicated in the drawings or concurrence is obtained from the County’s Representative. Make splices and terminations in accordance with the splice or termination manufacturer’s instructions.

   b. Give two working days’ notice to the Owner’s Representative prior to making splices or terminations in order to allow the Owner’s Representative to be present during the actual work if he elects to do so.

4. Preliminary Inspection/Test

   a. Upon completion of the work and prior to acceptance, the Contractor shall test all
conductors to insure freedom from unwanted grounds, continuity, proper splicing, and insulation values in accordance with National Electrical Code requirements. In addition, the Contractor shall check all conduits for continuity. Preliminary testing with a magneto or ohmmeter shall be permitted, but final results shall be obtained with a "Megger" of suitable voltage output. The Contractor shall furnish all required instruments, labor, material, and other equipment necessary for testing.

5. Insulation Resistance Tests

   a. Test each complete circuit prior to energizing. Insulation resistance between conductors and between each conductor and ground shall not be less than 25 megohms. Repair or replace wires or cables in circuits which do not pass this test and repeat the test.

6. Conditional Acceptance Inspection/Test

   a. None required.

END OF SECTION
SECTION 16140
SWITCHES AND RECEPTACLES

16140.01 GENERAL

A. Description

1. This section describes materials and installation of light switches and receptacles.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit material list for each type of switch, receptacle, and cover plate. Indicate type, ratings, material, color, and manufacturer.

16140.02 MATERIALS

A. General

Provide switches and receptacles that are listed by Underwriter’s Laboratories, Inc.

B. Receptacles


2. Ground Fault Interrupter Duplex Receptacles: Receptacles shall be rated 20 amperes and comply with UL-943, Class A. Provide Leviton 6198-I, 3M GFI-2701, or equal.

C. Switches

1. Switches shall be molded composition, brown, specification grade, single pole, 20 ampere, three-way and four-way as shown on the drawings.

2. 120 or 277-Volt Lighting: Provide switches rated 20 amperes, 120/277-volt a-c. Provide quiet operation, toggle type switches.

D. Cover Plates

1. Outside, or where indicated, use individually gasketed weatherproof cover plates.

2. Provide stain stainless 302 plates in all remaining locations.

**16140.03 EXECUTION**

A. Grounding

1. Provide a bonding jumper between the grounded outlet box and the receptacle and switch ground terminal.

B. Preliminary Inspection/Test

1. Operate each switch and verify that the load is turned on and off.

2. Test each receptacle with a circuit tester that checks voltage, polarity, and grounded conditions. Repair or replace defective receptacles and repeat the test.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection Test.

END OF SECTION
SECTION 16155
LOW VOLTAGE CONTROL

16155.01 GENERAL

A. Description

This section includes requirements for materials, testing, and installation of low-voltage motor control equipment and in accordance with the Contract Documents.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions.

2. Submit manufacturer’s descriptive data including ratings, circuit diagrams, dimensional data, conduit entry restrictions, and overload heater ratings. The complete wiring diagram shall show all wires continuous from end to end and identified by numbers and the physical relationship of all controls shall be identical to the arrangement shown on the general arrangement drawings. Where there is any correlation between the operation of any one unit and that of any other unit, a sequence of operations shall be furnished.

C. Ratings

Motor horsepower ratings and enclosures shown are minimum expected. This does not limit the equipment size. When motors furnished differ from the minimum ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner.

16155.02 MATERIALS

A. Combination Magnetic Motor Starters

1. Comply with NEMA ICS, Class A, and with NEC Article 430.

2. Combination motor starters shall include thermal magnetic circuit breakers and NEMA rated starters as shown on the drawings. The short-circuit rating shall be greater than or equal to the motor control center short circuit rating.

3. Provide 120-volt control circuit transformer where indicated. Provide 100-volt-ampere spare capacity that is in addition to contactor load plus other loads specified. Fuse one side of secondary winding and ground other side. Provide primary winding fuses Class CC rejection type where shown on drawings.
4. Provide solid state overload relays in lieu of motor starter overloads. The solid state overload relay shall be the same manufacturer as the starter and include 2:1 adjustable full-load amps, phase current loss protection, phase current unbalance, and a manual reset. The manufacturer shall verify the motor ratings and coordinate the solid state overload relay with the actual horsepower ratings of the motors installed.

5. Provide 30.5 mm, heavy duty, oil tight, LED cluster, indicator lights, selector switches, elapsed run time indicators, push-buttons, etc., as shown in the wiring diagrams and single line diagrams. Mount on the front panel of the starter. Refer to Section 16946.

6. Provide externally operable overload relay reset buttons and disconnect operators.

7. Provide control relays within the starter enclosure as shown in the schematic wiring diagrams. Control relays shall be provided with led indicator lights. 120-Volt relays shall be plug in pin-type and 24VDC relays shall be plug in, blade-type.

8. Control relays shall be magnetically held and shall have convertible contacts. Control relays shall be UL listed with minimum 10 amp rated contacts and coil voltage, number of poles, and pole arrangement as indicated on the drawings. Relays shall be IDEC Series RR3, SquareD 8501 K Series, or equal.

9. Time-delay relays shall be UL listed with contacts rated 10-ampere non-inductive load, 120-volts, with coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated on the drawings. Relays with maximum timing adjustment 180 seconds or shorter shall be plug-in, solid state type with timing knob adjustment. Provide Potter Brumfield, Syracuse Electronics, ISSC, or equal. Relays with maximum timing adjustment longer than 180 seconds shall be synchronous motor driven with timing knob adjustment. Provide Automatic Timing & Controls Series 322, G&W Eagle Signal BRI Series, or equal.

10. Indicating lights shall be 30.5mm, heavy duty, oil tight type, LED type, complete with color of lens indicated on drawings and legend plate. Lamps shall be 120-volt a-c. Indicating lights shall be push-to-test type. Indicating lights shall be LED cluster type.

11. Control switches shall be 30.5mm, heavy-duty, round, oil type, complete with legend plates and quantity of contact blocks required for the control function.


13. Percentage timers shall be the solid-state type with repeat accuracy of 1/2% of full scale.
The "on" and off times shall be adjustable.

14. Elapse time meters shall be synchronous motor driven, 0 to 99,999.9-hour range, non-reset type, suitable for semi-flush, panel mounting.

15. Auxiliary contacts shall be provided as indicated, and as required for operation.

16. Provide a terminal strip in each starter where external controls or indicators are required. A schematic diagram shall be provided inside the cover of each starter. This diagram shall show terminal strip identifications for each external connection. Terminal strips shall be Phoenix Contact, Weidmuller, or equal.

17. All 120 VAC control wires energized form a source external from the starters or device control transformers shall be yellow in color.

B. Combination VFD/Motor Starters

1. Solid-state, pulse-width modulated (PWM) Variable Frequency Drives for use with NEMA design AC motors.

2. The variable frequency drive package shall consist of a circuit breaker disconnect, line reactor, two (2) contactor bypass, 120V control transformer, control circuit terminal board for digital and analog field wiring.

3. Provide 120-volt control circuit transformer where indicated. Provide 100-volt-ampere spare capacity that is in addition to contactor load plus other loads specified. Fuse one side of secondary winding and ground other side. Provide primary winding fuses Class CC rejection type where shown on drawings.

4. The drive shall have a Hand-Off-Auto switch, Manual Speed Potentiometer, and VFD-Off-Bypass selector switch mounted on the door of the enclosure.

5. The drive and all associated apparatus shall be housed in a NEMA Type 1 enclosure with a circuit breaker disconnect, user terminal strip connections, and bypass controls. The enclosure shall provide dedicated user terminals for power and control device connections. Provisions shall be included for locking the disconnect in the OFF position with a padlock.

6. All enclosure and heat sink fans shall be accessible from the front and shall not require the removal of the drive power converter for fan replacement.

7. The drive shall operate on 480Vac, 3-phase input line voltage with an input frequency range of 60 Hz (±) 5%. The displacement power factor shall not be less than .98 lagging.
under any speed or load condition and with an efficiency of not less than 97% the at 100% speed. The variable torque rated drive over current capacity shall be not less than 110% for 1 minute.

8. The drive shall have a minimum AC under-voltage power loss ride-through of 200 milliseconds (12 cycles) and a programmable ride-through function, which shall allow the logic to maintain control for a minimum of one-second (60 cycles) without faulting. For a fault condition other than a ground fault, short circuit, or internal fault, an auto restart function shall provide up to 6 programmable restart attempts. The time delay before restart attempts shall be 30 seconds. Upon loss of the analog process reference signal, the drive shall be programmable to display a fault. There shall also be three (3) skip frequency ranges that can be programmed to a bandwidth of ± 2.5 Hz. The acceleration and deceleration ramp times shall be adjustable from 0.05 to 999.9 seconds. The memory shall retain and record run status and fault type of the past eight faults.

9. Control features shall include a touch keypad display interface to access all electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, and adjustment storage, and diagnostics. The control power for the digital inputs and outputs shall be 24 Vdc. Two voltage-free relay output contacts shall be provided. One of the contacts shall indicate AC Drive fault status and the other contact shall indicate a drive run status. The combination enclosure shall include terminal point connection for safety interlocks, to prevent drive or bypass operation. The interlock must shut down the motor in the drive and bypass modes.

10. The combination drive unit shall include mechanically and electrically interlocked isolation and bypass contactors complete with a Class 20 thermal overload relay. The operator shall have full control of the bypass starter by operation of the VFD/OFF/BYPASS selector switch. In the Automatic mode of operation the bypass contactors shall be sequenced by a 120-volt rated auto start contact. The isolation contactor for the bypass shall be sequenced to provide motor isolation during a drive ready state of operation.

11. Harmonic mitigation for the drive shall include a line reactor mounted inside the drive enclosure to reduce power system harmonics and provide power quality protection for the drive. The Contractor shall be responsible to conduct harmonics testing at the Point of Common Coupling (PCC) and report results to demonstrate that the installation of the VFD's meets IEEE-519 requirements. Should this testing reveal total harmonic distortion (THD) greater than IEEE-519 Table 1, any additional harmonic filters needed for the VFD installation to comply with IEEE-519 will be supplied and installed at no additional cost to the County.

12. Provide 30.5 mm, heavy duty, oil tight, LED cluster, indicator lights, selector switches,
elapsed run time indicators, push-buttons, etc., as shown in the wiring diagrams and single line diagrams. Mount on the front panel of the starter. Refer to Section 16946.

13. Provide control relays within the starter enclosure as shown in the schematic wiring diagrams. Control relays shall be provided with led indicator lights. 120-Volt relays shall be plug in pin-type and 24VDC relays shall be plug in, blade-type.

14. Control relays shall be magnetically held and shall have convertible contacts. Control relays shall be UL listed with minimum 10 amp rated contacts and coil voltage, number of poles, and pole arrangement as indicated on the drawings. Relays shall be IDEC Series RR3, SquareD 8501 K Series, or equal.

15. Indicating lights shall be 30.5mm, heavy duty, oil tight type, LED type, complete with color of lens indicated on drawings and legend plate. Lamps shall be 120-volt a-c. Indicating lights shall be push-to-test type. Indicating lights shall be LED cluster type.

16. Control switches shall be 30.5mm, heavy-duty, round, oil type, complete with legend plates and quantity of contact blocks required for the control function.

17. Auxiliary contacts shall be provided as indicated and/or as required for proper operation of the system(s).

18. Provide a terminal strip in each starter where external controls or indicators are required. A schematic diagram shall be provided inside the cover of each starter. This diagram shall show terminal strip identifications for each external connection.

C. Auxiliary Control Panels

Where shown on the drawings, low voltage control panels for other auxiliary equipment, such as fan control panels, grinder/comminutor control panels, etc. shall also follow the requirements of section 16946 of these specifications.

16155.03 EXECUTION

A. Installation

1. Secure motor controls rigidly to surface or mounting racks with anchor bolts or concrete wedge anchors.

B. Preliminary Inspection/Test

1. Test the operation of each interlock to verify that the interlock performs its function.

2. Set adjustable trip circuit breakers two settings above the setting that causes the breaker
to trip during motor starting. Do not adjust the setting above 1,300% of the motor
nameplate current rating.

3. Set main and feeder circuit breaker adjustable set points, and time delays in accordance
with the manufacturer.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection Test.

2. Operate each device a minimum of three times under load condition. Make adjustments
as required to provide operation.

END OF SECTION
SECTION 16160
PANEL BOARDS

16160.01 GENERAL

A. Description

1. This section describes materials, testing, and installation of panelboards.

B. Submittals

1. Submit Contractor’s Drawings in accordance with General Conditions.

2. Show ratings and characteristics including voltage ratings, bussing arrangement, continuous current ratings, fault current withstand ratings, neutral bus rating, enclosure type, ratings and arrangement of over current protective devices, and mounting provisions.

3. Submit outline and dimensional drawings and conduit entry restrictions.

16160.02 MATERIALS

A. Materials

1. Low Voltage Panel Board

Provide dead front, safety-type panelboards with voltage ratings as scheduled. Panelboards shall be circuit breaker type and suitable for short circuit ratings of 18,000 AIC, minimum at 480 Vac and 10,000 AIC, minimum at 208 or 240 Vac. Panelboards shall be UL listed and labeled.

2. Cabinets

Install panelboard within the electrical equipment cabinet. Surface mount on aluminum backplane. Furnish with hinged front doors, catches, and locks (NEMA Type 1 enclosure) as shown on the drawings. Provide holder for the directory on the inside of the door.

3. Breakers

a. Molded-Case Breakers

i. Provide quick-make and quick-break toggle mechanism, inverse-time trip characteristics, and trip-free operation on overload or short circuit. Automatic
tripping shall be indicated by a handle position between the manual OFF and ON position. Provide trip ratings as indicated in the panelboard. Provide lock-on or lock-off devices where indicated on the drawings.

ii Single-pole breakers shall be full module size; two poles shall not be installed in a single module. Multiple circuit breakers shall be of the common-trip type having a single operating handle.

iii Circuit breakers shall be rated 18,000 AIC, minimum at 480 Vac and 10,000 AIC, minimum at 208 or 240 Vac.

b. Breaker Connections

Circuit breaker current-carrying connections to the bus shall be bolted type.

c. Bus Bars

Bus bars shall be copper. Provide a copper ground bus bar installed on the panelboard frame, bonded to the box, and containing at least 10 terminal screws.

d. Space Only

Where “space only” is noted on the drawings, provide connectors, mounting brackets, etc., for the future insertion of an overcurrent device of the size indicated.

B. Directories

Provide typed circuit directories on the inside face of the door of each panel. Do not provide handwritten directories.

C. Nameplates

Provide nameplates as specified in Section 16010. Designate the identifying nomenclature, voltage and phase of the panel as shown on the drawing; for example, “PANEL LP, 208Y/120V, 3-phase, 4-wire, 100-ampere bus.”

D. Surge Protection

Provide surge protection for the panelboard as indicated as outlined in Section 16670.

16160.03 EXECUTION

A. Installation

1. Mount the panelboard within the electrical equipment cabinet as shown on the drawings.
B. Preliminary Inspection/Test

1. Operate each circuit breaker and verify that all phases of each load are disconnected.

C. Conditional Acceptance Inspection/Test

1. Repeat Preliminary Inspection/Test.

END OF SECTION
SECTION 16440
CATHODIC PROTECTION

16440.01 GENERAL

A. These specifications define materials and installation practices for the impressed current cathodic protection system for the Cape St. John 1 Sewage Pumping Station and associated piping in Anne Arundel County, Maryland.

B. Installation of corrosion control components shall be in accordance with the following specifications, and accompanying design drawings. All installation practices and components shall be approved by the Engineer.

C. The cathodic protection system will consist of three deep anode groundbeds (three high silicon cast iron anodes per groundbed), anode header cable, structure lead cables, electrical bonding of ductile iron piping, test facilities, anode junction box, rectifier, and associated electrical work.

D. The Contractor shall be responsible for verifying the location of all underground utility piping, structures, wiring, etc. prior to any excavations. The Contractor shall avoid damage to all existing underground structures, utilities, wiring, etc. and shall repair any and all damage that occurs to any and all existing underground structures, utilities, wiring, etc.

E. All work shall be in accordance with all Federal, State and Local Regulations including, but not limited to the following:

1. National Electrical Code
2. Environmental Protection Agency
3. Occupational Safety and Health Agency

F. Well Driller: The Contractor shall have in its employ, or shall subcontract the services of a qualified well driller. This driller shall be well versed in the installation of cathodic protection deep anode groundbeds. The driller shall have installed a minimum of 10 deep anode groundbeds similar to those included in this contract over the past five years.

G. Upon completion of the work, the Contractor shall test, operate, inspect, and survey the installed work under the direct supervision of the Engineer. Any and all repairs or replacement of defective or improperly installed corrosion control/corrosion monitoring systems shall be corrected by the Contractor at no additional cost to the Owner.

H. Submittals

1. Catalog cuts of all materials to be installed shall be required and shall be submitted for approval in accordance with Anne Arundel County general provisions.
2. Qualifications of independent corrosion control firm including test personnel (NACE International Certified Corrosion Technicians) and NACE International Certified Cathodic Protection Specialist qualifications, shall be required and shall be submitted for approval in accordance with Anne Arundel County general provisions. Copies of NACE International Certification Certificates must be submitted for personnel.

3. Standard test data format shall be required and shall be submitted for approval in accordance with Anne Arundel County general provisions.

4. Test procedures and equipment list for post installation testing shall be required and submitted for approval in accordance with Anne Arundel County general provisions.

16440.02 CATHODIC PROTECTION MATERIALS

A. Impressed Current Anodes

1. Each anode shall have a nominal weight of 50 pounds. The anode shall be 84 inches long and 2.2 inches in diameter.

2. Composition of the anode shall be ASTM A518 Grade 3 as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon</td>
<td>14.20 - 14.75%</td>
</tr>
<tr>
<td>Chromium</td>
<td>3.25 - 5.00%</td>
</tr>
<tr>
<td>Carbon</td>
<td>0.70 - 1.10%</td>
</tr>
<tr>
<td>Manganese</td>
<td>1.50% max</td>
</tr>
<tr>
<td>Copper</td>
<td>0.50% max</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>0.20% max</td>
</tr>
<tr>
<td>Iron</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

3. The anode shall be a Type 2284 Centertec Tubular as manufactured by the Anotec Industries, Inc. or an approved equal.

4. The lead wire connection to the anode shall be made by the anode fabricator. The connection shall be exactly at the center of the anode using a one piece anchor swaged into matching cast seat with anchor grooves. The connection shall be protected by interior retention grooves which positively lock the epoxy sealant. The anode lead wire shall be a minimum of AWG No. 8 stranded copper with Permarad insulation or an approved equal. The anode lead wire shall be of sufficient length to reach the anode roadway box without splicing.

5. Each anode shall be fabricated with 75 feet of 3/8" polyethylene lowering rope permanently attached.

B. Anode Centralizers
1. A stainless steel centering device shall be capable of maintaining each anode in a concentric position within a 10-inch diameter hole.

2. The anode centralizer shall be as manufactured by The Loftis Company or an approved equal.

C. Anode Vent

3. One-inch diameter PVC anode venting conduit shall be installed the full length of the active area (area backfilled with coke breeze) of each deep anode groundbed. Openings of 1.5 inches in length by 0.006 inches in width shall be positioned 1-inch in circumferential distance from one another and 6-inches center-to-center longitudinally. Nominal wall thickness of the vent pipe is 0.16 inch.

4. The anode vent material shall be Allvent as manufactured by Cathodic Engineering Equipment Co. or an approved equal.

5. Solid vent pipe for the inactive area (bentonite plug and above) of the deep anode shall be without slots, and shall be of the same nominal diameter as the slotted pipe.

D. Anode Backfill (Coke Breeze)

1. The space between the anode and the augured hole shall be backfilled with a carbonaceous earth contact backfill (coke breeze). The earth contact backfill shall have the following composition:

<table>
<thead>
<tr>
<th>Component</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Carbon</td>
<td>99.77%</td>
</tr>
<tr>
<td>Ash</td>
<td>0.10%</td>
</tr>
<tr>
<td>Moisture</td>
<td>0.00%</td>
</tr>
<tr>
<td>Volatiles</td>
<td>0.00% (950°C)</td>
</tr>
<tr>
<td>Bulk Density</td>
<td>74 lbs./cu.ft.</td>
</tr>
<tr>
<td>Particle Size</td>
<td>Dust-free with maximum particle size of 1.0 millimeter</td>
</tr>
</tbody>
</table>

2. The anode earth contact backfill material shall be Loresco Type SC-3 as manufactured by Cathodic Engineering Equipment Co. or an approved equal.

E. Environmental Plug Seal

1. An environmental plug seal shall be installed within the 12-inch diameter PVC casing above the top of the anode column.

2. The plug seal shall be a Loresco Perma Plug Seal, as manufactured by Cathodic Engineering Equipment Co. or an approved equal.

F. Cathodic Protection Cables
1. Structure Cables: Cable from the structure connection to the rectifier shall be #8 AWG insulated concentric lay, stranded, annealed copper wire with type THWN insulation.

2. Anode Header Cables: Cable from the anode roadway box to the anode junction box shall be #8 AWG insulated concentric lay, stranded, annealed copper wire with type CP high molecular weight polyethylene (HMWPE), 7/64-inch thick insulation, 600-volt rating.

3. Rectifier Positive Cable: Cable from the anode junction box to the rectifier connection shall be #2 AWG insulated concentric lay, stranded, annealed copper wire with type THWN insulation.

4. Bonded Joints Cable: Cable for bonding ductile iron pipe joints shall be single conductor, stranded copper with high molecular weight polyethylene (HMWPE) insulation (black). Wire size shall be AWG No. 6.

5. Test Station Wire: Wire for test lead connections to the piping shall be single conductor, stranded copper wire with 600-volt THWN white insulation. Wire size shall be AWG No. 8.

G. Thermite Weld Equipment

Thermite weld molds and charges shall be suitable for the sizes and types of materials and shapes encountered. Adapter sleeves shall be utilized for all thermite welds. Thermite weld equipment shall be as manufactured by Erico, Inc. or approved equal.

H. Coating for Thermite Welds

1. Thermite welds are to be coated with a prefabricated assembly specially designed for covering cathodic protection wire connections to piping and fittings. The prefabricated assembly shall consist of the following components:

a. Top plastic sheet formed with an igloo shaped dome and entry tunnel for the lead wire;

b. A special elastomeric compound in the plastic dome firm enough to resist flow at normally encountered application and operating temperatures, but soft enough to mold itself around and completely cover the irregular welded profile;

c. A double row of parallel, flexible serrations on either side of the dome to assist with conforming around small diameter pipe;

d. A base of black unbacked elastomeric tape with exceptional adhesive properties for bonding firmly to a surface when used with the appropriate primer.

2. Caps shall be as manufactured by Royston Laboratories Division, Model Handy-Cap or approved equal. The appropriate primer as required by the elastomeric cap manufacturer...
shall be used. Primer for the Royston Handy-Cap shall be as manufactured by Royston, Model Roybond 747 Primer.

I. Cathodic Protection Rectifier

1. General: The air cooled, wall mount rectifier shall be a standard, constant voltage solid state electronic type provided by a manufacturer who has a minimum of ten years experience in the production of rectifiers. The rectifiers shall be single phase, 120 VAC. The rectifiers shall be manufactured by Universal Rectifiers, Inc. or an approved equal.

2. Cabinet: The cabinet will have a hot dipped galvanized finish (after fabrication).

3. Chassis: All of the rectifier components shall be mounted on the exterior wall of the existing brick building to facilitate tests, inspections and maintenance. Service entry wire locations to be permanently labeled to facilitate proper reconnection.

4. AC Breaker: The rectifier shall contain an independent AC breaker that is readily accessible. The rectifier shall be provided with panel mounted AC and DC fuses.

5. Mode of Operation: The rectifier shall be a standard, solid state constant voltage transformer unit. It will utilize bridge connected silicon diodes. The rectifier shall provide a range of operation up to 50 volts DC and 10 amperes DC.

6. Metering: Continuous duty metering shall include one DC voltmeter and one DC ammeter connected to an external shunt, plainly marked to indicate ampere rating and millivolt drop. The ammeter shunt will be mounted in a readily accessible location on the front panel of the rectifier.

7. Lightning Protection: The rectifier shall have AC and DC lightning protection. DC lightning protection shall be installed between the negative and positive output of the rectifier as well as between the negative output and ground.

8. Interior Nameplate: The following information shall appear on a nameplate affixed to the inside of the rectifier door:
   a. Manufacturer's name and address;
   b. Rectifier model number;
   c. Rectifier serial number;
   d. Full-load AC amperes;
   e. AC line volts;
   f. AC line frequency (60 Hz);
g. Number of phases;

h. DC output volts;

i. DC output amperes;

j. Ambient temperature rating shall be from minus 40 degrees F to plus 160 degrees F.

J. Anode Junction Box

1. The anode junction box shall be 12" x 12" x 6" fiberglass reinforced plastic (FRP), complete with hinged covers and locking hasps, meeting the requirements of NEMA 4X. The boxes shall be provided with sufficient conduit connections for the required wiring. The junction boxes shall be as manufactured by Hoffman Company or approved equal.

2. The junction box shall have an engraved nameplate on the outside identifying the circuits contained within the box.

3. The anode junction box shall be supplied with all interior hardware as shown on the Drawings including the non-conductive mounting board, copper bus, mounting hardware, etc.

K. Test Station

The flush test station shall consist of a nonconductive terminal board mounted in a locking cover, suitable for placement in heavy traffic areas. The test station shall consist of a cast iron lid (yellow with CP TEST stamped into it) with a cast iron collar. The body of the test station shall be 5 inches inner diameter with a length of 18 inches. The mounting board shall be non-conductive material and shall have a minimum of five terminal posts. The test station shall be as manufactured by C.P. Test Services, Inc. Model NM-5 or approved equal.

L. Test Station Concrete

Pour concrete for the flush-mounted test station slabs shall be Mix Number 2 (3,000 psi) per Anne Arundel County Standard Specifications, Section 03310. The concrete shall be reinforced with welded wire fabric (4" by 4" - W2.1 by W2.1).

M. Test Station Terminal Lugs

Test station terminal lugs shall be one-hole, compression terminal lugs for 0.25 inch bolt size.

N. Reference Electrode
The reference electrode shall be a permanent saturated gelled copper/copper sulfate reference electrode designed for a minimum 30 year life. The electrode shall have a PVC housing 10" long, and a minimum overall package size of 8" diameter by 16" long. The reference electrode shall be prepackaged in a permeable cloth bag with special copper/copper sulfate reference electrode backfill. Lead wire shall be a minimum of 25 feet long. The lead wire shall be AWG No. 14 stranded copper wire with HMWPE insulation. The wire insulation shall be black. The lead wire shall be attached to the electrode core with the manufacturer's standard connection. The connection shall be stronger than the wire. The reference electrode system shall be as manufactured by Electrochemical Devices, Inc. Model UL-CUG-SW or approved equal.

O. Anode Roadway Box

The anode roadway box shall be reinforced concrete suitable for placement in traffic areas. The roadway box shall be manufactured by Garsite, Inc. or approved equal.

16440.03 CATHODIC PROTECTION EXECUTION

A. Deep Anode Groundbeds

1. The Contractor shall be completely familiar with all of the following factors at all deep anode groundbed installation sites:

   a. Access for equipment to hole locations;

   b. Prohibitions to the discharge of drilling water, grout, cuttings, coke backfill or other liquid waste to the surrounding environment;

   c. Subsurface utilities and other obstructions;

   d. Availability of water.

2. The Contractor shall have all necessary equipment, manpower, and materials to perform the installation in an uninterrupted manner. If any anode hole fails to reach the required depth due to unusual obstruction, the Contractor shall notify the Engineer. The Contractor shall allow the Engineer to measure the depth of any anode hole and to inspect samples of materials recovered before start of installation of the anodes and/or removal of the drilling equipment.

3. The Contractor shall abandon and backfill any holes rendered useless due to problems with equipment or materials. Drill replacement holes at a location approved by the Engineer. Contractor is responsible for the cost of abandonment and redrilling.

4. Drill anode hole as indicated on the Drawings. Maintain an accurate log of the drilled holes, including the equipment used, date and time of drilling, and a complete log of the materials encountered. Include soil classification, elevation of water table, location of
special features such as mud seams, open cracks, soft or broken ground, points where loss or gain of drill water occurred and all other items of interest in connection with the work. The log shall be submitted to the Engineer upon completion of drilling.

5. The deep anode holes shall have a minimum of two feet of clearance with other underground structures.

6. Excess materials from the excavation not required for fill or backfill shall be disposed of as directed by and in a manner approved by the Engineer. The Contractor shall be responsible for compliance with all Federal, State and Local laws relative to spoil disposal and general safety requirements.

B. Anode Vent

Anode vent material shall be installed to the full depth of each deep anode groundbed. The vent shall extend into the anode roadway box as indicated on the Drawings.

C. High Silicon Cast Iron Anodes

1. High silicon cast iron anodes shall be installed where shown on the Drawings. Prior to installation, remove all shipping covers from the anode. Install the anodes in the holes and backfill the area around the anodes with coke breeze (Loresco Earth Contact Backfill Type SC-3). The work shall be done carefully to avoid damage to the anodes and cables.

2. The anodes shall NOT be lowered into the hole by using the anode lead wires. The anodes shall be lowered into the hole by using the polyethylene ropes provided with the anodes.

3. Suspend the anodes in the deep anode hole by tying the anode support ropes to a hanging rod installed at the top of the excavation for this purpose.

D. Deep Anode Backfill

1. The deep anodes shall be backfilled with coke breeze (Loresco Earth Contact Backfill Type SC-3). The coke breeze shall be poured slowly into the hole to assure full settlement of the coke breeze. The coke breeze shall be continuously agitated to assure that the coke breeze flows evenly into the deep anode hole.

2. The depth to the top of the coke breeze column shall be measured to verify proper installation. The coke breeze column shall be allowed to set a minimum of 24 hours after installation before making this measurement. If the top of the coke breeze column is not at the correct depth, finish filling the deep anode hole in the same manner.

3. Seal the top of the anode column with an environmental seal as indicated on the Contract Drawings.
E. Anode Junction Box

1. The anode junction box shall be installed where shown on the Drawings.

2. The Contractor shall be responsible for compliance with all National Electrical Code (NEC) requirements and all other applicable State and Local electrical codes. All work shall be accomplished in a neat and workman type manner.

F. Rectifier

1. Location: The rectifier shall be installed where convenient at the approximate location shown on the Drawings, close to the main AC power source and in accordance with the manufacturer's recommendations. The rectifier shall be wall mounted at a location approved by the Engineer. The rectifier shall be installed so that all doors and access panels can be fully opened for servicing and with sufficient clearance for easy removal of all interior components. In no case will the rectifier be located near areas where it may be exposed to roof drainage or damage by vehicular traffic.

2. AC Power: The AC power source shall be a separate 20 amp circuit on the main electrical panel. The breaker shall be of a type which will trip in the event of an overload or fault condition. Identify the circuit breaker in the panel with "Cathodic Protection, Must Remain ON". All conduit and wiring shall be in accordance with the local Electrical Code, NEC and NFPA 30, and must be completed by electricians licensed to perform the installations.

3. DC Wiring: Connect the anode (positive) header cable running from the anode junction box bus to the positive DC terminal in the rectifier. Connect the structure (negative) cables running from the steel interior wall of the pump station to the negative DC terminal in the rectifier.

4. Operation Check: Following completion of the installation, set the rectifier taps to the lowest available setting, turn on the AC power supply and turn the rectifier circuit breaker on. Push the meter switch and note the readings on the meter. If there is no meter reading, check the AC and DC circuits, locate any loose or open connections and re-test. Upon completion of the operation check, the rectifier circuit breaker and AC power supply shall be turned OFF and LEFT OFF. If the circuit breaker trips or a fuse blows out during the test, a short circuit is indicated. The Contractor shall locate the short circuit and correct it at no additional cost.

G. Structure Cable Connections

1. Prior to making any thermite weld connections, the structure shall be tested for integrity. No welding shall be performed on the structure in the area of any corrosion damage or surface imperfection (pitting, crack, etc.).

2. All structure cable connections shall be made by thermite welding at the locations shown
on the Drawings.

3. Conduit Installation

4. Conduits shall be routed as shown on the Drawings. All conduits shall be installed in a manner approved by the Engineer. All conduits containing cables shall be sealed with liquid tight sealant at the beginning and at termination.

5. Exact routing of all conduits after emergence within the pump station and to the rectifier shall be determined in the field. The conduits shall be routed to minimize the length of run and avoid physical interferences. Field verify the location of all electrical equipment. Exact equipment location and the conduit routing shall be approved by the Engineer.

6. All openings due to the installation of electrical equipment, including conduit penetrations shall be patched in an approved manner. Prior to the performance of work, submit method of patching to the Engineer for approval.

H. Cable Labeling

Each cable or wire shall be labeled at the point of origination and at the point of termination. The labels utilized shall be permanently marked with the cable identification. The printing on the plastic labels shall be mechanically produced, no hand printed labels will be permitted. The plastic labels shall be constructed of heavy grade plastic that is resistant to water, fuels, lubricants and solvents.

I. Conduit Labeling

Each above grade conduit shall be labeled. The labels utilized shall be permanently stamped brass tags with the appropriate cable designations. The printing on the brass tags shall be mechanically produced, no hand printed tags will be permitted.

J. Cable Splices

1. No splices except those specifically shown on the Drawings shall be permitted.

2. Splice the anode lead wires in the anode roadway boxes as shown on the Drawings.

3. Extreme care shall be taken with all cables. Insulation shall not contact sharp or pointed objects. Cable insulation must be kept intact at all times.

K. Thermite Welding

1. Assure that the area where the attachment is to be made is absolutely dry. Remove mill coating, dirt, grime and grease from the steel pump station interior wall, pipe or fitting surface at the weld location by wire brushing or by the use of suitable safety solvents. Clean a two-inch square area of the structure at the weld location to a bright shiny
surface, free of all serious pits and flaws by use of a mechanical grinder.

2. Prepare the wire for bonding by assuring that the cable is absolutely dry. The cable shall be free of dirt, grease and other foreign products. Cut the cable in such a way as to avoid flattening or forcing out of round. To prevent deformation of the cable, cut the cable with cable cutters. Remove the insulation in a manner that will avoid damage to strands. Install adapter sleeves for all bonds, test wires and structure connections prior to welding. Hold the cable at an approximate 30 degree angle to the surface when welding.

3. When the weld has cooled, remove the weld slag and test the weldment for strength by striking a sharp blow with a two pound hammer while pulling firmly on the wire. Reweld unsound welds and retest weldments. Thoroughly clean mold and mold covers after completion of each weld to assure that no slag will penetrate into the next weld.

4. After soundness of the weld has been verified, thoroughly clean with a stiff wire brush and coat with a cold applied thermite weld elastomeric cap. Apply primer over the entire weld area. Push the dome of the prefabricated cap containing elastomeric material firmly into weld area. Lift the wire away from the structure and apply the elastomeric material completely around and underneath the wire. Push the wire back down on the structure. Repair damage to the structure coating in accordance with the coating manufacturer's recommendations.

L. Bonded Pipe Joints

1. Pipeline joints, including those on pipe, fittings, valves and branch connections, except those specified to be insulated, shall be bonded as shown on the Drawings and in accordance with the manufacturer's recommendations using the proper combination of equipment for the pipe and wire size being welded. All welding materials and equipment shall be the product of a single manufacturer.

2. All joints are to be bonded with two AWG No. 6 HMWPE insulated copper cables as shown on the Drawings.

M. Test Stations

1. Install the test stations at the locations indicated. The test stations are to be located directly over the pipeline.

2. Attach test wires as indicated using the proper thermite welding equipment and charges specified for the wire size and respective pipe material. Follow all procedures as outlined for thermite welding.

3. All test station wires shall be routed a minimum of two feet below finished grade. Maintain sufficient slack in the test wires so that the wires can extend a minimum of 18" from the test station. Connect the test wires to the test station terminal block with one-hole, compression terminal lugs for 0.25 inch bolt size.
4. The test station shall be set in poured concrete, two feet on each side and six inches thick reinforced with 4" by 4" - W2.1 by W2.1 welded wire fabric. The flush mounted test station lids shall be free of concrete and not cemented over.

N. Reference Electrode

Install the reference electrode at the test station as shown on the Drawings. The reference electrode shall be installed at an approximate depth of six inches above the top of the pipe and at a distance of approximately six inches from the centerline of the pipe. Native trench material shall be used to backfill the reference electrode for a minimum of six inches. Prior to installation, remove the plastic shipping cover from the reference electrode. The cloth bag containing the special backfill shall remain intact.

O. Earthwork

1. General: The Contractor shall perform all excavations of every description and whatever substances encountered, indicated on drawings or as otherwise specified. The Contractor shall verify all underground structures prior to excavation and shall avoid damage to any and all structures encountered. The Contractor shall be responsible for the repair and/or replacement of any damaged structures encountered during the excavations.

2. Trenches: The trenches for the cables shall be a minimum depth of two feet below grade and not less than four inches in width. Excess material from excavations, not required to fill or backfill, and debris, shall be disposed of as approved by the Owner.

P. Protection of Existing Service Lines and Utility Structures

1. The Contractor shall be responsible for all existing utilities in the construction area. Utilities shall be protected during all earthwork operations and, if damaged, repaired by the Contractor at his expense. Above provisions are applicable to all service lines or utility structures, all or any portion of which protrude above the original ground surface or lie beneath the ground surface in any area of operations.

Q. Backfilling Trenches

1. The anode header cable trench shall be backfilled with clean fine earth or sand. The trench shall be backfilled in one foot layers of approved fill material free from rubbish, debris, vegetable matter and stones.

2. Backfill under pavement must conform to Anne Arundel County Standard Specifications.

3. Any trench improperly backfilled, or where settlement occurs, shall be reopened to the depth required for proper compaction, then refilled and compacted, with the surface restored to required grade and compaction.
4. Vegetation shall not be unnecessarily disturbed. All lawns, shrubbery, trees, etc. shall be restored or replaced to the satisfaction of the Engineer.

5. Pavements shall not be unnecessarily disturbed. All pavements shall be restored or replaced to the satisfaction of the Engineer in accordance with Anne Arundel County Standard Specifications.

16440.04 POST INSTALLATION TESTING

A. Qualifications

1. General: The Contractor shall retain an independent corrosion control engineering company to perform post installation testing of all cathodic protection/corrosion monitoring components.

2. Qualifications and Submittal Requirements: The independent corrosion control company shall have a minimum of five years of documented experience in the testing of corrosion control systems that are similar to those specified in these documents. The independent corrosion control company shall employ, on staff, a NACE International Certified Cathodic Protection Specialist to oversee all work associated with the corrosion control aspects of the project. The independent corrosion control company shall employ, on staff, field personnel who are certified, at a minimum, as NACE International Certified Corrosion Technicians. The corrosion technicians shall perform all field work associated with the post installation testing.

3. Submit for approval by the Engineer, the qualifications of the corrosion control company including a list of a minimum of 5 projects that involve testing of impressed current cathodic protection systems that were performed by the same individuals that are proposed for use on this project. The list of cathodic protection projects that are submitted shall be of similar type and equal complexity as the cathodic protection system to be tested. The documentation provided for each project shall include:

   a. Project name;
   b. Project location (city and state);
   c. Structure protected;
   d. Dimensions of structure protected;
   e. Description of cathodic protection system provided for the structure;
   f. The name and phone number of a contact at the owner of the cathodic protection system.
   g. The names of the responsible corrosion control company staff members that
participated in the project.

4. Submit the name of the NACE International Certified Cathodic Protection Specialist. Documentation that shall be submitted shall include:

   a. Copy of the individual's NACE International Cathodic Protection Specialist Certificate;

   b. A list of a minimum of five impressed current cathodic protection system testing projects that the individual was in responsible charge of. The five cathodic protection projects that are submitted shall be of similar type and equal complexity as the system to be tested. The project documentation shall include the same information listed in 1014.04.A.3 a through f above.

5. Submit the names of the NACE International Certified Corrosion Technicians who will be performing the field work associated with the project. Documentation that shall be submitted shall include:

   a. Copy of the individuals' NACE International Corrosion Technician Certificates;

   b. A list of a minimum of three impressed current cathodic protection system projects that the individuals were involved in. A list of projects shall be submitted for each Certified Corrosion Technician that will be involved with the new cathodic protection project. The list of cathodic protection projects that are submitted shall be of similar type and equal complexity as the cathodic protection to be constructed. The project documentation shall include the same information listed in 1014.04.A.3 a through f above.

6. The qualifications of the corrosion control engineering company and their personnel shall be submitted for review and approval by the Engineer prior to the start of construction. No cathodic protection testing shall be performed until the corrosion control engineering company and their personnel are approved by the Engineer.

7. No substitutions of NACE Certified personnel during the project, will be permitted without the approval of the Engineer.

B. Post Installation Testing

1. All testing shall be witnessed by the Engineer. The Contractor shall provide the Engineer a minimum notice of one week prior to the conducting of any testing.

2. Test Station Wiring Test Procedures

   Each test wire shall be tested with a high impedance (minimum 10 megohms) DC voltmeter and copper/copper sulfate reference electrode. The testing shall include the permanent reference electrodes, anodes, and all piping test wires. Testing shall be
conducted before the rectifier is turned on. Acceptance criteria: steel and ductile iron will be between 0.50 to 0.65 volt to a copper/copper sulfate (Cu/CuSO₄) reference; and the permanent copper/copper sulfate reference electrode will be between -0.05 and +0.05 volt to a portable copper/copper sulfate. All data (with GPS coordinates) shall be recorded and included in the final acceptance test report.

3. Structure-to-Earth DC Potential Measurements

Structure-to-earth DC potential measurements shall be obtained at each test station and at four equally spaced locations around the pump station before the rectifier is turned on (base potentials), with the rectifier turned on and adjusted for protection of the pump station (on potentials), and with rectifier temporarily turned off (instant off). The on and instant off potentials shall be measured no sooner than one week after the rectifier is initially turned on and adjusted. All data (with GPS coordinates) shall be recorded and included in the final acceptance test report. The potential measurements shall be performed with the following equipment:

a. M.C. Miller, Model M-3-A2 Multimeter or equal.

b. Copper/copper sulfate reference electrode.

c. Acceptance criteria for effective cathodic protection (according to NACE International Standard SP0169) as follows:

1) A negative polarized (instant off) potential of at least 850 mV relative to a saturated copper/copper sulfate reference electrode, or

2) A minimum of 100 mV of cathodic polarization (instant off potential minus the base potential) between the structure surface and a stable reference electrode contacting the electrolyte. The formation or decay of polarization can be measured to satisfy this criterion.

d. The acceptance criteria shall be required at each of the four test locations around the pump station.

4. Anode Current Output Measurements

Anode current output measurements shall be conducted using the shunts installed in the anode junction box, and a M.C. Miller, Model M-3-A2 Multimeter or equal.

5. Insulating Joint Testing

Test each insulating joint after assembly and prior to backfilling for insulation, using methods generally accepted in corrosion control engineering. Repair or replace defective or ineffective insulating joint.
Submit records of insulated joint testing including:

a. Test method and instruments used, with sketch of test connections.

b. Location of insulated joint, giving pipe station and/or street address.

c. Instrument readings of current, voltage, and calculated resistance.

6. Test Station As-Built Sketches

As-built sketches shall be made at each test station. The as-built sketches shall include measurements to three permanent structures in the immediate area of each test station and GPS coordinates for each test station. The as-built sketches shall be submitted in hard copy and electronically in AutoCAD format.

7. Preparation of a Final Test Report that includes all final test data (tabulated in computer generated format), a description of all test procedures, legible sketches with GPS coordinates of test locations, test station as-built tie-down sketches in AutoCAD format, and conclusions as to the condition and the operating status of, and the effectiveness of the cathodic protection (in accordance with NACE International SP0169 criteria) system. Certification that the cathodic protection system is functioning in accordance with NACE SP0169 shall be included. The Contractor's NACE Certified Cathodic Protection Specialist shall sign the Final Acceptance Test Report and include their NACE certificate number with their signature.

8. The Contractor shall utilize, as a minimum, the following corrosion control test equipment to perform the post installation testing. Any substitutions shall be submitted for approval by the Engineer.

a. M.C. Miller, Model M-3-A2 Multimeter or equal.

b. Multiple wire reels.

c. Copper/copper sulfate reference cells.

C. Defective or Improperly Installed Components

The repair or replacement of any defective or improperly installed systems shall be the sole responsibility of the Contractor. Any and all repairs or replacement of defective or improperly installed corrosion control systems shall be performed by the Contractor at no additional cost.
SECTION 16450

GROUNDING

16450.01 GENERAL

A. Description

1. This section includes materials, testing, and installation of electrical grounding.

B. Related Work Specified Elsewhere


C. Submittals

1. Submit shop drawings in accordance with the General Provisions.
2. Submit material list for all grounding materials and equipment. Indicate size, material, and manufacturer.

16450.02 MATERIALS

A. The Contractor shall provide and install a ground ring of minimum #4, stranded bare copper wire around the exterior of the pump station and wetwell. The wire shall be buried approximately 24” below grade. The ends of the wire shall be brought above grade and connected to the service entrance ground bus.

B. Ground Rods

Ground rods shall be copper-clad steel, 3/4-inch diameter, minimum 10 feet long, with hardened steel points.

C. Ground Clamps

Ground clamps shall be bronze.

D. Ground Resistance Tester

The ground resistance tester shall be an instrument specifically designed for ground resistance testing.

16450.03 EXECUTION

A. Ground Electrode
1. Install a bare copper ground loop as shown on the drawings. Bring the loop to the ground at the motors, distribution transformers, ground main service disconnect bus, or motor control centers. Buried or concealed joints or terminations are not permitted. Protect wires with PVC coated rigid steel conduit where wires stub up through slab at motor control center.

2. Install ground rods 6” below grade for new structures. Connect to ground loop with exothermic weld.

3. Equipment Grounding:
   a. Connect the ground buses of the distribution transformer to the ground bus within the panel with a grounding conductor.
   b. Ground raceways and non-current carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding. Grounding through the conduit system shall be in excess of any ground conductors shown on the drawings.
   c. Circuits in nonmetallic conduit shall carry one ground conductor for equipment grounding.

B. Preliminary Inspection/Test

Before making connections to the ground electrode, measure the resistance of the electrode to ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated. If a resistance of 5 ohms or less is not obtained, provide additional ground rods as necessary, driven below grade, and connect to ground test well with No. 4 AWG bare copper wire and repeat the test until 5 ohms or less is met. The Contractor and testing company shall then re-measure the ground resistance and submit the measurements to the County. If the resistance is still above 5 ohms install an additional ground rod and inform the County. Additional work will be authorized through a change order to obtain a 5-ohm resistance.

END OF SECTION
SECTION 16500

LIGHTING

16500.01 GENERAL

A. Description

1. This section includes materials and installation of lighting fixtures as indicated in accordance with Contract Documents.

B. Submittals

1. Submit shop drawings in accordance with the General Provisions as follows:
   a. Manufacturers catalog data including complete catalog number, photometric data, and descriptive literature.

16500.02 MATERIALS

A. General

1. Furnish lighting fixtures of the type indicated on the drawings, complete with lamps, sockets, wiring, and mounting hardware.

2. The use of a manufacturer’s name and model or catalog number in the drawings is for the purpose of establishing the standard of quality, photometrics, and general appearance desired only. Products of other manufacturers will be considered in accordance with the General Provisions.

B. Lamps

1. Fluorescent:
   a. 32 watt – T-8, energy saving, rapid start, 3000 lumen minimum initial output lamps for use with low ambient type electronic ballasts only, or of similar type for other fixtures.

2. High Pressure Sodium:
   a. Mogul base, instant re-strike, unless otherwise noted.

3. Incandescent:
   a. Ceiling or wall-mounted vapor proof w/guard and globe as noted on the drawings.
4. Manufacturers:
   
a. Fluorescents: General Electric, Sylvania, Westinghouse, or equal.

   b. Incandescent: Crouse Hinds, or equal.

   c. High Pressure Sodium: Lithonia, or equal

C. Ballasts

1. Fluorescent:

   Provide solid-state, low temperature, electronic T-8 ballasts compatible with the lamps provided. Provide ballasts with 97% minimum power factor, less than 20% THD, less than 1.7 current crest factor, Class A sound rating, IEEE 587A (ANSI C62.41) transient protection, FCC Part 18C, Class A EMI filtering, and UL listed.

2. High Pressure Sodium:

   Provide indoor-outdoor low temperature type ballasts. Ballasts shall be single lamp, volts and watts as indicated. At any lamp voltage, from nominal through life, lamp wattage shall not exceed 5% for +/-10% line voltage variation. Ballasts shall have a minimum power factor of 90% and be magnetic regulator type.

3. Manufacturers:

   Advance, General Electric, Jefferson, Universal, or equal.

D. Fixture Types

Refer to lighting schedule on drawings for fixture type.

16500.03 EXECUTION

A. Installation

1. Install lighting fixtures as close as possible to the locations shown on the drawings, making adjustments only for the purpose of avoiding interferences.

2. Install lighting fixtures plumb and level, with fixture surfaces parallel and perpendicular to walls and other major structures.

3. Install continuous rows of fixtures straight and true and equip with necessary parts, such as joining straps, couplings, and nipples.
4. Support fluorescent lighting fixtures at two point minimum from structural elements which are capable of carrying the total weight. Mount fixtures rigidly with no rocking action. Where fixtures are mounted in or on a suspended grid-type ceiling, support fixtures at two points in addition to support from the ceiling grid.

5. Aim exterior adjustable lighting fixtures after dark. Notify Engineer at least three (3) days in advance of adjustments.

6. Provide pendant stem-mounted fixtures with swivel hangers. Stem shall be one piece without coupling and shall be finished the same color as the canopy and the fixture, unless otherwise noted.

7. Provide mounting and anchoring of fixtures in accordance with the manufacturer’s requirements.

8. Emergency lighting units shall be arranged to provide the required illumination automatically in the event of any interruption of normal lighting such as failure of public utility or outside electrical power supply, opening of a circuit breaker or fuse or any manual act(s) including accidental opening of a switch controlling normal lighting facilities. Provide all the required components for a complete operation.

B. Preliminary Inspection/Test

Operate each fixture, at least five times, demonstrating that all lamps and fixtures are fully operational.

C. Final Inspection/Test

Repeat Preliminary Inspection/Test.

END OF SECTION
SECTION 16670

SURGE SUPPRESSION

16670.01 GENERAL

A. Description

This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

B. References

The following standards and publications are referenced for use in various sections of this specification.


C. Manufacturers Qualifications

1. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for the protection of electrical circuits and electronic equipment.

2. The surge suppressor manufacturer shall provide factory repair service for all non-encapsulated assemblies and replacement parts for all encapsulated units.
D. Warranties

1. All surge suppression devices shall be guaranteed by the manufacturer of the suppression devices for a concurrent five (5) year period on the equipment.

2. Should the suppressor be destroyed by lightning, a one-time replacement shall be provided during the warranty period at no cost to the Owner.

E. Submittal Requirements

1. Provide product data for each suppressor type in accordance with General Provisions.

2. The surge suppression submittal shall also include, but shall not be limited to, the following additional data:

   a. Dimensions for each suppressor type indicating mounting arrangement and required accessory hardware.

   b. Manufacturer’s certified test data derived from test results conducted on a completed unit indicating the ability of the product to meet or exceed the requirements of this specification.

16670.02 MATERIALS

A. Service Entrance Suppressor Device

1. Main distribution panel location shall be defined as designated in IEEE C62.41.1-2002, location Category C.


3. For 3 phase, 4-wire configurations, suppressors shall provide suppression elements between all phases and each phase conductor and the system neutral, providing a total of six (6) suppression elements.

4. Suppressor manufacturer shall provide certified test data confirming a fail short failure mode.

5. Visible indication of proper suppressor connection and operation shall be provided.

6. Suppressors shall meet or exceed the following criteria:

   a. Maximum single impulse current rating: 25,000 amperes (8 x 20 us - waveform).
b. Pulse life rating: 10,000 amperes (8 x 20 us - waveform): 30 occurrences.

c. Pulse life rating: 5,000 amperes (8 x 20 us - waveform): 180 occurrences.

d. Maximum clamping voltage and current rating:

<table>
<thead>
<tr>
<th>Phase Voltage (RMS)</th>
<th>Maximum Clamp Voltage (Peak)</th>
<th>Current Waveform 8 x 20 us</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 volts</td>
<td>450 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>120 volts</td>
<td>570 volts</td>
<td>10,000 amps</td>
</tr>
<tr>
<td>240 volts</td>
<td>785 volts</td>
<td>5,000 amps</td>
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<tr>
<td>240 volts</td>
<td>880 volts</td>
<td>10,000 amps</td>
</tr>
<tr>
<td>277 volts</td>
<td>1,040 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>277 volts</td>
<td>1,250 volts</td>
<td>10,000 amps</td>
</tr>
<tr>
<td>480 volts</td>
<td>1,600 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>480 volts</td>
<td>1,820 volts</td>
<td>10,000 amps</td>
</tr>
</tbody>
</table>

e. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

f. Suppressors shall be of solid-state componentry and shall operate bi-directionally.

7. Panel Board Suppressor Device

a. Subpanel location shall be defined as designated in IEEE C62.41.1-2002 location Category B.


c. For 3 phase, 4-wire configurations, suppressors shall provide suppression elements between all phases and each phase conductor and the system neutral. An additional suppression element is required between the system neutral and the electrical grounding conductor providing a total of seven (7) suppression elements.

d. The suppressor manufacturer shall provide certified test data confirming a fails short failure mode.
e. Visible indication of proper suppressor connection and operation shall be provided.

f. Suppressors shall meet or exceed the following criteria:

i. Maximum single impulse current rating: 10,000 amperes (8 x 20 us - waveform)

ii. Pulse life rating: 5,000 amperes (8 x 20 us - waveform): 50 occurrences.

iii. Pulse life rating: 1,000 amperes (8 x 20 us - waveform): 100 occurrences.

iv. Maximum clamping voltage and current rating:

<table>
<thead>
<tr>
<th>Phase Voltage (RMS)</th>
<th>Maximum Clamp Voltage (Peak)</th>
<th>Current Waveform 8 x 20 us</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 volts</td>
<td>490 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>120 volts</td>
<td>875 volts</td>
<td>10,000 amps</td>
</tr>
<tr>
<td>240 volts</td>
<td>810 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>240 volts</td>
<td>1,150 volts</td>
<td>10,000 amps</td>
</tr>
<tr>
<td>277 volts</td>
<td>1,170 volts</td>
<td>5,000 amps</td>
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<tr>
<td>277 volts</td>
<td>1,540 volts</td>
<td>10,000 amps</td>
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<tr>
<td>480 volts</td>
<td>1,750 volts</td>
<td>5,000 amps</td>
</tr>
<tr>
<td>480 volts</td>
<td>1,980 volts</td>
<td>10,000 amps</td>
</tr>
</tbody>
</table>

g. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

h. Suppressors shall be solid-state componentry and operate bi-directionally.

i. Suppressors shall also be provided for variable frequency drives.

16670.03 EXECUTION

A. Service Entrance Installation

1. Install one SPD at the main circuit breaker at each utility service entrance to the facility, according to manufacturer’s recommendations, and as shown on the drawings.

2. The SPD shall be installed on the load side of the service entrance.
3. The SPD ground shall be bonded to the service entrance ground.

4. Suppressors shall be close-nippled to the device being protected. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection.

5. Securely mount surge suppressor to wall, or panel with stainless steel hardware.

6. Conductors for connection of surge suppression shall be as recommended by the manufacturer for this application, and shall be wrapped together the full length of the conductors.

B. Panel Board Installation

1. Install SPD as indicated on the drawings and according to manufacturer’s recommendations.

2. Conductors between SPD and point of attachment shall be kept short and straight.

3. Neutral and ground shall not be bonded together at the panelboard locations.

C. Other Installation

Install SPD as required by equipment specifications and as shown on the drawings.

D. Testing

Provide factory certified test reports for each model of suppressor supplied, including test methods and equipment.

END OF SECTION
SECTION 16900

GENERAL INSTRUMENTATION REQUIREMENTS

16900.01 GENERAL

A. Description

This section includes requirements for materials, testing, and installation of control devices and instrumentation as specified herein and indicated on the drawings.

1. Instrumentation equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:
   a. Instrumentation: Instrument Society of America (ISA).
   b. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4.
   c. Control Panels and Equipment: NEMA, UL, and ANSI.
   d. Control Logic: Joint Industrial Council (JIC).

2. The system supplier (Subcontractor) shall provide the specified equipment under the following sections:
   a. Instrumentation: 16920.
   c. Description of Operation: 16965.

B. Submittals

1. Submittal Drawings and Data: Submittals shall be in accordance with the General Provisions with the following additional requirements. These drawings and data shall be submitted as a complete package at one time.
   a. Submittals shall be in three-ring hard-cover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced.
   b. Detailed JIC-style schematic diagrams of each discrete I/O point.
   c. Detailed instrumentation diagrams of each analog I/O point and control loop, per ISA S5.3 and S5.4 standards.
d. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:

i. Component name.

ii. Manufacturer’s model number.

iii. Project location.

iv. Input and output characteristics.

v. Requirements for electric supply.

2. The data sheets shall be grouped together in the submittal by systems or loops. If within a single system, a single component is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that component in that system.

3. Submit component interconnect drawings showing the interconnecting wiring between each component including equipment supplied under other sections requiring interfacing with the control system. Submit wiring diagrams, schematics and loop drawings for each panel and enclosure provided. Drawings shall include terminal block and wire identification for panel and field equipment connections. This shall include the PLC/bubbler control panel, SCADA control panel, motor control terminal blocks and field equipment terminal blocks.

4. Submit arrangement and construction drawings for control panels and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly including a finish color sample.

5. Submit installation, mounting and anchoring details for all new and relocated components or entry details.

6. Complete detailed bills of material.

7. Operation, maintenance, and repair manuals.

a. The organization of the initial submittal shall be compatible to eventual inclusion one volume of the operation, maintenance and repair manuals.

b. Operation manuals shall be prepared and submitted to the Engineer in accordance with the General Provisions.
c. In addition to the General Provisions, the complete operation and maintenance manual shall contain all the information included in the submittal drawings and data, and the additional information required herein, all bound in hard cover binders and arranged for convenient use including tab sheets, all indexed and cross referenced, and all final as-built drawings.

d. The operation manual shall contain:

i. Programming operating instructions written for the benefit of plant operating personnel for normal operational conditions.

ii. Calibration and maintenance instructions.

iii. Trouble-shooting instructions.

iv. Instructions for ordering replacement parts.

8. Software

a. Submit all drawings in AutoCAD format on CD, version 2006 or higher.

b. Submit all configuration software logic on CD in applicable PLC language.

c. Any software shall be registered to Anne Arundel County. Submit verification prior to purchase.

C. Qualifications and Responsibility of the Subcontractor

1. The Contractor shall furnish and install all proposed hardware and/or software as specified herein. All systems shall be the unit responsibility of a Control System Integrator subcontracted by the Contractor. The system installation and wiring connections to peripheral equipment and instruments shall be the responsibility of this subcontractor using qualified personnel possessing the necessary equipment and having experience in making similar installations. Evidence of such qualification, as well as notification of the supplier assuming unit responsibility, shall be furnished to the County in writing prior to commencement of the work. The qualification evidence shall include the following:

a. The subcontractor shall have had a minimum of five years’ experience with the installation of systems similar to those to be installed in this project.

b. The Subcontractor’s main place of business shall be located within a 50-mile radius of the jobsite.
c. A list of completed similar installations including name and address of owner, name of project, and date of completion.

d. The name and qualifications of supervisory personnel to be directly responsible for the installation of the control system.

e. All supervisory personnel shall be regularly employed by the Control System Integrator and shall have their employment address within 50 miles of the jobsite.

2. The Control System Integrator shall be responsible for coordinating and interfacing with equipment and instrumentation supplied under other divisions of the contract documents or to existing equipment which are an integral part of the system(s). This interfacing shall be incorporated in the detailed systems drawings and data sections.

3. The proposed field instruments shall be new. Manufacturers and model or type numbers are provided as part of the instrument narrative descriptions. The proposed manufacturers are those on which the instrument design has been based.

4. The Engineer will witness calibration and final checkout of the instrumentation and control system, prior to testing to determine if the system complies with the contract documents.

D. System Programming and Configuration

1. The Control System Integrator shall provide all programming required for system configuration; communications to the I/O, communications via the Open Bus network, and general system operation. The Contractor shall make the system completely operational, less the PLC control strategy logic.

2. A Programming Engineer representing the County will provide the final system programming of the control strategy logic after successful configuration of the system is demonstrated by the Contractor. All system configuration application software will be provided to the Programming Engineering prior to the Preliminary testing for implementation in the control logic.

3. The Control System Integrator shall be responsible for providing all software, hardware, and equipment necessary for configuration, programming, and testing of the specified control system equipment and instrumentation.

E. Warranty

1. The Contractor shall repair or replace defective components, rectify malfunctions, and correct faulty workmanship, at no additional cost to the County during the one-year
warranty period. To fulfill this obligation, he shall utilize technical service personnel designated by the equipment supplier who was originally assigned project responsibility. Services shall be performed within five calendar days after notification by the County.

16900.02 MATERIALS

A. Designated Components

In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in Instrument Society of America Standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer’s standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Instrument Tagging

1. Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number. The manufacturer’s standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

2. Once final field calibrations have been completed, the contractor shall tag the instrument with the final calibrated range on an engraved plastic tag. The tag shall be black with white engraved lettering and attached to the instrument with a stainless steel wire-tie.

C. Instrument System Power

1. Power provided for the instrument system at the facility shall be 120-volt A-C, single phase, 60 Hz.

2. Where D-C power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies. Power supplies shall be sized for the load plus 25% spare capacity.

D. Matching Style, Appearance, and Type

All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and points.

16900.03 EXECUTION

A. Execution
1. Uniformity of Components

Components which perform the same or similar functions shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and have the same appearance.

2. Mounting of the Control Devices and Instruments

   a. Mount the Control Devices and instruments in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Engineer. Install equipment so that it is rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Cabinets shall not be installed until heavy construction work adjacent to any PLC panels have been completed to the extent that there shall be no damage to the PLC and terminal equipment.

   b. All devices, including accessories, shall be located where they shall be accessible from grade, except as shown otherwise.

   c. Mount all equipment in cabinets as specified under this contract. Associated terminals shall be mounted on a common panel or rack; mounting panels and rack shall be constructed as described herein.

   d. Coordinate the installation of the electrical service to the components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

   e. Test the completed system after installation to assure that all components are operating within the specified range and all interlocks are functioning properly.

B. Calibration

1. Each instrument requiring factory calibration shall be furnished with a calibration data sheet. The calibration data shall be factory certified to NIST standards and a copy of the calibration data sheets included with the O&M manuals.

2. In addition to factory calibration, calibrate systems after installation in conformance with the component manufacturer’s instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration and accuracy, either individually or within a system, shall be replaced. Accomplish this calibration
work by a technical field representative of the single instrument supplier. He shall certify in writing to the Engineer that all calibrations have been made and that all systems are ready to operate.

3. Once final field calibrations have been completed, the contractor shall tag the instrument with the final calibrated range on an engraved plastic tag. The tag shall be black with white engraved lettering and attached to the instrument with a stainless steel wire-tie.

C. Factory Testing

1. Operational tests shall be performed prior to shipping control system(s) to the jobsite to demonstrate that the hardware and configuration is correct and will perform each operation required for all specified conditions. The connections and wiring to all the open bus communications modules shall be performed at the factory test with the specified components. Additionally all instrumentation shall be included and connected to the control system(s) for demonstration. The Engineer and a representative for the County shall have the right to witness the tests. After the testing is completed, provide a certification and log of all tests to the County for review and comment. The panel wiring shall be checked against the submittal drawings.

2. The factory witness test shall take as long as necessary to demonstrate to the County and the Engineer that the hardware performs each operation as required per the specifications. The control system equipment shall not be shipped to the site until the factory test is successfully completed and approved by the County.

3. Fourteen days prior to factory system testing, submit a written detailed test procedure for review by the County. Notify the County in writing four weeks in advance of the scheduled testing.

D. Preliminary Inspection/Testing

1. After control system(s) installation is complete, all instruments are calibrated, and all wiring is installed and connected, a preliminary test shall be performed by the Contractor.

2. All hardware and/or configuration software shall be exercised through point to point tests, including the factory test procedure by the Instrument System Subcontractor, in the presence of the Engineer, in order to demonstrate achievement of the specified performance.

3. Schedule tests among all parties involved so that the tests may proceed without delays or disruptions by uncompleted work. Coordinate operational tests dependent upon completion of work specified elsewhere.
E. Conditional Acceptance Inspection/Test

1. When hardware and system configuration is assessed to have been successfully carried through a preliminary test and the County concurs in this assessment, a date for Conditional Acceptance Testing, involving the County’s operating personnel and the programming engineer will be agreed upon.

2. The complete control system and instrumentation shall be rechecked by the contractor as required in the preliminary inspection test at this time to verify proper operation, and final adjustments shall be made.

3. Upon 100% successful completion of the preliminary testing, and approval of the test results by the Owner, the County’s Programming Engineer will load any control logic software in the PLC.

4. The programming engineer will debug their software for a total time of 10 (ten) working days, with the assistance of the Contractor verifying the hardware, prior to the start of the Conditional Acceptance Test.

5. Upon completion of the debug period, the system start-up testing shall consist of 14 consecutive days of system testing. The operational tests shall have a success factor of 95% system uptime. If the instrumentation, hardware control system, cabling, or configuration should fall below the 95% factor, the system problems shall be corrected by the contractor and the system start-up shall start over again from day one. This will continue until the system functions for 14 consecutive days with a 95% uptime success factor. The contractor is responsible for all hardware operation of the system, and the initial determination of the problem.

F. Operator Training (On-Site)

1. Provide the County’s operation and maintenance personnel and/or the Engineer with three (3) days of formal instruction in the functions and operations of the hardware, system configuration, and overall system operation as provided under this contract, prior to the Conditional Acceptance Inspection/Test. The training shall cover overall system theory, hardware architecture, system configuration and diagnostics. Emphasis shall also be placed on safety features, maintenance and features, which may require readjustment, resetting or checking and recalibration.

2. The training shall include PLC operation, Open bus operation, I/O configuration, instrument indication and control, configuration software and PLC interface. The training sessions shall be provided at the County’s facilities and on the equipment furnished under this contract. The approved final O&M manual shall be utilized as a guide for the training
sessions. The education and instruction of operating personnel shall be a qualified instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the County.

3. A detailed training session curriculum shall be provided to the Engineer a minimum of four weeks prior to the start of the training session.

G. PLC Training (Off-Site)

1. The following training shall be provided for a minimum of (4) county personnel. The training shall be with the same equipment as provided for the project.

2. Provide “Siemens S7-1200, Programming I Course,” course # S7200 P1B or “Rockwell Automation Developing an RSLogix5000 Project Course,” course #CCP-143.

3. Training shall be provided within 50 miles of site at authorized training facility.

END OF SECTION
SECTION 16920

INSTRUMENTATION

16920.01 GENERAL

A. Description

1. This section includes requirements for supplying and testing calibrated field-mounted transmitters, and associated equipment to be provided under Section 16900.

B. Submittals

1. Submit shop drawings for the instrumentation in accordance with Section 16900 and Section 5.04 of the General Provisions.

2. Submit certified dimensional drawings and catalog cuts for each size and type of instrument specified herein. Catalog cuts are to be highlighted to define specific materials of construction and features specified herein. Show tag number of each applicable instrument.

3. Submit instruction bulletins for each type of instrument specified herein. Show tag number for each applicable instrument. The instruction bulletin shall include installation instructions, wiring diagrams, power requirements, maintenance instructions, and any other details of a specialized nature to the instruments furnished.

4. Submit certificates of compliance that the flow meter satisfies the requirements stipulated in this section.

5. Submit Operating and Maintenance Data.

6. Submit Manufacturer's Certification that equipment has been installed properly and observed to function properly when operated

16920.02 MATERIALS

A. Instrumentation Provided Under This Section Includes:

1. Display Meters.

2. Float Switch.

3. Airflow Switch (Drywell Supply/Exhaust Fans).

B. Display Meters
1. The display meters shall be 24 VDC powered device with a DC input 4-20 mA. The display meter shall be a digital indicator and shall display 3.5 digits with an accuracy of +0.1% of full scale.

2. Provide a display meter for each wet well level indication. The calibrated range of the indicator should match the calibrated range of the transmitter.

3. Install the display meters for the wet well level on the Bubbler Panel.

4. Provide Red Lion Model #CUB5PBOO, 24 Volt DC, or equal.

C. Float Switch

1. Float (ball) shall be 5-1/2” diameter leakproof, shockproof, corrosion resistant and constructed of type 316 stainless steel. Float shall have continuously welded seams.

2. Switch assembly shall be a mercury-free, tilt type sensor, which shall be non-floating displacement type with less than 1-inch differential. Switch assembly shall be permanently encapsulated in plastic cartridge (glass shall not be acceptable). Switch contacts shall be rated a minimum of 20 amperes at 115 VAC. Switch shall be a single pole, single throw type. Furnish normally closed contacts. The float body shall be grounded by the green insulated conductor of the cable supporting the float switch.

3. Cable shall be provided with the sensor and shall be PVC insulated, oil resistant suitable for use in raw wastewater applications. Cable shall be sealed at sensor utilizing a flexible boot and compression type lock seal. Cables shall be a 3-wire cable provided with a minimum size conductor of No. 14 AWG with green grounding conductor. Float switch cable length shall be furnished with continuous length to mount float switches in the wet well and up to the existing explosion-proof junction box on the pump station exterior, plus an additional 5 feet of cable. Excess cable shall be coiled and tie wrapped to mounting supports.

4. The float system shall be designed to protect against cable stress associated with constant flexing and shall incorporate a neoprene sleeve from the float through a flared stainless steel clamp tube. This design shall provide for a projected flexing life of 35 years of 15-minute cycling. The float system shall have a manufacturer's three (3) year guarantee against defects in material and workmanship.

5. Provide a wet well high level float and a drywell flood float as shown on the drawings.

6. Float switches shall be Model 9G-EF, mercury-free, Direct Acting Float Switches with cables and weights, as manufactured by Siemens Water Technologies, or equal.
D. Air Flow Switch

1. The flow switch shall utilize a rugged, hermetically sealed reed switch which is encapsulated in a polypropylene switch housing that fits into a standard heavy duty leak proof stainless steel body. The flow switch shall be field adjustable from normally open to normally closed. The airflow switch shall be suitable for installation in Class 1, Division 2 hazardous locations. The switch shall be UL recognized and CSA certified.

2. Flow switch shall be manufactured by W.E. Anderson (Dwyer) Model No.V6, or equal.

3. GENERAL

<table>
<thead>
<tr>
<th>Service</th>
<th>Dry Well Supply and Exhaust Fans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>2</td>
</tr>
<tr>
<td>Tag No.</td>
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<tr>
<td>Magnet</td>
<td>Ceramic.</td>
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<td>Temperature Limit:</td>
<td>-4 to 220 deg. F. (-20 to 105 deg. C)</td>
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<tr>
<td>Range</td>
<td>0-100 FPM</td>
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<tr>
<td>Location</td>
<td>Supply and Exhaust Fan Duct (Dry Well)</td>
</tr>
<tr>
<td>Mounting</td>
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</tr>
<tr>
<td>Switch Type:</td>
<td>SPDT snap switch</td>
</tr>
<tr>
<td>Contacts/Relay</td>
<td>5 A @ 120 VAC</td>
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<tr>
<td>Conduit Connection:</td>
<td>3/4&quot; female NPT.</td>
</tr>
<tr>
<td>Process Connection:</td>
<td>3/4&quot; male PDT. Provide 3/4&quot; fitting to HVAC pipe/duct</td>
</tr>
<tr>
<td>Mounting Orientation:</td>
<td>Within 5 deg. of vertical for proper operation.</td>
</tr>
</tbody>
</table>
Set Point Adjustment: For universal vane: five vane combinations.

Agency Approvals: UL, CSA, CE, FM, SAA and ATEX.

E. Spare Parts

1. The Contractor shall furnish to the County all necessary spare parts of components required to maintain the instrumentation system prior to final acceptance of work. The Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the County. The spare parts shall include but not be limited to, the following minimum requirements:

2. Minimum Spare Part List

<table>
<thead>
<tr>
<th>Item</th>
<th>Part Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Meter</td>
<td>Complete Unit</td>
<td>1 each</td>
</tr>
</tbody>
</table>

3. The Contractor shall deliver to the County all the required spare parts upon conditional acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee or startup period.

16920.03 EXECUTION

Refer to Section 16900 regarding mounting, calibration, testing and training requirements.

END OF SECTION
SECTION 16946
CABINETS, CONTROL SYSTEM, AND DEVICES

16946.01 GENERAL

This section includes requirements for materials, and installation of the cabinets, control panels and consoles to be provided by the Contractor and by the Control Systems Integrator subcontractor under Section 16900. All control panels shall be UL rated.

16946.02 MATERIALS

A. Cabinets, Panels and Enclosures

1. The enclosures shall be floor, wall or post-and-backboard mounted as indicated on the drawings. Interior enclosures shall be NEMA 1 for dry locations unless otherwise specified or indicated on the drawings. Provide NEMA 4X, non-metallic enclosures or NEMA 4X, stainless steel enclosures for exterior locations unless otherwise noted. Access door shall have continuous hinges with neoprene gaskets. Cabinets shall be constructed from formed 12-gauge steel. All exposed edges and welds on the enclosure shall be ground smooth.

2. The interior and exterior of steel enclosures shall be painted with a rust-inhibiting primer and two coats of epoxy gray paint or gray polyester powder paint over phosphatized surfaces. Stainless steel enclosures shall not be painted.

3. The interior shall be provided with a formed 14-gauge subpanel for attaching surface-mounted components and a hinged subpanel for front panel mounted hardware. All components shall be attached with screws and the subpanel shall be threaded. Rivets or back of panel nuts shall not be allowed. Each interior shall be equipped with lighting, 120-volt 20-ampere duplex GFI receptacle, and circuit breakers where shown on the drawings. The interior shall be painted with two coats of white enamel paint. Refer to instrumentation drawing for enclosure size and installation details. Enclosures shall be a Hoffman, or equal.

B. Panel Control Circuit Devices and Components

1. General: All components, except those on the front panels, shall be mounted behind on fixed or swing-out panels; terminal blocks for field connections shall be mounted on fixed channels located near the bottom of the sections but clear of the conduit entry area. Fixed panels shall be located so as not prevent access within the cabinets to other components, wiring, and terminal blocks on fixed panels or front panels.
2. Control Relays: Control relays shall have either 24-volt d-c or 120-volt a-c coils. Control relays shall be 10-ampere, 300-volt, DC relays shall be blade type and AC relays shall be pin type with dust cover, LED indication, and sockets. All relays shall be of one manufacturer, IDEC Series RR3, Square D 8501K Series, or equal.


4. Wire marking: Each signal and circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be Thomas & Betts sleeve markers, T&B Shrink-Kon, or equal.

5. Terminal Blocks: Terminal block shall be high-density type molded plastic with barriers and box lug terminals and shall be rated at 300-Volts. White marking strips, fastened securely to the molded sections shall be provided with printed wire numbers or circuit identifications. Terminal screws will be accessible with a standard size narrow blade screwdriver. Provide all required terminal blocks and 25% spare numbered terminal blocks. Terminal blocks shall be Phoenix Contact Type UK with mounting rack or equal.

6. D-C Power Supplies: Provide d-c power supplies as required for analog loops and d-c circuits. Each power supply shall be enclosed and include internal short-circuit protection. Current requirements shall not exceed 75% of manufacturer maximum rating. All power supplies shall provide a regulated DC output voltage within +/- 3% and shall be suitable for DIN rail mounting.

7. Receptacles: Duplex receptacles shall be molded composition, ivory, specification grade. Duplex receptacles for 120-volt, single-phase, 3-wire service to be rated 20-amperes, 125-volts, back or side wired, NEMA Type 5-20R. Provide ground fault interrupter type where indicated.

8. DC Signal Conditioner: Provide a DC Signal Conditioner where required to drive or isolate loads. The signal conditioner shall have input and output ranges compatible with the associated equipment. The DC input/output isolation shall allow up to 600 V differences between grounds. The conditioner shall have an accuracy of +/-0.1% of input span, a zero and span adjustment and a maximum response time of 100msec. The operating temperature range shall be 0 to 60 degrees C. Power for the signal conditioner shall be 120 VAC at 60 Hz. Provide an Action Instruments Action Pak Model 4300, or equal.

9. Push Buttons, Selector Switches, and Indicating Lights: Push buttons, Selector Switches, and Indicating Lights shall be 30.5-mm, round, heavy duty, oil tight type with synthetic
rubber boots and include any special gasketing required to make the installation watertight. Indicating lights shall be push-to-test LED type.

10. AC Power Line Protector: The AC power line protector shall be a solid state low pass non-linear filter to protect I/O cabinet equipment from spikes, transients, and noise on incoming AC power lines. The protector shall be rated 120-volts A-C, 15 amps, 60 Hz. The response time shall be 5 nanoseconds nominal with maximum attenuation and sinusoidal restoration through 50 microseconds. The protector load regulation shall be 1% or better across the range. The operating temperature range of the protector shall be -40 to +70 degrees C. The AC power line protector shall be an Islatrol manufactured by Control Concepts Corporation, or equal.

11. Cycle Timer: For fan controls, provide a cycle timer with a 120 VAC motor, timing range of 1.2 seconds to 300 hours, 5 amp contacts, and a repeat accuracy of +/- 0.31%. The cycle timer shall be manufactured by Omron, model H3CR-F8-300AC100-240, or equal.

12. Intrinsically Safe Relays (ISR)

a. Where indicated, intrinsically safe relays shall be provided with an energy barrier limiting the available voltage and current in the Hazardous Location. The relays shall interface with non-explosion proof field devices which are mounted in the hazardous Locations. The circuits shall be rated and suitable for field device protection in Class I, Division I, Group D Hazardous Locations.

b. The relay shall be constructed of plastic and glass reinforced nylon and suitable for back plate or DIN rail mounting. Terminals shall have captive screws with self-lifting clamps.

c. Intrinsically safe relays shall be single channel, accepting a dry contact input. The relay shall operate on 24VDC power supply and shall be provided with one SPDT programmable output relay to obtain (1) N.O. or (1) N.C. contact.

C. Panel Control Circuit Wiring

1. Instrumentation signal cables shall be of the type used for process control with shielded pairs or triads with polyvinyl jacket and overall shield over the multiple pairs or triads. The instrumentation cable shall be rated 300 volts at 90 C or better. The size of the instrumentation cable shall be AWG No. 16 with seven strands minimum, unless otherwise specified elsewhere. All instrumentation cables shall meet all the requirements of IPCEA S-61-402 and shall be UL listed.

2. 120-volt a-c wiring within the panel shall be AWG No. 14 MTW or THHN. Main power (120-volt a-c) to the panels shall be wired using color coded AWG No. 12. A-C power to
all system power supplies, CRTs, printers, and computers, shall be accomplished using molded 3-wire plug cords.

Wires shall be color coded in accordance with the following table:

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLACK</td>
<td>L1 (hot)</td>
</tr>
<tr>
<td>WHITE</td>
<td>L2 (neutral)</td>
</tr>
<tr>
<td>RED</td>
<td>A-C control circuits</td>
</tr>
<tr>
<td>BLUE</td>
<td>D-C circuits</td>
</tr>
<tr>
<td>YELLOW</td>
<td>Interlock control circuits wired from an external power source</td>
</tr>
<tr>
<td>GREEN</td>
<td>Equipment ground</td>
</tr>
</tbody>
</table>

*All conductors in this section shall be stranded.*

a. All interfacing between the cabinet and the field shall be accomplished at a terminal strip (TB-1). No internal panel wiring shall be connected to terminals on the “field side” of TB-1. Likewise, no field wiring shall be connected to terminals on the "panel side" of TB-1. DC and AC voltage circuits shall be separated utilizing independent terminal strips and wireway duct.

b. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties and shall be secured to panels at both sides of the hinge loop so that conductors are not strained at terminals.

c. Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using Panduit adhesive mounts with Eastman No. 910 adhesive.

d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

e. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer’s review.

f. Signal conditioners and control interface relays shall be provided wherever proper instrument interfacing dictates use of these components. Each auxiliary device shall
be assigned a tag number and shall appear on the panel shop drawings.

g. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be laminated plastic with an adhesive backing. The labels shall be consistent in size throughout the panel.

h. When input connections are made to existing circuits, the Contractor shall verify the control voltage. Provide power for the existing circuits compatible with the existing controls for dry contact inputs, powered outputs, and analog circuits as required.

i. All components, device, PLC I/O (including spares) shall be wired to terminal blocks. Each terminal block shall include a unique number. This is to include all contacts from relays in the control cabinet.

16946.03 EXECUTION

Refer to Sections 16900 and 16920.

END OF SECTION
SECTION 16965

DESCRIPTION OF OPERATION

16965.01 GENERAL

A. Description

1. The control system shall consist of new combination VFD/motor controls, and existing bubbler control panel with programmable controllers, a bubbler system, and PLC programming software. All new equipment shall be compatible with the existing equipment and shall be provided for the Project as shown on the drawings.

2. This section provides information with regard to the system operation, and overview of components. For actual quantities and requirements of equipment refer to specifications and drawings.

B. Exiting Bubbler Control Panel

The existing bubbler control panel will provide control for the new raw sewage pumps. The new combination VFD/Motor starters shall be incorporated into the existing control panel programmable logic which will provide automatic control and process and alarm monitoring for the new raw sewage pumps.

16965.02 CONTROL DESCRIPTIONS

A. General Description

1. The two (2) new raw sewage pumps will be located in the dry well.

2. New Combination VFD/full voltage starters will be provided for each pump as shown on the drawings.

B. Raw Sewage Pump Motor Controls

1. A VFD/full voltage motor controller will be provided for each raw sewage pump unless otherwise shown. Each drive enclosure will house the following:

   a. Main Disconnect Circuit Breaker.

   b. PWM-VFD and NEMA rated bypass Motor Starter as indicated.


   d. Control Transformer.
e. H/O/A Selector Switch.

f. Run Relay.

g. Run Indication Light.

h. Devices and Controls as shown on the Drawings.

C. Existing Bubbler Control Panel

1. The existing bubbler control panel will provide the control the two (2) new raw sewage pumps. The control panel shall operate the pumps (i.e. ON and OFF) at a preselected fixed speed programmed at the VFD or via the full voltage bypass starter as selected by the operator at the combination VFD/motor starter unit.

D. Programmable Controller Inputs and Outputs

1. The programmable controller inputs and outputs for the Raw Sewage Pumps will be wired to and from the PLC located in the Bubbler Control Panel, as shown on the drawings.

2. Description of Operation

a. The two raw sewage pumps will be operated by the VFD/motor controls and will be controlled by the individual H/O/A selector switches. The “hand” and “off” positions of the H/O/A selector switches provide manual start/stop control of the pumps. When the H/O/A switch is in the “hand” position, the pump may be manually controlled. When the pump H/O/A switches are in the “auto” position, the raw sewage pumps will be automatically controlled by the PLC from a start/stop signal as indicated. The signal will respond to the wet well level as follows:

i. Level setpoints will be programmed in the PLC for the following wet well levels:

   a. Lead Pump Stop.
   
   b. Lead Pump Start.
   
   c. Lag Pump Stop.
   
   d. Lag Pump Start.

b. The existing level controller will be configured in the programmable controller to control the starting and stopping of the pumps.
E. RTU Alarms

1. The following outputs shall be generated by the combination VFD/motor starter and transmitted to the SCADA RTU for alarming:
   
a. VFD Failure
   Control Relay/Contact In VFD

2. The Drywell Flood Alarm shall be generated when the drywell float switch is activated and a signal to the RTU.

3. A High Emergency Storage Tank Alarm shall be generated when the high level float is activated. The signal shall be connected directly to the RTU.

4. A ventilation air flow alarm shall be activated when there is a failure of the dry well supply or exhaust fans when provided. The alarm will provide a local indication as well as a remote alarm to the RTU.

5. A Personnel Alarm Pushbutton Station shall be installed in the Emergency Storage Tank for staff duress alarm notification to the RTU.

6. A Personnel Alarm Pushbutton Station shall be installed in the Emergency Storage Tank for staff duress alarm notification to the RTU.

16965.03EXECUTION

Refer to Sections 16900, 16920 and 16946.

END OF SECTION
SECTION 16970

TESTING AND COMMISSIONING

16970.01 GENERAL

A. Tests

1. All work shall be tested regularly during its progress. The Owner shall have the authority to require testing of any portion of the work at any time. The Contractor shall provide all labor and material as necessary in making such tests. The foreman in charge of work shall give his personal attention, together with any other assistance required, in order to investigate any portion of the work. As a minimum, the following tests shall be performed: insulation resistance, load balancing in switchboards and panelboards, correct rotation of motors.

2. Perform all tests in the presence of the Owner. Furnish labor, materials, and instruments necessary to conduct the tests.

3. On completion, the work is to be inspected and must satisfactorily pass tests against short circuits and grounds.

4. Motor rotation shall be checked and corrected if necessary.

5. The electrical Contractor shall be present during the test operation of all process, mechanical, and HVAC equipment to which electrical connections have been made.

6. After all the work is completely installed, the Contractor shall operate the systems and equipment in the presence of the Owner's personnel and shall demonstrate the proper operation of all controls.

7. The Contractor shall demonstrate the proper operation of all alarm devices.

B. Responsibility During Tests

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

C. Failure of Tests

1. Any defects in the equipment, or deviations from the requirements of the Contract Documents shall be promptly corrected by the Contractor by replacements or otherwise. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when re-tested shall fail again to meet the contract requirements, the Owner (notwithstanding having made partial payment for work and materials) may reject the
equipment and order the Contractor to remove it from the project at the Contractor's expense.

**16970.02 MATERIALS**

Not Used

**16970.3 EXECUTION**

Not Used

END OF SECTION
PART III

APPENDICES
APPENDIX A

GEOTECHNICAL EXPLORATION REPORT
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Appendices

APPENDIX A – Location Sketches (2)

APPENDIX B – Test Boring Logs (3)

APPENDIX C – Geotechnical Laboratory Test Results
1. EXECUTIVE SUMMARY

Pennoni Associates Inc. (Pennoni) completed the geotechnical exploration for the proposed below grade emergency storage tank and valve vault located at the existing Cape St. John 1 Sewage Pumping Station in Annapolis, Maryland. The purpose of our exploration was to: perform geotechnical field and laboratory testing; classify the subsurface soils in the proposed storage tank and valve vault areas; and provide our conclusions and recommendations for design and construction of the storage tank.

Based on the information provided, we understand that Anne Arundel County desires to construct a 16,000 gallon below grade emergency storage tank and an 8 feet long by 8 feet wide valve vault at the existing pumping station to comply with current guidelines. We understand that the storage tank bottom is proposed to be approximately 14 feet below existing grade (elev. -5 feet, NAVD88) and the bottom of the valve vault is proposed to be approximately 10 feet below existing grade (elev. -1.5 feet, NAVD88). The proposed location of the storage tank is the southeast corner of the site between Cape St John Road and the existing pumping station. The proposed location of the valve vault is at the southwest corner of the existing pumping station south of the existing dry well.

Currently, the proposed storage tank and valve vault location is a grass covered area south of the existing pump station and north of Cape St. John Road. An existing, abandoned soil odor filter system is located within this area. We understand that the soil odor filter system will be demolished prior to construction of the structures. Topography of the site is relatively flat, with elevations ranging from approximately 8 feet to 13 feet (NAVD88).

Three Standard Penetration Test (SPT, ASTM D1586) borings were performed on October 13th, 2014 to depths of approximately 30 feet below the existing ground surface at the southeast and northeast corners of the proposed tank and at the south east corner of the valve vault. See Appendix A for boring locations. Boring “B-4” was proposed at the northwest corner of the proposed valve vault but was not performed due to the existing soil odor filter system and adjacent underground surge valve vault impeding access.

Subsurface stratigraphy encountered by the test borings generally consisted of a surficial layer of topsoil underlain by fill consisting of loose to medium dense silty sand. The fill material is underlain by loose to medium dense silty sand. The silty sand material is underlain by very loose to loose fine to medium sand. A layer of very soft sandy silt was encountered in boring “B-3.” Groundwater was encountered at depths ranging from approximately 8.5 to 9 feet below existing ground surface (elevations -0.5 feet to 0.5 feet, NAVD88).
Based on the subsurface stratigraphy encountered in the proposed storage tank area, we recommend designing the mat foundation using a subgrade reaction modulus of 150 pounds per cubic inch for foundations bearing on the medium density or greater soils of Stratum B. Maximum net contact pressure should not exceed 3,000 psf for a mat foundation bearing in the medium density or greater silty sand (Stratum B). Total settlement is estimated to be on the order of less than 1 inch for footings/foundations sized using this allowable bearing capacity.

Based on the subsurface stratigraphy encountered in the valve vault area, we recommend designing the mat foundation using a subgrade reaction modulus of 25 pounds per cubic inch for foundations bearing on the very soft or greater soils of Stratum C. A subgrade reaction modulus of 200 pounds per cubic inch may be used if approximately 2 feet of Stratum C soil is removed below the proposed foundation and replaced with a layer of geogrid (e.g., Tensar BX1100 or equivalent) followed by 2 feet of #57 stone. Maximum net contact pressure should not exceed 1,000 psf for a mat foundation bearing in the very soft or greater clayey silt (Stratum C) or the #57 stone backfill mentioned above. Total settlement is estimated to be on the order of less than 1 inch for footings/foundations sized using this net allowable contact pressure.

Groundwater was encountered above the proposed foundation elevations. Therefore, hydrostatic uplift is a significant factor in selecting the foundation type and dewatering will most likely be necessary during installation. We understand that hydrostatic uplift calculations will be performed by the tank designer once the exact location and loading conditions have been determined. We recommend that a design water table elevation of 0.5 feet be used for normal groundwater conditions, with a flooded condition being used for a “worst case” scenario. Consideration can be given to tie downs, helical anchors, or a thicker concrete mat to counteract the uplift pressures.

Included in this report is a summary of our field and laboratory testing, subsequent analyses, and recommendations for design and construction of the proposed emergency storage tank and valve vault.
2. INTRODUCTION

2.1. PROJECT DESCRIPTION

The site is located within the Cape St. John 1 Sewage Pumping Station in Annapolis, Maryland as indicated on the site location sketch included in Appendix A. We understand that Anne Arundel County desires to construct a 16,000 gallon below grade emergency storage tank and an 8 feet long by 8 feet wide valve vault at the existing pump station to comply with current guidelines. We understand that the bottom of the storage tank is proposed to be approximately 14 feet below existing grade (elev. -5 feet, NAVD88) and the bottom of the valve vault is proposed to be approximately 10 feet below existing grade (elev. -0.5 feet, NAVD88). The proposed location of the storage tank is at the south end of the site between Cape St John Road and the existing pumping station. The proposed location of the valve vault is at the southwest corner of the existing pumping station, south of the existing dry well. We understand that the location of the storage tank may change but will be located within the area between the existing pump station and Cape St. John Road.

2.2. INFORMATION REVIEWED

The following information was utilized to develop this report:

- A statement of work titled “Cape St. John 1 Sewage Pumping Station Retrofit – Detailed Description of Scope of Project – Exhibit A,” developed by Anne Arundel County, dated May 10, 2012;
- A report titled, “Cape St. John 1 SPS Retrofit – Schematic Design Report,” developed by Pennoni, dated April, 2014; and
- A letter report titled “Cape St John 1 Sewage Pumping Station Retrofit – Emergency Storage,” developed by Pennoni, dated September 12, 2014.

2.3. EXISTING SITE CONDITIONS

Currently, the proposed storage tank and valve vault location is a grass covered area south of the existing pump station and north of Cape St. John Road. The existing soil odor filter system is located within the proposed storage tank and valve vault areas. We understand that the soil odor filter system will be demolished prior to construction of the structures. Topography of the site is relatively flat, with elevations ranging from approximately 8 feet to 13 feet (NAVD88).
2.4. OBJECTIVES OF GEOTECHNICAL EXPLORATION PROGRAM

The objectives of our geotechnical evaluation were to determine subsurface conditions at the project site, evaluate these conditions with respect to the proposed construction, and present recommendations regarding:

- buoyancy from shallow groundwater and its influence on the proposed structures;
- foundation design of the proposed structures, including discussion of alternate solutions if necessary;
- discussion of potential for consolidation and/or differential settlements of substrata encountered;
- design frost depth;
- a discussion of sheeting and shoring requirements including lateral earth pressure parameters to be used in design;
- “general procedure” soil Site Class based on applicable IBC requirements;
- groundwater conditions and their influence on design and construction;
- monitoring and/or protection of adjacent structures and construction during earthwork;
- removal or treatment of objectionable material;
- suitability of on-site material for re-use as fill as part of the site work for the project;
- quality assurance and field-testing and inspection during construction.

3. FIELD AND LABORATORY WORK

3.1. STANDARD PENETRATION TEST BORINGS

Three (3) Standard Penetration Test (SPT) borings, labeled “B-1” through “B-3” were performed at the site on October 13th, 2014. The test borings were performed at the southeast and northeast corners of the proposed storage tank and at the southeast corner of the proposed valve vault. The test borings were performed to depths of approximately 30 feet below existing ground surface. SPT borings were performed in general accordance with ASTM D1586. Sampling was continuous in the upper 10 feet of each boring and in five feet increments thereafter. Test borings were backfilled with the soil cuttings upon completion.

Boring “B-4” was proposed at the northwest corner of the proposed valve vault but was not performed due to the existing soil odor filter system and adjacent underground surge valve vault impeding access.

Test borings were performed by Connelly & Associates Drilling Services using a Diedrich D-50 truck-mounted auger rig with 3¼ inch hollow stem augers. Our T. Thomson, Jr., PhD, PE, DGE, LEED AP directed the field work and J. Steven Donahue, PE observed the test drilling. A Test Boring Location Sketch is provided in Appendix A. Logs of the test borings are provided in Appendix B.
3.2. GEOTECHNICAL LABORATORY TESTING

Following conclusion of the SPT drilling, the soil samples were delivered to our laboratory for visual classification and testing. The geotechnical laboratory program consisted of the following:

- Moisture Content (ASTM D 2216) 4 tests
- Atterberg Limits (ASTM D 4318) 1 tests
- Sieve Analysis (w/o hydrometer, ASTM D 422) 3 tests

Samples for testing were selected by Pennoni Associates’ geotechnical engineer. Results of the laboratory testing are provided in Appendix C of this report.

4. SUBSURFACE CHARACTERISTICS

4.1. GEOLOGY

According to the Geologic Map of Maryland prepared by the Maryland Geological Survey in 1968, the project site is located within the Atlantic Coastal Plain Physiographic Province, specifically the Aquia Formation. The Aquia Formation generally consists of dark green to gray-green, argillaceous, highly glauconitic, well sorted fine to medium grained sand. The Aquia Formation ranges from 0 to 100 feet thick. Lowland Deposits are also common in this area and generally consist of gravel, sand, silt, and clay. Medium to coarse grained sand and gravel, and cobbles and boulders are common near the base of the formation. The Lowland Deposits commonly contain reworked Eocene glauconite, varicolored silts and clays, and brown to dark gray lignitic silty clay. The Lowland Deposits range from 0 to 150 feet thick. Based on the site’s presence in coastal plain geology, massive rock is not anticipated to be encountered.

4.2. SUBSURFACE STRATIGRAPHY

Subsurface stratigraphy encountered by the test borings generally consisted of a surficial layer of topsoil underlain by fill consisting of loose to medium dense silty sand. The fill material is underlain by loose to medium dense silty sand. The silty sand material is underlain by very loose to loose fine to medium sand, which is subsequently underlain by very soft clayey silt.
For descriptive purposes the soil layers can be classified as follows:

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Approximate Thickness (ft)</th>
<th>Description</th>
<th>USCS Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>0.25 – 0.33</td>
<td>TOPSOIL</td>
<td>---</td>
</tr>
<tr>
<td>F[1]</td>
<td>2.5</td>
<td>FILL: Light brown, brown, and gray fine to medium to coarse sand, little to some silt, trace fine gravel (moist, loose to medium dense)</td>
<td>---</td>
</tr>
<tr>
<td>A[2]</td>
<td>1.5 – 13.5</td>
<td>Brown and gray fine to medium SAND, little to some silt, trace coarse sand (moist to wet, very loose to loose)</td>
<td>SM</td>
</tr>
<tr>
<td>B[3]</td>
<td>5 - …</td>
<td>Gray, blue-gray, brown fine to medium SAND, trace to little silt, trace fine gravel (moist to wet, very loose to dense)</td>
<td>SM</td>
</tr>
<tr>
<td>C[4]</td>
<td>8.5</td>
<td>Dark gray and black SILT, and fine to coarse sand, trace fine gravel (wet, very soft)</td>
<td>MH</td>
</tr>
</tbody>
</table>

Notes:
[1] Stratum F was not encountered in boring “B-2.”
[2] Stratum A was not encountered in boring “B-1.”
[3] Stratum B was not fully penetrated in borings “B-1,” “B-2,” and “B-3.”
[4] Stratum C was not encountered in borings “B-1” and “B-2.”

4.3. GROUNDWATER

Observations for apparent groundwater were made in each boring during sampling and shortly after completion of drilling. Groundwater was encountered in each of the test borings ranging from approximately 8.5 feet to 9 feet below existing ground surface (elevations -0.5 feet to 0.5 feet, NAVD88). Historical groundwater data for the site was not available.

These observations are for the times indicated and may not be indicative of seasonal or daily variations in the ground water levels. Seasonal variations on the order of several feet from the observed depths should be anticipated.
5. ANALYSIS AND RECOMMENDATIONS

5.1. BUOYANCY

Groundwater was encountered at the site above the proposed bottom of the structures. Therefore, hydrostatic uplift is a significant factor in selecting a foundation type. We understand that hydrostatic uplift calculations will be performed by the tank designer once the exact location and loading conditions of the storage tank and valve vault have been determined. A ground surface elevation of 8.5 feet, a design water table elevation of 0.5 feet for normal groundwater conditions, and a flooded condition for a “worst case” scenario were assumed when determining the following uplift pressures:

<table>
<thead>
<tr>
<th>Location</th>
<th>Uplift at Observed Water Table Condition (elev. 0.5 feet)</th>
<th>Uplift at Flooded Condition (elev. 8.5 feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Storage Tank</td>
<td>375 psf</td>
<td>875 psf</td>
</tr>
<tr>
<td>Valve Vault</td>
<td>125 psf</td>
<td>624 psf</td>
</tr>
</tbody>
</table>

The resulting uplift pressures should be compared to the net bearing pressures from the tank and valve vault in the “fully loaded” condition and when empty (if applicable). We recommend a minimum factor of safety of 1.5 is being met. If the embedment depth of the tank or valve vault is changed, the uplift pressures need to be re-evaluated.

If the dead load of a structure does not provide a factor of safety of 1.5 against the uplift pressures, consideration can be given to thickening the mat foundation to increase the dead load. However, if the thicker mat requires a deeper embedment depth, the uplift pressures will also increase. Consideration can also be given to tie downs or helical anchors.

5.2. FOUNDATIONS

Based on the results of our field exploration and laboratory testing, the composition of subsurface material encountered at the site was observed to be relatively consistent. Beneath a surficial stratum of topsoil, apparent fill material was encountered subsequently underlain by natural soils consisting of silty sand and relatively clean sand. Strata C was encountered within the valve vault area and consisted of very soft silt.
5.2.1. EMERGENCY STORAGE TANK

We understand that the cast-in-place concrete emergency storage tank is currently proposed to be below-grade and founded on a mat foundation with a cut of approximately 14 feet to reach the proposed bottom of mat elevation. Based on the subsurface stratigraphy encountered in this area, we recommend designing the mat foundation using a subgrade reaction modulus of 150 pounds per cubic inch for foundations bearing on the medium density or greater soils of stratum B. Maximum net contact pressure should not exceed 3,000 psf for a mat foundation bearing in the medium density or greater silty sand (Stratum B). Total settlement is estimated to be on the order of less than 1 inch for footings/foundations sized using this net contact pressure. If the dead load of the structure does not compensate for the hydrostatic uplift forces, additional resistance consisting of anchors (helical piles) or tie downs will be necessary, as discussed in Section 5.1.

5.2.2. VALVE VAULT

We understand that a precast concrete valve vault is currently proposed to be below-grade and founded on a mat foundation with a cut of approximately 10 feet to reach the proposed bottom of mat elevation. Based on the subsurface stratigraphy encountered in this area, we recommend designing the mat foundation using a subgrade reaction modulus of 25 pounds per cubic inch for foundations bearing on the very soft or greater soils of stratum C. A subgrade reaction modulus of 200 pounds per cubic inch may be used if approximately 2 feet of the stratum C soil is removed below the proposed invert elevation and replaced with a layer of geogrid (Tensar BX1100 or equivalent) followed by 2 feet of #57 stone. Maximum net contact pressure should not exceed 1,000 psf for a mat foundation bearing in the very soft or greater clayey silt (Stratum C) or the #57 stone backfill mentioned above. Total settlement is estimated to be on the order of less than 1 inch for footings/foundations sized using this net allowable contact pressure. If the dead load of the structure does not compensate for the hydrostatic uplift forces, additional resistance consisting of anchors (helical piles) or tie downs will be necessary, as discussed in Section 5.1.

The subgrades of all foundations exposed to freezing temperatures during construction and/or the life of the structure should be established at least 24 inches below adjacent exposed grades or otherwise protected against frost action. Foundation subgrades should be checked by a representative of the Geotechnical Engineer to confirm conditions suitable for support of the design bearing pressure. Where an area is questionable, it should be further explored and/or remedied by removal and replacement of unsuitable material.
5.3. SHEETING AND SHORING / BELOW-GRADE WALLS

5.3.1. SHEETING AND SHORING

It appears that sheeting and shoring will be required based on the proposed embedment depths if benching/sloping of the soils is not practical due to the adjacent structures. The table below provides design parameters for use in sheeting and shoring design. If the top of the shoring is restrained from movement, thereby preventing the mobilization of active soil pressures, the structure should be designed using the at-rest pressure coefficient, \( k_o \).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Stratum F</th>
<th>Stratum A</th>
<th>Stratum B</th>
<th>Newly Compacted Granular Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight</td>
<td>120 pcf</td>
<td>115 pcf</td>
<td>125 pcf</td>
<td>130 pcf</td>
</tr>
<tr>
<td>Angle of Internal Friction, degrees</td>
<td>30</td>
<td>28</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>Cohesion</td>
<td>0 psf</td>
<td>0 psf</td>
<td>0 psf</td>
<td>0 psf</td>
</tr>
<tr>
<td>( k_a )</td>
<td>0.33</td>
<td>0.36</td>
<td>0.31</td>
<td>0.26</td>
</tr>
<tr>
<td>( k_o )</td>
<td>0.5</td>
<td>0.53</td>
<td>0.47</td>
<td>0.41</td>
</tr>
<tr>
<td>( k_p )</td>
<td>3.0</td>
<td>2.77</td>
<td>3.25</td>
<td>3.85</td>
</tr>
</tbody>
</table>

The earth pressure coefficients are based on the assumption of vertical walls, horizontal backfill, no surcharges, no wall friction, and a safety factor of 1.0. Based on the ground water levels observed in the borings, hydrostatic pressures are expected below an elevation of 0.5 feet.

5.3.2. BELOW-GRADE WALLS

Below-grade walls should be designed to withstand lateral earth pressures and any surcharge loads within a 45° slope from the base of the wall. Our calculations assume that no surcharge loads are present. We assume that the tank wall will also serve to retain the lateral earth loads (i.e., no separate permanent retaining walls will be constructed). Therefore, these walls should be designed utilizing the “at-rest” earth pressure. The soils parameters presented in the “Sheeting and Shoring” section of this report are recommended for determining lateral earth loads.

The space between the back of the walls and excavation should be backfilled with an inorganic, free draining granular material, free of debris. We recommend that
the foundation walls be backfilled with soils that classify as ML or more granular. High plasticity soils (MH, CH) are not acceptable for use as below grade wall backfill.

To achieve a desirable balance between minimizing excessive pressures against below-grade walls and reducing the settlement of the wall backfill, heavy earthwork equipment should maintain a minimum of 1 foot space per foot of vertical wall height away from the wall. Lighter compaction equipment should be used close to the below grade walls and the loose thickness of the lifts should be reduced to no more than 6-inches to achieve proper compaction. The soil should be compacted to at least 95 percent of the maximum dry density in accordance with the standard proctor.

Groundwater was observed at elevations located above the proposed footing bearing elevations at each structure. Waterproofing should be applied to the outside of the walls. Waterproofing should consist of a bituminous coating and a rubber membrane with overlap at the seams. Sprayed-on membrane waterproofing may also be used.

5.4. SEISMIC SITE CLASSIFICATION

Based on the sampling performed in the SPT borings, a Site Class D as classified in general accordance with Table 20.3-1 of ASCE 7 and referenced in Section 1613.3 of the 2012 International Building Code, appears suitable. Site Class determination is based on the properties in the upper 100 feet of the ground surface. The borings performed herein were advanced to a maximum depth of 30 feet. Values beyond 30 feet were estimated based on our local experience in this area.

5.5. GROUND AND SURFACE WATER MANAGEMENT

Groundwater is expected to be encountered at elevations ranging from -0.5 feet to 0.5 feet. The water table elevations are anticipated to be above the proposed bottom of the tank foundation. Lowering of the groundwater during construction appears to be required based on the proposed excavation depths and observed groundwater elevations. Well points should be considered to maintain stable conditions during foundation construction.

The foundation excavations should not be used as a detention basin or sump. During construction surface runoff should be prevented from entering the excavations by creating soil berms or diversion swales along the perimeter if the excavation is expected to be open for a long period of time. Where ponding does occur, the water should be pumped immediately and grades should then be established to prevent further ponding. During dewatering, a change in effective stress will occur on the nearby wet and dry wells. The change in effective stress will result in the nearby structures being more susceptible to settlement. Based on the size and typical loads for these types of
structures, it does not appear that this will be a significant issue; however, it will need to be addressed prior to dewatering.

5.6. EARTHWORK

Prior to placing any new fill, and before the construction of the proposed structure, any vegetation and associated topsoil must be removed from within the areas of proposed construction. These materials can remain in proposed landscaped areas provided that future plans do not include building in those areas.

Our experience indicates that the on-site, near surface soils of Strata A and B can be reused for the construction, provided all organics and debris larger than 3 inches in its greatest dimension be removed prior to reuse. If necessary, granular fill should consist of well-graded material with a maximum particle size less than 3 inches, not more than 20 percent passing the No. 200 sieve and have a plasticity index (PI) not greater than 8 percent.

New fills consisting of granular soil should be placed in layers not exceeding 10 in. loose measure. This criterion might be adjusted by the geotechnical engineer in the field depending on the conditions present at the time of construction, on the compaction equipment used, and on the fill material selected. Fills for support of structures should be compacted to at least 98 percent of the laboratory determined maximum dry density, ASTM D 698, when small hand operated compaction equipment is used and to at least 95 percent of the laboratory determined dry density, ASTM D 1557, when self-propelled, heavy duty compaction equipment is used. Fills should extend a minimum of 5 feet beyond the exterior edge of a loaded area and have side slopes not steeper than 2 horizontal to 1 vertical.

Specifications should indicate that the percentage of maximum dry density attained in the field is not the only criteria to be used for assessing fill compaction. Observation of the behavior of the fill under the loads of construction equipment should be used. If the test results indicate that the percentage of compaction is being achieved, but the soil mass is moving under the equipment, placement of additional fill should not be continued until the movement is stabilized. Otherwise, settlement of the fill may occur.
6. LIMITATIONS

This work has been done in accordance with our authorized scope of work and in accordance with generally accepted professional practice in the fields of geotechnical and foundation engineering. This warranty is in lieu of all other warranties either expressed or implied. Our conclusions and recommendations are based on the data revealed by this exploration. We are not responsible for any conclusions or opinions drawn from the data included herein, other than those specifically stated, nor are the recommendations presented in this report intended for direct use as construction specifications. This report is intended for use with regard to the specific project described herein; any changes in loads, structures, or locations should be brought to our attention so that we may determine how they may affect our conclusions. An attempt has been made to provide for normal contingencies but the possibility remains that unexpected conditions may be encountered during construction. If this should occur, or if additional or contradictory data are revealed in the future, we should be notified so that modifications to this report can be made, if necessary. If we do not review relevant construction documents and witness the relevant construction operations, then we cannot be responsible for any problems that may result from misinterpretation or misunderstanding of this report or failure to comply with our recommendations.
APPENDICES
APPENDIX A

SITE LOCATION SKETCH
TEST BORING LOCATION SKETCH
Note: This sketch is adapted from Figure 1 included in the report titled “Cape St. John 1 SPS Retrofit Schematic Design Report,” developed by Pennoni Associates Inc., dated April 2014.
APPENDIX B

TEST BORING LOGS
### LOG OF BORING

**No. B-1**

**PROJECT:** Cape St. John 1 SPS - Emergency Storage Tank  
**PROJECT NO.:** AACO1302  
**PROJECT LOCATION:** Annapolis, Maryland  
**ELEVATION:** 8.5 feet +/- NAVD1988  
**DRILLING FIRM:** Connelly & Associates  
**FOREMAN:** Zack M.  
**LOGGED BY:** S. Donahue  
**DATE STARTED:** 10/13/14  
**DATE COMPLETED:** 10/13/14  
**DEPTH TO WATER INITIAL:** 9 feet  
**AFTER 24 HOURS:** NM  
**CAVING:** 4 feet +/-

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description</th>
<th>Graphic Stratum</th>
<th>Sample No.</th>
<th>Recovery (in.)</th>
<th>Blow Counts</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><strong>4” Topsoil</strong></td>
<td>I</td>
<td>F</td>
<td>16</td>
<td>6-14-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>FILL:</strong> Brown and gray fine to medium sand, little to some silt, trace fine gravel (moist)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td><strong>Gray fine SAND, trace silt(wet)</strong></td>
<td>B</td>
<td>S-2</td>
<td>7</td>
<td>4-3-4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blue-gray fine to medium SAND, trace to little silt (wet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><strong>Mottled brown, light brown, gray fine to medium SAND, trace silt (wet)</strong></td>
<td>B</td>
<td>S-3</td>
<td>9</td>
<td>2-1-3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><strong>Gray and brown fine to medium SAND, trace silt (moist to wet)</strong></td>
<td>B</td>
<td>S-4</td>
<td>12</td>
<td>3-2-3</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>B</td>
<td>S-5</td>
<td>12</td>
<td>3-7-11</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>B</td>
<td>S-6</td>
<td>14</td>
<td>10-15-35</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>B</td>
<td>S-7</td>
<td>13</td>
<td>7-9-14</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>B</td>
<td>S-8</td>
<td>13</td>
<td>7-9-11</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td><strong>Boring terminated at 30 ft.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switched to mud rotary drilling at approximately 8.5 feet below existing ground surface.
<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description</th>
<th>Sample No.</th>
<th>Recovery (in.)</th>
<th>Blows</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4&quot; Topsoil 0.33</td>
<td>S-1</td>
<td>10</td>
<td>1-2-8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brown fine to medium SAND, little to some silt, trace coarse sand (moist)</td>
<td>S-2</td>
<td>15</td>
<td>4-4-5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gray and brown fine to medium SAND, little to some silt, trace coarse sand (moist)</td>
<td>S-3</td>
<td>12</td>
<td>3-2-3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Gray and brown fine to medium SAND, little to some silt, trace coarse sand (wet)</td>
<td>S-4</td>
<td>18</td>
<td>1-1-1</td>
<td></td>
</tr>
<tr>
<td>13.5</td>
<td>Mottled orange, brown, and reddish brown fine SAND, little silt (moist to wet)</td>
<td>S-5</td>
<td>14</td>
<td>7-11-12</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Brown, orange, and gray fine to medium SAND, little silt (wet)</td>
<td>S-6</td>
<td>18</td>
<td>6-10-14</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Brown, orange, and gray fine to medium SAND, little silt, trace fine gravel (wet)</td>
<td>S-8</td>
<td>10</td>
<td>7-10-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boring terminated at 30 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switched to mud rotary drilling at approximately 23.5 feet below existing ground surface.
**LOG OF BORING**

No. B-3

<table>
<thead>
<tr>
<th>Depth (feet)</th>
<th>Description</th>
<th>Graphic Stratum</th>
<th>Sample No.</th>
<th>Recovery (in.)</th>
<th>Blow Counts</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3&quot; Topsoil</td>
<td>F</td>
<td>S-1</td>
<td>16</td>
<td>3-4-6</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>FILL:</strong> Light brown fine to coarse sand, little silt, trace fine gravel (moist)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>Blue-gray fine SAND, some silt (moist)</td>
<td>S-2</td>
<td>4</td>
<td>4-4-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Blue-gray fine to medium SAND, little silt (wet)</td>
<td>A</td>
<td>S-3</td>
<td>8</td>
<td>1-2-1</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Blue-gray fine to medium SAND, trace silt (gray clayey silt in shoe) (wet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>S-4</td>
<td>7</td>
<td>1-1-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Dark gray and black SILT, and fine to coarse sand, trace fine gravel (wet)</td>
<td>C</td>
<td>S-5</td>
<td>13</td>
<td>1-1-1</td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td>Dark gray to blue-gray fine to medium SAND, little to some silt (wet)</td>
<td>A</td>
<td>S-6</td>
<td>10</td>
<td>1-2-1</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Brown fine to medium SAND, trace to little silt (moist)</td>
<td>B</td>
<td>S-7</td>
<td>13</td>
<td>5-8-8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Brown and gray fine to medium SAND, trace silt (moist to wet)</td>
<td></td>
<td></td>
<td></td>
<td>3-7-6</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Boring terminated at 30 ft.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switched to mud rotary drilling at approximately 18.5 feet below existing ground surface.
APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS
# SUMMARY OF LABORATORY DATA

<table>
<thead>
<tr>
<th>BORING NUMBER</th>
<th>SAMPLE NUMBER</th>
<th>DEPTH (ft)</th>
<th>SOIL GROUP SYMBOL</th>
<th>GRAIN SIZE DISTRIBUTION</th>
<th>PLASTICITY</th>
<th>VOLUMETRIC</th>
<th>COMPACTION DATA</th>
<th>SHEAR STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>S-5</td>
<td>13.5-15</td>
<td>SM</td>
<td>1</td>
<td>86</td>
<td>13</td>
<td>26.7</td>
<td></td>
</tr>
<tr>
<td>B-2</td>
<td>S-5</td>
<td>13.5-15</td>
<td>SM</td>
<td>0</td>
<td>87</td>
<td>13</td>
<td>24.4</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>S-4</td>
<td>8.5-10</td>
<td>SM</td>
<td></td>
<td></td>
<td></td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>B-3</td>
<td>S-5</td>
<td>13.5-15</td>
<td>MH</td>
<td>1</td>
<td>42</td>
<td>57</td>
<td>52</td>
<td>37</td>
</tr>
</tbody>
</table>

**GRAIN SIZE DISTRIBUTION**
- GRAVEL %
- SAND %
- SILT/CLAY %

**PLASTICITY**
- LIQUID LIMIT $w_l$
- PLASTIC LIMIT $w_p$
- PLASTICITY INDEX $I_p$

**VOLUMETRIC**
- SPECIFIC GRAVITY (G)
- DRY UNIT WEIGHT (pcf)
- VOID RATIO ($e$)
- DEGREE OF SATURATION %

**COMPACTION DATA**
- MAXIMUM DRY DENSITY (pcf)
- OPTIMUM MOISTURE CONTENT %
- STANDARD/MODIFIED PERMEABILITY
- FALLING/CONSTANT HEAD

**SHEAR STRENGTH**
- UNCONFINED COMRESSIVE STRENGTH (tsf)
- COHESION (tsf)
- AXIAL STRAIN (%)

---

**PENNONI ASSOCIATES INC.**

**DRAWN BY:** JSD
**CHECKED BY:** TAT
**DATE:** 11/10/2014
**PROJECT:** Cape St. John 1 Sewage Pump Station
**LOCATION:** Annapolis, MD

**DRAWN BY:** AACO1302
**CHECKED BY:**
**DATE:** 11/10/2014
**PROJECT:**
**LOCATION:**
**TABLE No.:** 1
Particle Size Distribution Report

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>SOURCE</th>
<th>SAMPLE NO.</th>
<th>DEPTH (ft.)</th>
<th>Material Description</th>
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<tr>
<td>○</td>
<td>B-1</td>
<td>S-5</td>
<td>13.5</td>
<td>F SAND, LITTLE SILT, LITTLE M-C SAND, TRACE F GRAVEL</td>
<td>SM</td>
</tr>
<tr>
<td>□</td>
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<td>13.5</td>
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<td>SM</td>
</tr>
<tr>
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<td>B-3</td>
<td>S-5</td>
<td>13.5</td>
<td>SILT, AND F-C SAND, TRACE F GRAVEL</td>
<td>MH</td>
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</table>

PENNONI ASSOCIATES INC.

Client: Anne Arundel County
Project: Cape St. John 1 SPS Emergency Storage Tank
Project No.: AACO1302
Figure L-1

Tested By: JRM
Checked By: JSD
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

<table>
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<tr>
<th>MATERIAL DESCRIPTION</th>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>%&lt;#40</th>
<th>%&lt;#200</th>
<th>USCS</th>
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Project No.  AACO1302  Client:  Anne Arundel County
Project:  Cape St. John 1 SPS Emergency Storage Tank

*Source of Sample:  B-3  Depth:  13.5  Sample Number:  S-5

PENNONI ASSOCIATES INC.

Tested By:  JRM  Checked By:  JSD
APPENDIX B

CONTRACTOR CUSTOMER SERVICE PROGRAM
Customer Relations Requirements

All consultants, contractors, subcontractors, suppliers and etc., are required to assume their part in the County's Customer Oriented Programs. A description of the Department's policy and its action items are as follows:

"The Department of Public Works has a customer oriented philosophy that requires all employees, consultants, contractors, etc., to adhere to the five dimensions of quality service."

The Five Dimensions of Quality Service Are:

1. Reliability: Is what was promised provided dependably and accurately?
   a. Scheduling
   b. Proper notification
   c. Traffic control
   d. Sediment control
   e. Quality of work

2. Assurance: Are the employees knowledgeable and courteous, and can they express trust and confidence?
   a. Citizen interaction - knowledgeable
   b. Concerns remedied

3. Empathy: Are caring and individual attention provided?
   a. Citizen interaction - polite, courteous
   b. Callbacks will be treated as part of the construction effort
4. **Responsiveness:** Is there a willingness to help customers and provide proper service?

   a. Response to citizen concern within two days. If required work is anticipated to exceed two days, a schedule must be provided indicating when work will be completed.

   b. Additionally, follow-up must be accomplished. Whether the work is complete or not, the follow-up must be done.

5. **Tangibles:** Are the physical facilities and equipment customer friendly?

   a. Traffic control
   b. Sediment control
   c. Safe driving - includes control of speed of vehicles
   d. Sanitary facilities provided for manpower

As a means of ensuring the contractor's participation, each contractor must provide a customer plan and a team composition responsible for adhering to the "Five Dimensions of Customer Service" given previously. Additionally, the plan and the team composition are to be submitted within fourteen (14) calendar days of NTP or concurrent with the contractor's on-site mobilization. The team leader is required to oversee the entire program and be available to assist in resolution of concerns. The other members of the team will provide courteous and prompt assistance to concerns. Any contractor's employee(s) not performing in accordance with the above will be subject to removal from further participation in the project upon written order from the County representative. Failure to participate or respond as required shall be cause for termination of the contract for non-performance.
APPENDIX C

CONTRACTOR SECURITY PROGRAM
ANNE ARUNDEL COUNTY

CAPE ST. JOHN 1 SEWAGE PUMPING STATION RETROFIT
Proposal No.: S7918129
Project No.: S791800

APPENDIX “C”

CONTRACTOR SECURITY PROGRAM

This appendix describes measures to be taken by the contractor to reduce the risk of vulnerability to Anne Arundel County Department of Public Works (DPW) Utility Operations facilities for each of the Homeland Security Threat Advisory Levels. Utility Operations personnel may take measures based on the Department of Public Works Policy and Procedures Manual that will impact the contractor’s work. Consultants, contractors, subcontractors, suppliers, etc. are required to perform their part in this program.

The following measures shall be implemented based on the security threat level declared by Utility Operations.

**Standard Practice & Measures**

1. Carry identification while on Utility Operations property. Minimum identification may consist of a printed or hand written business card or paper bearing the hiring company’s name, the individual’s name and the signature of the hiring company foreman, supervisor or other representative.

2. Challenge unknown visitors. Request identification and purpose of visit.

3. Review security procedures with personnel.

4. Report suspicious activity (carrying suitcases / containers, photographing, noting or asking questions about operations, pumping or pipeline operations or security measures) to supervision. Supervision determines whether to contact law enforcement and chain of command.

5. Report unidentified vehicles parked or operated in a suspicious manner on or in Utility Operations facilities, equipment or rights-of-way. Notify supervision of infractions. Supervision determines whether to contact law enforcement and chain of command.

**Elevated Threat Advisory Level – No Specific Information on Timing or Location**

1. Remind personnel to:
   a. Carry identification while on Utility Operations property. Minimum identification may consist of a printed or hand written business card or paper bearing the hiring company’s name, the individual’s name and the signature of the hiring company foreman, supervisor or other representative.
   b. Challenge unknown visitors.
   c. Request identification and purpose of visit.

1 of 3
2 Cease public tours.

3 If directed by Utility Operations:
   a. Remove vehicles and objects (e.g. dumpsters) parked within 25 yards of specified facilities.
   b. Park vehicles outside facilities. Implement centralized parking and shuttle service.
   c. Report suspicious vehicles or objects to Utility Operations supervision.
   d. Verify the identity of individuals entering specified facilities.
   e. Facility gates and entrances will be locked, except when passing through. Limit access to essential employees and contractors. Verify the identity of individuals entering facilities. Issue visitor badges to visitors.
   f. Inspect buildings, rooms and storage areas not in regular use, daily.
   g. Inspect the interior and exterior of buildings for suspicious activities or packages. Check for signs of tampering or indications of unauthorized entry.

4 Utility Operations may:
   a. Erect barriers to control the direction of traffic flow and parking.
   b. Consult with law enforcement to close public roads and facilities.

**Imminent Threat Advisory Level – Threat at Location Impending or Very Soon**

1 Remind personnel to:
   a. Display identification while on Utility Operations property. Minimum identification may consist of a printed or hand written business card or paper bearing the hiring company’s name, the individual’s name and the signature of the hiring company foreman, supervisor or other representative.
   b. Challenge unknown visitors.
   c. Request identification of anyone not displaying it and ask the purpose of his or her visit.

2 Limit access to facilities and activities to personnel with legitimate and verifiable need to enter.
   a. Cease Public Tours

3 Buildings, rooms, and storage areas will be locked. Inspect baggage, briefcases, and packages brought to the facility.

4 If directed by Utility Operations:
   a. Remove vehicles and objects (e.g. dumpsters) parked within 25 yards of specified facilities. Identify owners of vehicles on Utility Operation property. Have unidentified vehicles inspected by law enforcement personnel and, if appropriate, removed.
   b. Park vehicles outside facilities. Implement centralized parking and shuttle service.
c. Inspect delivery vehicles and containers entering the facility. Require advance delivery notification and validate credentials of the driver.

d. Implement daily inspections of specified buildings and grounds.

e. Take steps to control access to specified facilities.

f. Facility gates and entrances will be locked, except when passing through. Limit access to essential employees and contractors. Verify the identity of individuals entering facilities. Issue visitor badges to visitors.

g. Inspect buildings, rooms and storage areas not in regular use daily.

h. Inspect the interior and exterior of buildings for suspicious activities or packages. Check for signs of tampering or indications of unauthorized entry.

i. Implement mailroom procedures. Have mail and packages sent to a central, secure location and inspected before distribution.

Utility Operations may:

a. Restrict access to specific facilities.

b. Request closure of public roads and facilities in the vicinity of specified facilities.

c. Stop work in part or in total.

d. Erect barriers to control the direction of traffic flow and parking.

e. Consult with law enforcement to close public roads and facilities.

f. Post guards.
APPENDIX D

ELECTRICAL INFRARED TESTING PROCEDURES
INFRARED SURVEY/TESTING

I. General

Conduct an infrared survey of major electrical and rotating equipment in accordance with the guidelines contained herein. All equipment tested and readings taken should be done with the equipment operating under loaded conditions. Motor starters shall be loaded at the full load ampere rating of the motor. All other equipment, unless indicated otherwise, shall be loaded at 80% of the overcurrent protective device rating ahead of the equipment. All equipment shall be loaded for a minimum of 30 minutes before scanning. A load bank shall be used when the connected equipment can’t provide the required load.

II. Equipment to be Tested

4. Motor Starters
5. Bus Bars, Bus Splices, Bus Connectors
6. Main Breakers
7. Automatic Transfer Switch
8. Generator Breaker
9. Motor Connections at Motor
10. Any other components as directed by the County

I. Infrared Scanning of Electrical Equipment

A. Visual Inspection
   1. Inspect for physical, electrical, and mechanical condition.
   2. Inspect for bus alignment.

B. Infrared inspection. Perform a qualitative (Level 1) infrared inspection on the equipment listed in Section H above. The infrared scanning device used shall meet the requirements contained in Part D below.

C. Provide a report indicating the following:
   1. Location, equipment, date
   2. Problem area (location of "hot spot")
   3. Indicate temperature of "hot spot" and ambient temperature
4. Indicate cause of heat rise if known
5. Indicate phase imbalance, if present
6. List of areas scanned.

D. Test Parameters

1. Infrared scanning equipment shall detect 1° rise between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Both identifying photographs and thermographic photos shall be provided of the deficient areas. The thermographic photos shall be as seen on the imaging system. The thermographs and identifying photos will be contained in the report to provide a baseline inventory of the plant's electrical system immediately preceding conditional acceptance.

E. Test Results/Tolerances. Operating temperatures shall not exceed the manufacturer's or listing agency's rating for the equipment or attached conductors. The following temperature tolerances are for equipment temperature ratings of 75° C or above.

1. Three phase equipment - the following tolerances are applied to temperature gradients/differences between phases on balanced three phase loads:
   a. Temperature gradients between phases of 5°C to 10°C indicate possible deficiency and warrant investigation.
   b. Temperature gradients between phases of 11°C and above indicate deficiency; repair as soon as possible.

2. The following absolute temperature tolerances are applied to all components:
   a. Temperature of 70°C or more requires immediate correction.
   b. Temperature of 60°C to 70°C requires correction as time permits.
   c. Temperature of 50°C to 60°C indicates possible deficiency and warrants investigation.
A. General

1. Perform a vibration analysis on all pumps after they are installed and ready to run. All final vibration readings used for acceptance will be taken with the machinery under normal full load operating conditions. The analysis is to be performed by qualified technicians whose credentials are approved in advance by the County. An authorized representative of the County shall also witness the testing.

2. Overall lateral vibrations (i.e. vibrations acting side-to-side, up and down or axially) are all that is required in the field.

B. Methods for Taking Vibration Data

1. Vibration shall be taken with an FFT analyzer or data collector. Spectrum plots shall be available in printed form. The test equipment shall also be capable of providing a complete broadband or “overall (OA)” value in addition to individual frequency components. The type, model, serial number, and latest certified calibration date of all test equipment used in the measurement of vibration levels for machine acceptance shall be documented. Measurements will be taken with a Hanning Window setting and (4) linear, non-overlapping averages.

2. The sensor used shall be an accelerometer with a magnetic mount. Handheld pickups are not acceptable unless machine casing design interferences preclude the use of a magnetic base. The magnetically mounted sensors shall be mounted such that the magnetic base can be attached firmly without rocking.

3. Vibration amplitude readings in inches/second. RMS vs. frequency in Cycles Per Minute (CPM) shall be used. Both a vibration spectrum and overall value shall be recorded for each measurement point shown on the testing diagram at the end of this section.

4. When coupled or belt-driven equipment is running and operating under load, record vibration data. If the equipment fails to meet the vibration tolerances, record the vibration readings on the driver unit disconnected from the driven equipment. Use this data to compare with the vibration of the complete unit to determine the source of the problem.

C. Documentation

1. (4) copies of a vibration report on tested machinery shall be provided to the Engineer for distribution;
a. outlining the procedures used;
b. stating the vibration standards used for the equipment;
c. stating the analysis results for each piece of equipment;
d. discussing the source of any unacceptable vibration found (rotor unbalance, shaft misalignment, bearing problems, vane pass vibration, etc.) and recommended actions to correct.

2. A complete set of vibration spectra shall also be provided for each piece of equipment tested under this contract. Vibration spectra printouts shall be provided in the following manner:

a. Vibration measurement point location description
b. Performance test condition description
c. Vibration amplitude (y-scale): Linear scale and with maximum scale set the same for all measurements.
d. Vibration frequency (x-scale): Linear scale, Cycles Per Minute, maximum scale set the same for all measurements.
e. Maximum of two spectra per page
f. Cursor markers placed on 1X, 2X and 3X peaks (minimum)

D. 1. Vibration tolerances to be applied to each measurement point on the vertical buildtogether pumps in the field are as follows:

a. The “Overall (OA)” or total broadband unfiltered reading shall be no more than .25 inches/second RMS vibration velocity.

b. Vibration tolerances to be applied to the individual frequency peaks in the vibration spectrum shall be as follows:

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsynchronous (below motor RPM)</td>
<td>No vibration peaks in excess of .05 inches/sec RMS velocity</td>
</tr>
<tr>
<td>At motor or pump RPM</td>
<td>Not to exceed .10 inches/sec RMS velocity</td>
</tr>
<tr>
<td>At impeller blade pass frequency</td>
<td>Not to exceed .30 inches/sec RMS velocity</td>
</tr>
<tr>
<td>Above impeller blade frequency out</td>
<td>No vibration peaks in excess of .05 inches/sec RMS velocity</td>
</tr>
<tr>
<td>to 120,000 Cycles Per Minute (CPM)</td>
<td></td>
</tr>
</tbody>
</table>
2. On Variable Frequency Drive (VFD) applications, vibration shall be evaluated against the above tolerances as follows:

a. Store and evaluate the vibration data against the above tolerances at all measurement points designated on the attached testing diagram under full speed conditions. These readings shall be included in the vibration report.

b. Select the measurement point with the highest amplitude vibration frequency of interest and/or overall vibration level and place the accelerometer at that location.

c. The equipment speed shall then be manually reduced at the VFD in 1 Hertz increments from full speed to designated minimum speed (or flow) while observing or storing (vibration analyst option) the vibration data.

d. Note and record any significant increases in vibration which may indicate a critical speed or resonance problem. Also note and record the pump shaft speed or VFD Hertz output setting at which the problem (if any) occurs. Include any problem speeds or speed ranges in the vibration report. This data will be used to program frequency ‘skip’ settings into the VFD as necessary.

E. Equipment to be tested under this standard:

Pump No. 1 and Pump No. 2.
CUSTOMER RELATIONS

The Contractor shall conduct all work with the utmost attention to detail and focus on customer satisfaction. In addition to the requirements set forth in Appendix B "Contractor Customer Service Program" the additional contract specific requirements apply:

A. Distribution of County provided flyers or door hangers to customer residences prior to work commencing; frequency and timing of notification materials will be as coordinated thru the County's representative

B. All trucks or vehicles used for conducting the Work shall be clearly marked with the Contractor's company name or a sign indicating that the Contractor is "Working for Anne Arundel County" or a "Subcontractor to Anne Arundel County". In some cases, the Engineer may require both signs be displayed on all vehicles. Sign shall include bold letters that are a minimum of 3” in height

C. Workers shall present themselves in a professional manner; especially while working in close proximity to children and customers.

D. When approached by the public they shall be able to communicate with the customer and provide only limited information about the work they are performing on behalf of Anne Arundel County. Where possible, only the Site Superintendent or Lead Person shall communicate with local residents or customers, thru coordination and notification to the County Engineer, Inspector, and/or designated representative.

E. Each worker shall have some form of identification on their person at all times. At a minimum, the identification shall include their name, supervisor's name, emergency contact phone number, and the name of the company they work for.

F. Workers shall either wear a T-Shirt or other form of clothing that includes the name of their company or ID badge may be worn and displayed for the customer to easily identify the person as a contractor or subcontractor working for Anne Arundel County.

Any costs associated with these tasks or requirements shall be included in the individual lines for each type of work conducted. No additional costs or change order requests relevant to public or customer relations will be considered for review.
**PURPOSE / APPLICABILITY**

A. This procedure establishes Confined Space policy for the Department of Public Works (DPW).

B. This procedure implements 29 CFR 1910.146 Permit-Required Confined Space.

C. This procedure implements 29 CFR 1926.651(g), Hazardous Atmospheres, for excavations greater than 4 feet deep.

D. This procedure implements 29 CFR 1910.132(d), Hazard Assessment and [Personal Protective] Equipment Selection.

E. This procedure cancels and supersedes the Permit-Required Confined Space Entry Program prepared by O'Brien & Gere Engineers, Inc., dated August 3, 1994, Revised August 2003.

F. This procedure applies to all DPW personnel.

**RESPONSIBILITY**

A. The DPW Program Manager – Safety and Security Services (hereafter the Safety Manager) is responsible for the Department of Public Works Confined Space program. As the Program Administrator the Safety Manager is responsible for:

1. Writing, revising and implementing this procedure.

2. Arranging for spaces to be classified or re-classified for Confined Space entry considerations.

3. Ensuring that Confined Space program reviews are performed.

B. DPW management and supervision are responsible for:

1. Notifying the Safety Manager of the need to classify or re-classify spaces for Confined Space entry consideration.

2. Monitoring spaces for changes in their use that might increase the hazards to people entering them.

3. Arranging for or providing training required by this procedure.

4. Retaining records generated by this procedure.

5. Participating in / supporting Confined Space program reviews.

6. Providing and maintaining equipment needed to make safe entries in Confined Spaces (ex. atmosphere analyzers, communication equipment, lighting, barriers, shields, ladders, and retrieval devices).

C. The Deputy Director – Bureau of Engineering is responsible for ensuring that the requirements specified herein for Contractor Confined Space programs are implemented.

D. Personnel that participate in activities associated with Confined Spaces are responsible for complying with the requirements of this procedure.
PROCEDURE

A. Definitions

1. Confined Space. A space that is:
   a. Large enough for a person to enter into and do work in AND
   b. Has limited or restricted means of entry or exit AND
   c. Is not designed for continuous occupancy.

2. Non-Permit Confined Space. A Confined Space that does not contain or, with respect to atmospheric hazards, have the potential to contain, any hazard capable of causing death or serious physical harm.

3. Air Sample Required Confined Space: A Confined Space where:
   a. The only hazard in the space is an actual or potential hazardous atmosphere AND
   b. Continuous forced air ventilation alone is enough to keep the air good in the space AND
   c. An air sample is taken and the results recorded before going into the space.

4. Permit-Required Confined Space. A Confined Space that does not satisfy the definition of Non-Permit Confined Space or Air Sample Required Confined Space or Special Permit Required Confined Space.
   Permit Required Confined Spaces:
   a. Contain or have potential to contain a hazardous atmosphere OR
   b. Contain material that can engulf someone inside the space OR
   c. Are configured such that a person could be trapped or suffocated by collapsing walls or by a floor that slopes downward and tapers to a smaller cross-section OR
   d. Contain other serious health or safety hazards (ex. electricity, moving equipment, etc.) that cannot be eliminated by design or by implementing DPW P&P D-05, Lockout / Tagout (Energy Control) Procedure.

   NOTE
   The "Entry Supervisor" is not the same as the Entrant's line or activity supervisor. The latter is an organizational position.
   The line or activity supervisor does not need to be present at the Confined Space during the entry.

5. Special Permit-Required Confined Space. A Permit-Required Confined Space that requires approval before the space is entered from the Entrant's line supervisor or the supervisor responsible for the activity because:
a. The space is a chemical tank OR
b. The space has uncontrolled mechanical or electrical equipment OR
c. Welding, cutting, brazing or burning will be done in the space OR
d. In the opinion of line or activity supervision a Special Permit is needed.

6. Engulfment. The surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction or crushing.

B. General

1. Attachment 1, DPW Confined Spaces, lists Confined Spaces for the Department of Public Works.

   Attachment 1 does not include every space that could possibly qualify as a Confined Space. Supervision and workers must question whether spaces that are not included in this list should be subject to the requirements of this procedure.

   The Safety Manager must be notified of the need to classify or re-classify spaces.

2. DPW personnel shall not enter spaces that have an unacceptable atmosphere unless specifically allowed by DPW Policy and Procedure D-18, Respiratory Protection.

3. DPW personnel that participate in activities associated with Confined Spaces shall wear / use personal protective equipment listed in Attachment 2, Confined Space Personal Protective Equipment.

C. Non-Permit Confined Space Entry

1. By definition Non-Permit Confined Spaces do not contain bad air or the potential for bad air. Given this, air sampling is not required for Non-Permit Confined Spaces.

2. By definition Non-Permit Confined Spaces do not contain any hazard capable of causing death or serious physical harm. Given this, Permit-Required Confined Space entry requirements do not apply to Non-Permit Confined Spaces.

3. Other Policies and Procedures, Federal and State regulations may impose entry requirements on Non-Permit Confined Spaces. For example: fall protection and lockout / tagout energy control. Entrants and supervision are responsible for knowing what other entry requirements apply to the work being done and complying with the requirements. Questions should be directed to the Safety Manager or Risk Management.

D. Excavation Requirements – for excavations greater than 4 feet deep.

1. If the excavation: 
   a. Is inside the fenced area of a landfill. 
   Then test the atmosphere: Before entry.
b. Is within 50 feet of underground hazardous material storage (like gas stations, etc.). Before entry.

c. Has a gas line in it that has been ruptured and subsequently repaired. Before entry.

d. Has a gas line in it that has been damaged or disturbed (hit, cut, scratched, pulled out of place, etc.) to an extent that the lead or Competent person believes that a gas leak is more likely. Before entry.

e. Has gas powered equipment being used inside for 5 minutes or more. Continuously while gas powered equipment is in use but not before the first 5 minutes of run time.

f. Has an open sewer main in it. Before entry and periodically thereafter.

g. Has a lead or Competent person that wants to monitor the air for any reason. Whenever the lead / Competent person wants.

2. Atmosphere analyzer must be a calibrated, direct-reading instrument with an audible alarm.

3. Atmosphere testing must include:
   a. Oxygen
   b. Flammable gases / vapors
   c. Toxic air contaminants (ex. Hydrogen Sulfide, Methane, Carbon Monoxide, % LEL).

4. Record atmosphere test results.
   Record the following information on the job Work Order, Crew Day Card, Attachment 3, Permit – Required Confined Space Entry Permit or a similar document.
   a. The date.
   b. The location of the excavation.
   c. Atmosphere test readings (oxygen, flammable gases / vapors, toxic air contaminants).
   d. Signature or initials of the person that performed the atmosphere test.

5. If the oxygen level is less than 19.5 % OR a hazardous atmosphere exists then the excavation is a Permit – Required Confined Space. Permit – Required
Confined Space requirements must be met.
If the oxygen level is equal to or greater than 19.5 % AND a hazardous
atmosphere does not exist then the excavation is a Non-Permit Confined Space.

E. Air Sample Required Confined Space Requirements

1. Air Sample Required Confined Spaces must:
   a. Have continuous forced-air ventilation during entry OR
   b. If forced-air ventilation is lost then Permit Required Confined Space
      Requirements must be met.
   c. Forced-air ventilation may be provided from an installed ventilation
      system or a portable ventilation system.
      (1) Portable ventilation must be directed to the immediate area where
      the person / people will be working within the space.
   d. The ventilation system must have a clean air supply source.
   e. The ability of natural air circulation to keep the atmosphere safe must be
      demonstrated by air sampling with each entry.

2. People that enter an Air Sample Required Confined Space must:
   a. Eliminate any condition that makes opening the space unsafe before
      opening the space.
   b. For at-grade spaces, guard the opening to prevent accidental falls and
      foreign objects from entering. Railings, temporary covers or other
      temporary barriers must be used.
   c. Test the atmosphere prior to entering the space.
      (1) Atmosphere analyzer must be a calibrated, direct-reading
          instrument with an audible alarm.
      (2) Allow forced air ventilation systems to operate for 5 minutes or
          more prior to initial atmosphere testing and entry.
      (3) Atmosphere testing must include:
          (i) Oxygen
          (ii) Flammable gasses / vapors
          (iii) Toxic air contaminants (ex. Hydrogen Sulfide, Methane,
                Carbon Monoxide, % LEL).
      d. Test the atmosphere at 4-hour intervals or less during entry or whenever
         the atmosphere is suspect.

NOTE
It is a good practice to monitor the atmosphere continuously while inside
the space.
(1) Leave the space immediately if the atmosphere is unsafe.
(2) Notify your supervisor immediately of the unsafe atmosphere.
(3) Do not re-enter the space unless:
   (a) An evaluation has been done to determine how the hazardous atmosphere developed OR
   (b) Permit-Required Confined Space requirements are followed.

e. Record atmosphere test results.
   Record the following information in a facility logbook, Attachment 3, Permit Required Confined Space Entry Permit or a similar document for the initial entry atmosphere test.
   (1) The date.
   (2) The location or name of the space. If a facility logbook is used then the facility name must be on the logbook.
   (3) Atmosphere test readings (oxygen, flammable gases / vapors, toxic air contaminants).
   (4) Signature or initials of the person that performed the atmosphere test.

f. If Attachment 3, Permit Required Confined Space Entry Permit is used then:
   (1) Write “Air Sample Required Confined Space” in the space provided for DPW Permit #.
   (2) Leave Communications and Authorized Personnel sections blank.
   (3) The person making the entry shall sign as the supervisor and print his / her name.
   (4) Forward the completed Attachment 3 to your supervisor.
   (5) If a similar document is used then forward the completed document to your supervisor.

g. Supervisors must retain the atmosphere test record for one year from the date of the entry.

h. If an Air Sample Required Confined Space atmosphere is found to be hazardous during a pre-entry test or periodic retest then an evaluation must be done to determine how the hazardous atmosphere developed.

i. Supervisors notified of a hazardous atmosphere test result shall notify the Safety Manager.

j. The Safety Manager shall work with the supervisor responsible for the space to determine why the hazardous atmosphere developed.
(1) The results of the evaluation shall be documented and made available to employees that enter the space.

(2) Supervisors must notify the Safety Manager of changes in the use of Air Sample Required Confined Spaces that might increase the hazards to people entering them. The Safety Manager shall work with the supervisor responsible for the space to determine if the space should be reclassified.

F. Permit-Required Confined Space Requirements

1. Supervisors responsible for Permit-Required Confined Spaces shall install a danger sign at the space or use any other equally effective means of identifying the existence and location of the danger. Signs should read:

   "DANGER – Permit – Required Confined Space. Do not enter."

2. Supervisors responsible for Permit-Required Confined Spaces shall implement measures to prevent unauthorized entry into the space. This may include perimeter fences, locks, covers, mechanical fasteners, bolted hatches, etc.

3. People entering Permit-Required Confined Spaces must:
   a. Be tied off to allow for non-entry rescue.
      (1) The Entrant must wear a full body harness with a retrieval line attached to it.
      (2) The retrieval line must be attached to a fixed point or a mechanical retrieval device.
      (3) If the Confined Space is a vertical space that is more than 5 feet deep then a mechanical retrieval device must be available.
   b. Not weld, cut, burn or braze. If welding, cutting, burning or brazing is required then the entry must be done in accordance with Special Permit-Required Confined Space entry requirements.
   c. If entering a Waste Management Services Riser Manhole: provide continuous forced air ventilation throughout the entry.
   d. If entering a Waste Management Services Forecmain Manhole or Meter Manhole: remove the entire concrete cover prior to entry provided the concrete cover is not permanently sealed or fixed in place. Do not enter if the cover is permanently sealed or fixed in place.
   e. Provide pedestrian, vehicle or other barriers as necessary to protect people entering the space from external hazards.
   f. Isolate the space to the extent possible by locking out / tagging out systems.

NOTE
There must be at least 2 people present at the Confined Space to make a
g. Identify/designate the Confined Space:
   (1) Entrant
   (2) Attendant. The Attendant may not be the Entrant.
   (3) Entry Supervisor. The Attendant may be the Entry Supervisor.

h. Test the atmosphere of the space prior to entering.

i. Atmosphere analyzer must be a calibrated, direct-reading instrument with an audible alarm.
   (1) If the atmosphere analyzer does not test for all of the following at the same time then:
      (a) Test for oxygen first.
      (b) Test for combustible gas and vapor second.
      (c) Test for toxic gas and vapor last.
   (2) Test near the top of the space, then in the middle, then near the bottom of the space. Move the atmosphere analyzer horizontally when testing at each level.
   (3) If atmosphere is not acceptable then purge the space to eliminate or control the atmosphere hazard.
      (a) Direct the ventilation exhaust to the immediate area where people will be working within the space.
      (b) Provide a clean air supply for the ventilation system.
      (c) Ventilate for long enough to replace the air in the space 7 times.
         (i) Estimate the space volume in cubic feet. Attachment 4, Calculating Space Volume explains how to calculate space volume.
         (ii) Divide the space volume by the blower capacity in cubic feet per minute.
         (iii) Multiple by 7. This is the minimum time in minutes that the space must be ventilated.

\[ \text{Space volume (feet}^3\text{)} \times \frac{\text{Blower capacity (feet}^3\text{/ minute})}{7} = \text{Minimum purge time (minutes)} \]

j. Close off the space upon completion of the work and cancellation of the entry permit.
4. Entry Supervisors shall:
   a. Before letting anyone enter the space:
      (1) Know the hazards of the entry.
      (2) Verify that barriers are in place.
      (3) Remove unauthorized personnel from the area.
      (4) Verify that the space is isolated to the extent possible (locked out / tagged out).
      (5) Verify that the Entrant has a full body harness and is tied off to allow for non-entry rescue.
      (6) Verify that the retrieval line is attached to a fixed point or a mechanical retrieval device.
      (7) Verify that a mechanical retrieval device is available for vertical Confined Spaces that are greater than 5 feet deep.
      (8) Verify availability and operability of communications between the Entrant and Attendant and between the Attendant and rescue services (911 Center or Dispatch).
         (i) Telephone operability may be checked by verifying that a dial tone exists.
         (ii) Radio operability may be checked by calling a base station.
      (9) Verify that the atmosphere was tested.
      (10) Complete and sign a Permit-Required Confined Space Entry Permit, Attachment 3.
         (i) The duration of the permit may not exceed the estimated time required to complete the assigned work.
         (ii) The completed permit must be available at the space being entered. The permit may be posted at the space or kept in a vehicle. If not posted at the space then the permit must be made available to appropriate personnel upon request.
   b. During entry:
      (1) Verify that the atmosphere is tested continuously. Record test results every hour on the Permit-Required Confined Space Entry Permit.
      (2) Monitor, supervise, and review operations to ensure entry conditions do not change.
   c. If entry conditions cannot be met, instruct Entrant to leave the space and cancel the entry permit.
   d. After entry is complete close out the entry permit.
5. Attendants shall:
   a. Attend no more than two Entrants in adjacent spaces or spaces in close proximity at a time.
   b. Know the hazards of the entry.
   c. Verify that the Entrant's name is entered on the Permit-Required Confined Space Entry Permit.
   d. Verify that one end of the Entrant's retrieval line is attached to the Entrant's full body harness and the other end is tied off to a fixed point or a mechanical retrieval device.
   e. Verify that a mechanical retrieval device is available for Entrants going into a vertical Confined Space that is more than 5 feet deep.
   f. Stay at the assigned Permit-Required Confined Space until relieved of Attendant duties OR the permit is terminated.
   g. Not enter the Permit-Required Confined Space for any reason regardless of the circumstances.
   h. Talk to the Entrant regularly and keep the Entrant informed.
   i. Be alert for changes in behavior of the Entrant (poor judgment, dizziness, etc.) that may indicate exposure to hazards.
   j. Verify that atmosphere testing is done continuously for working in sewers or at one-hour intervals or less for other spaces.
   k. Know what's going on inside and outside the space so that the entry can continue or be terminated. Reasons for termination include:
      (1) Unacceptable atmosphere test results.
      (2) Inappropriate Entrant behavior.
      (3) Activity outside the space that is dangerous to or has potential to endanger the Entrant.
      (4) You cannot perform the duties required of an Attendant.
   l. Keep unauthorized personnel out of the space and immediate area around the space entrance.

   **NOTE**
   Rescue services are provided by the County Fire Department (available through the 911 Center or Dispatch).

   m. Retrieve the Entrant if necessary using the retrieval line.
   n. Call for rescue services if necessary.
      (1) Call the 911 Center OR
      (2) Call Dispatch. Instruct Dispatch to call the 911 Center.
6.  Entrants shall:
   a.  Know the hazards of the entry.
   b.  Verify that his / her name is on the Permit-Required Confined Space Entry Permit.
   c.  Wear a full body harness that is attached to a retrieval line.
   d.  Verify that the other end of the retrieval line is attached to a fixed point or a mechanical retrieval device.
   e.  Verify that a mechanical retrieval device is available if the Confined Space is more than 5 feet deep.
   f.  Talk to the Attendant regularly and keep the Attendant informed of conditions in the space.
   g.  Test the atmosphere in the space or verify that the atmosphere is tested continuously when working in sewers or at one-hour intervals or less for other spaces.
   h.  Exit the space immediately if:
       (1)  The atmosphere is hazardous or suspect OR
       (2)  Unanticipated conditions develop in the space OR
       (3)  The entry permit is terminated OR
       (4)  The Attendant or Entry Supervisor ask you to exit OR
       (5)  You feel that your safety is in jeopardy.

G.  Special Permit-Required Confined Space Requirements

1.  A Special Confined Space Permit shall be used for the following:
   a.  Entry into any chemical storage tanks OR
   b.  Entry into any space for welding, burning, brazing or cutting OR
   c.  Any time line or activity supervision believes that a Special Permit is warranted.

2.  Entry requirements for Special Permit-Required Confined Space Permit use are the same as Permit-Required Confined Space Permit entry EXCEPT:
   a.  A Special Confined Space Permit, Attachment 5, shall be used in lieu of a Permit-Required Confined Space Permit.
   b.  The Special Confined Space Permit shall be completed and signed by the Entrant’s line supervisor before entry into the space.
   c.  Atmosphere test results shall be recorded on the permit as required by the Special Confined Space Entry Permit.

H.  Contractors

1.  If a contractor will perform work in a Permit-Required Confined Space then the
Department of Public Works will:

a. Notify the contractor in writing that:
   
   (1) The work to be performed involves entry into Permit-Required Confined Spaces AND
   
   (2) Entry into these spaces requires the contractor to have and enforce a Permit-Required Confined Space Program AND
   
   (3) The Permit-Required Confined Space Program must meet the requirements of 29 CFR 1910.146.

b. Inform the contractor of the aspects of the space that make it a permit-required space (including identified hazards, and experience in working in the space).

c. Provide the contractor a copy of this procedure to inform them of measures that DPW implements to protect employees in or near permit spaces where the contractor will be working.

d. Coordinate with the contractor when DPW personnel and contractor personnel will be working in or near Permit-Required Confined Spaces so that neither organization is endangered by the others work.

e. Debrief the contractor on hazards confronted or created in Permit-Required Confined Spaces during entries.

2. If a contractor will perform work in a Permit-Required Confined Space then the Department of Public Works will require the Contractor to:

a. Provide and work under their own Permit-Required Confined Space program.

b. Obtain information regarding Permit-Required Confined Space hazards and entry operations from the DPW.

c. Coordinate Permit-Required Confined Space entries with the DPW.

d. Inform the DPW of hazards confronted or created in the Permit-Required Confined Spaces.

1. Training

   1. Personnel that participate in Confined Space entries shall be provided training to allow them to safely perform their duties.

   2. Training shall be provided:

   a. Before people are first assigned duties covered by this procedure.

   b. Every three years.

   c. Whenever there is a change in Confined Space operations that present a hazard that people have not been trained on.

   d. Whenever there is reason to believe that there are deviations from this
procedure.

e. Whenever there is reason to believe that there are inadequacies in people’s knowledge or use of this procedure.

J. Reviews

1. The Safety Manager shall ensure that Confined Space program reviews are performed:
   a. Annually.
   b. When there is reason to believe that measures taken under this procedure may not protect employees. Reasons include:
      (6) Unauthorized entry into a Confined Space.
      (2) Detection of Confined Space hazards not covered by the permit.
      (3) Detection of conditions prohibited by a Confined Space Permit.
      (4) A change in the use or configuration of a Confined Space.
      (5) An employee submits a formal complaint about the effectiveness of the program.

2. The Safety Manager shall ensure that this procedure is revised or other action is taken to correct deficiencies found to exist before subsequent Confined Space entries are authorized.

K. Records

1. Supervisors of personnel that make or participate in Confined Space entries shall retain or make provisions to ensure the retention of, Confined Space entry records.

2. Completed Confined Space entry documentation (logbooks, permits or “other documents”) shall be retained for one year from the date of the entry.

3. Training records shall be retained by Bureau specific training organizations or by the supervisors of personnel assigned Confined Space entry responsibilities.

4. Current training records shall be retained for each employee participating in the program.

5. Training records shall be kept for one year from the date of employee termination of employment.
Attachment 1

DPW Confined Spaces
4 pages

This attachment does not include every space that could possibly qualify as a Confined Space. Supervision and workers must question whether spaces that are not included in this list should be subject to the requirements of this procedure. The Safety Manager must be notified of the need to classify or re-classify spaces. Confined Space classification justifications are on the DPW web page: [http://countyweb/dpw](http://countyweb/dpw)

<table>
<thead>
<tr>
<th>Space ID</th>
<th>Type of Confined Space</th>
<th>Potential Hazard</th>
<th>Unauthorized Entry Control (one or more of these)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin, enclosed, with installed ventilation, drained for entry.</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Perimeter fence</td>
</tr>
<tr>
<td>Basin, enclosed, without installed ventilation, drained for entry.</td>
<td>Permit-Required</td>
<td>Low O₂</td>
<td>Perimeter fence</td>
</tr>
<tr>
<td>Basin, open, any type, drained for entry.</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Perimeter fence</td>
</tr>
<tr>
<td>Chamber, Wastewater Valve, inside &amp; outside.</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Inside, locked building. Inside, perimeter fence</td>
</tr>
<tr>
<td>Culverts *</td>
<td>Non-Permit</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Drywells, can type</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Perimeter fence</td>
</tr>
<tr>
<td>Excavation / trench &gt; 4 feet deep AND atmosphere testing indicates:</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable /</td>
<td>Cover, Barrier, Fence</td>
</tr>
<tr>
<td>• &lt; 19.5% Oxygen OR</td>
<td></td>
<td>explosive gas</td>
<td></td>
</tr>
<tr>
<td>• A hazardous atmosphere</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grinder Pump Manways</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable /</td>
<td>Locked manway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>explosive gas</td>
<td></td>
</tr>
<tr>
<td>Incinerator (decommissioned)</td>
<td>Special Permit-Required</td>
<td>Low O₂, Flammable /</td>
<td>Heavy lid manway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>explosive gas, Toxic gas</td>
<td></td>
</tr>
<tr>
<td>LFG (Landfill Gas Flare)</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable /</td>
<td>Covered louvers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>explosive gas, Toxic gas</td>
<td></td>
</tr>
<tr>
<td>Manhole, Sewer, Storm Drain, Riser, Foremain, Meter</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable /</td>
<td>Manhole cover, Bolted manhole cover, Perimeter fence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>explosive gas, LEL, Toxic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>gas</td>
<td></td>
</tr>
<tr>
<td>Pit, Glen Burnie Convenience Center compactor pit / ram.</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Locked lid, Fenced area, Locked building.</td>
</tr>
</tbody>
</table>

EFFECTIVE DATE: 11.18.09
REVISED: 11.02.09
Page 13 of 24
Recycled paper.
<table>
<thead>
<tr>
<th>Space ID</th>
<th>Type of Confined Space</th>
<th>Potential Hazard</th>
<th>Unauthorized Entry Control (one or more of these)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit, Tank Area Sump drain, scale, oil / water separator, grit separator, scale, hydraulic area w' floor drain</td>
<td>Permit-Required</td>
<td>Low O₂ Flammable / explosive gas, Toxic gas</td>
<td>Lid Locked lid Heavy grate / cover Manhole cover</td>
</tr>
<tr>
<td>Pressure Filters, Water Treatment</td>
<td>Special Permit-Required</td>
<td>Low O₂ Toxic gas</td>
<td>Locked building</td>
</tr>
<tr>
<td>Scrubbers</td>
<td>Special Permit-Required</td>
<td>Low O₂ Toxic gas</td>
<td>Heavy lid man way</td>
</tr>
<tr>
<td>Separator, oil / water</td>
<td>Permit-Required</td>
<td>Low O₂ Flammable / explosive gas.</td>
<td>Heavy cover</td>
</tr>
<tr>
<td>Silo, Lime</td>
<td>Special Permit-Required</td>
<td>Low O₂ Toxic gas</td>
<td>Bolted hatch Locked door Perimeter fence</td>
</tr>
<tr>
<td>Storm drain inlet, grate covered. *</td>
<td>Non-Permit</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Storm drain pipes day-lighted at both ends. *</td>
<td>Non-Permit</td>
<td>None</td>
<td>NA</td>
</tr>
<tr>
<td>Storm drain pipes accessed through storm drain manholes. *</td>
<td>Permit-Required</td>
<td>Low O₂</td>
<td>Manhole cover.</td>
</tr>
</tbody>
</table>
| Storm drain pipes accessed through either *:  
* A storm drain inlet OR  
* The pipe opening. | Air Sample-Required | Low O₂ | Heavy grate. Manhole cover. |
<p>| Storm water pond stand pipes and associated outfall pipe(s) * | Air Sample-Required | Low O₂ | Locked |
| Storm water pond pre-cast concrete box structures &amp; associated outfall pipes. * | Non-Permit Required | None | NA |
| Tank, Chemical | Special Permit-Required | Low O₂ Toxic gas | Bolted hatch Locked door Perimeter fence |
| Tank, Fuel | Permit-Required | Low O₂ Flammable / explosive gas, LEL Toxic gas | Bolted hatch Perimeter fence |
| Tank, Leachate Storage | Permit-Required | Low O₂ Toxic gas | Bolted hatch Locked door / access Perimeter fence |</p>
<table>
<thead>
<tr>
<th>Space ID</th>
<th>Type of Confined Space</th>
<th>Potential Hazard</th>
<th>Unauthorized Entry Control (one or more of these)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank, process, open</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable / explosive gas, LEL, Toxic gas</td>
<td>Perimeter fence, Covered louvers</td>
</tr>
<tr>
<td>Tank, Septic, sludge</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable / explosive gas, Uncontrolled electricity</td>
<td>Bolted hatch</td>
</tr>
<tr>
<td>Note: Does not include septic tank pump basket if one is installed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tank, water, elevated, ground level, truck mount</td>
<td>Special Permit-Required</td>
<td>Low O₂</td>
<td>Locked door, Perimeter fence</td>
</tr>
<tr>
<td>Note: Tank refers to the “tank bowl.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanker, sludge, sewage</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable / explosive gas, LEL, Toxic gas</td>
<td>Bolted hatch</td>
</tr>
<tr>
<td>Tanker, leachate</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable / explosive gas</td>
<td>Bolted hatch</td>
</tr>
<tr>
<td>Transfer Trailers with manway type entry hatch.</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Access limited</td>
</tr>
<tr>
<td>Truck, Rear Compactor</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Access limited</td>
</tr>
<tr>
<td>Vault, water, any vault large enough to fit an average person's head, shoulders and chest (the chest includes all ribs).</td>
<td>Air Sample-Required</td>
<td>Low O₂, Flammable / explosive/toxic gas.</td>
<td>Locked hatch, Locked door, Manhole cover, Perimeter fence</td>
</tr>
<tr>
<td>Vault, wastewater, (including Air Relief Valve Vaults; excluding pump-around vaults) any vault large enough to fit an average person's head, shoulders and chest (the chest includes all ribs).</td>
<td>Permit-Required</td>
<td>Low O₂, Flammable / explosive/toxic gas. (H₂S, CO, LEL)</td>
<td>Locked hatch, Locked door, Manhole cover, Perimeter fence</td>
</tr>
<tr>
<td>Vault, wastewater, pump-around any vault large enough to fit an average person's head, shoulders and chest (the chest includes all ribs).</td>
<td>Air Sample-Required</td>
<td>Low O₂</td>
<td>Locked hatch, Locked door, Manhole cover, Perimeter fence</td>
</tr>
<tr>
<td>Space ID</td>
<td>Type of Confined Space</td>
<td>Potential Hazard</td>
<td>Unauthorized Entry Control (one or more of these)</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------</td>
<td>------------------</td>
<td>-----------------------------------------------</td>
</tr>
</tbody>
</table>
| Wetwells:  
- Ridgeway SPS Wetwell  
- Any wetwell ≤ 4 feet deep  
- Any wetwell > 4 feet deep that has an installed grate that separates the entrant from the water. | Air Sample-Required | Low O₂, Flammable / explosive gas, LEL, Toxic gas | Locked hatch / lid, Heavy lid, Perimeter fence, Placards |
| Wetwells:  
- Greater than 4 feet deep AND do not have an installed grate that separates the entrant from the water. | Permit-Required | Low O₂, Flammable / explosive gas, LEL, Toxic gas | Locked hatch / lid, Heavy lid, Perimeter fence, Placards |

* Confined Space classification justifications prepared for this space.

End of Attachment 1
Attachment 2

Confined Space Personal Protective Equipment

Page 1 of 1

This list constitutes the minimum requirements for Confined Space entry. Additional personal protective equipment may be needed based on the work being done.

<table>
<thead>
<tr>
<th>Required Personal Protective Equipment (PPE)</th>
<th>Hazard / risk / reason for PPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel toe safety shoes</td>
<td>Foot injury. Must be worn in:</td>
</tr>
<tr>
<td></td>
<td>• Air Sample Required Confined Spaces.</td>
</tr>
<tr>
<td></td>
<td>• Permit-Required Confined Spaces.</td>
</tr>
<tr>
<td>Hardhat</td>
<td>Head injury. Must be worn in Permit-Required Confined Spaces.</td>
</tr>
<tr>
<td>Hearing Protection</td>
<td>Hearing loss. Must be worn:</td>
</tr>
<tr>
<td></td>
<td>• In posted high noise areas.</td>
</tr>
<tr>
<td></td>
<td>• When required by the facility or site.</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Eye injury. Must be worn in Permit-Required Confined Spaces.</td>
</tr>
<tr>
<td>Gloves (cotton, rubber or leather)</td>
<td>Hand injury. Must be worn when working in Permit-Required Confined Spaces.</td>
</tr>
<tr>
<td>Full body harness with retrieval line</td>
<td>Must be worn / used in all Permit-Required Confined Spaces.</td>
</tr>
<tr>
<td>Mechanical retrieval device.</td>
<td>Must be used in vertical Permit-Required Confined Spaces that are more than 5 feet deep.</td>
</tr>
</tbody>
</table>
### Attachment 3

**Confined Space Entry Permit**

<table>
<thead>
<tr>
<th>DPW Permit #</th>
<th>Date:</th>
</tr>
</thead>
</table>

**Emergency Rescue Services:**
- Phone: 911
- Radio:
- Employees DO NOT enter space to rescue; outside services are to be summoned

**Acceptable Entry Conditions:**
- Oxygen: 19.5% - 25.5%
- LEL: < 10%
- Hydrogen Sulfide < 10 ppm
- Carbon monoxide < 35 ppm

**Communications:**
- Verbal?
- Radio?
- Visual contact?
- Other?

**Authorized Personnel:**
- Entrants:
- Attendees:

<table>
<thead>
<tr>
<th>PARAMETER / ISSUE</th>
<th>SPACE #1</th>
<th>SPACE #2</th>
<th>SPACE #3</th>
<th>SPACE #4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Address and/or Location:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Purpose of Entry (check those that apply):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cleaning</td>
<td></td>
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</tr>
<tr>
<td>inspection</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>meter reading</td>
<td></td>
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</tr>
<tr>
<td>repairs/maintenance</td>
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</tr>
<tr>
<td>other</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Nature of Hazard (check those that apply):</strong></td>
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<td></td>
</tr>
<tr>
<td>arc (O3/H2S/LEL/tox)</td>
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</tr>
<tr>
<td>electrical/mechanical</td>
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</tr>
<tr>
<td>fall</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>confined</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>slippery surface</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>drowning</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>other</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Equipment Used / Hazard Control Measures Implemented (check those that apply):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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### Atmospheric Test Record

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End of Attachment 3
Calculating Space Volume

Page 1 of 1

1. For cylindrical spaces (manholes, wet wells, tanks, etc.)
   Measure: 
   - Height (H), in feet (if it's a tank on its side, measure the length)
   - Diameter (D), in feet
   Calculate: \( \frac{(3.14) \times D^2 \times H}{4} \) to get volume in cubic feet (ft³)

   Example: A wet well is 30 feet deep, and 10 feet across.
   \( \frac{(3.14) \times 10^2 \times 30}{4} = 2355 \text{ cubic feet} \)

2. For square or rectangular spaces (valve vault, meter vault, pumping station, etc.)
   Measure: 
   - Length of room (L), in feet
   - Width of room (W), in feet
   - Height of room (H), in feet
   Calculate: \( L \times W \times H \) to get volume in cubic feet (ft³)

   Example: A valve vault measures 6 feet long and 8 feet wide, and is 5 feet high.
   \( 6 \times 8 \times 5 = 240 \text{ cubic feet} \)

3. To calculate time needed for seven air exchanges:
   Information available: Volume of space is 1200 cubic feet.
   Blower to be used is rated 750 cfm.

   Calculate: \( \frac{\text{Volume}}{\text{Blower cfm}} \times 7 = \text{time in minutes} \)

   Example: \( \frac{1200 \text{ cubic feet}}{750 \text{ cubic feet/minute}} \times 7 = 11.2 \text{ minutes} \)
   Round up to 12 minutes.
### Special Confined Space Entry Permit

<table>
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<th>DPW Permit #:</th>
<th>Date:</th>
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#### Emergency Rescue Service:
- Phone: 911
- Radio:

**NOTE:** Employees DO NOT enter space to rescue; outside services are summoned.

#### Acceptable Entry Conditions:
- Oxygen: 19.5% - 23.5%
- T.E. < 10%
- Hydrogen Sulfide: < 10 ppm
- Carbon monoxide: < 35 ppm

#### Communications:
- Voice?
- Radio?
- Visual contact? Other?

#### Authorized Personnel:
- Entrants:
- Attendees:

#### Purpose of Entry (check those that apply):
- Cleaning
- Maintenance
- Repairs/transformer
- Other (specify)

#### Hot Work to be Performed (check those that apply; specify type of welding):
- Welding
- Soldering/looming
- Cutting
- Other (specify)

#### Gas mask/hood to be used:

#### Nature of Hazard (check those that apply):
- Atmosphere (specify)
- Exhaust vent
- Electric arc/welding
- Hot or heated surface
- Sharp surfaces
- Fire
- Dusting

#### Equipment Used / Hazard Control Measures Implemented (check those that apply):
- Removal: hose
- Covering equipment
- Ventilation blower
- Table
- Oxygen/Flame meter
- Nonsparking tools
- Backhoe for isolation
- Light

#### Communication equipment:
- Fire extinguisher

#### Welder's protective clothing:
- Other (specify)

#### Atmospheric Test Record:
- Pre-entry
- 1/2 hour
- 1 hour
- 2 hour

#### Chemicals:
- Others (specify)

#### Other/Chemical/Health:
- Other (specify)

#### Duration of permit:
- From: a.m. p.m.
- Until: a.m. p.m.

#### Supervisor Authorization (print):
- Initiate:
- Cancel:

---

**EFFECTIVE DATE:** 11.18.09

**REVISED:** 11.02.09

Recycled paper.
<table>
<thead>
<tr>
<th>Supervisor Signature</th>
<th>Initiate</th>
<th>Cancel</th>
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End of Attachment 5