Monarch Engineering, Inc.

February 13, 2015

Mr. Jeff Derouen
Executive Director
Commonwealth of Kentucky
Public Service Commission
211 Sower Blvd.
PO Box 615
Frankfort, Kentucky 40602-0615

Re: McCreary County Water District
Water Treatment Plant No. 1 – Phase 2 Improvements &
Rattlesnake Ridge Water Booster Pump Station Upgrade
PSC Case No. 2015-00053

Dear Mr. Derouen:

Please find enclosed one electronic file copy of the plans and specifications for the above-referenced projects on CD.

Should you have any questions or need additional information, please advise.

Sincerely,

Deron S. Byrne, P.E.
Project Engineer

/dsb

Enclosures

556 Carlton Dr. • Lawrenceburg, Ky. 40342 • 502-839-1310 • Fax 502-839-1373

CONTRACT DOCUMENTS AND SPECIFICATIONS
FOR THE
MCCREARY COUNTY WATER DISTRICT

RATTLESNAKE RIDGE PUMP STATION UPGRADE

Project No. 1013

December 2014

TABLE OF CONTENTS

Documents are included in the following order.

ADVERTISEMENT FOR BIDS

McCREARY COUNTY WATER DISTRICT, WHITLEY CITY, KENTUCKY

Separate Sealed BIDS to furnish materials for the Rattlesnake Ridge Pump Station Upgrade consisting of a skid-mounted booster pump station, piping and valves, automatic central control panel(s) with breakers, variable frequency drives (VFDs), and all internal wiring will be received by the McCreary County Water District at the McCreary County Water District water office, 19 Crit King Road, Whitley City, Kentucky until 11:00 AM, local time, December 19, 2014 and then at said Office publicly opened and read aloud.

The CONTRACT DOCUMENTS may be examined at the following locations:

McCreary County Water District, 19 Crit King Road, Whitley City, Kentucky 42653
MONARCH ENGINEERING, INC., 556 Carlton Drive, Lawrenceburg, Kentucky 40342

Copies of the CONTRACT DOCUMENTS may be obtained at the office of Monarch Engineering, Inc., 556 Carlton Drive, Lawrenceburg, KY 40342, upon request in writing and payment of $50.00 refundable for each set. Bidders must purchase plans from the Engineer and payment shall be made via check in the name of the Bidder. Plans purchased by one party and bid by another party shall not be accepted. Plans will be available for purchase until 4:00 PM (E.D.T.), December 17, 2014.

No Bidder may withdraw his bid for a period of 90 days. CONTRACTS shall be completed within 90 calendar days after date of authorization to start work.

Federal law prohibits discrimination on the grounds of race, color, national origin, religion, age, handicap and sex in this project.

McCREARY COUNTY WATER DISTRICT, WHITLEY CITY, KENTUCKY

BY: _____
Raymond Taylor, Chairman

INFORMATION FOR BIDDERS

BIDS will be received by the McCreary County Water District (herein called the "OWNER"), at the District Water Office located in Whitley City, Kentucky until 11:00 AM, local time; December 19, 2014, and then at said building publicly opened and read aloud.

Each BID must be submitted in a sealed envelope, addressed to the McCreary County Water District. Each sealed envelope containing a BID must be plainly marked on the outside as "Bid for Rattlesnake Ridge Pump Station Upgrade" and the envelope should bear on the outside the BIDDER'S name, address, and license number if applicable. If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the OWNER, McCreary County Water District, PO Box 488, Whitley City, Kentucky, 42653.

Each Bidder must accompany his BID with a list of at least three projects, similar in scope and cost to this project, with references in which his company has performed work. The company which performed the work as shown on the list of references must be the same company submitting the BID. The references shall include the name of the job, approximate date the job was completed, name of the utility company including contact person, and the name of the engineer including contact person.

All BIDS must be made on the required BID form. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID may be withdrawn prior to the above scheduled time for the opening of BIDS or authorized postponement thereof. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 90 days after the actual date of the opening thereof. Should there be reasons why the CONTRACT cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the BIDDER.

BIDDERS must satisfy themselves of the accuracy of the estimated quantities in the BID schedule by examination of the site and a review of the drawings and specifications including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or of the nature of the WORK to be done.

The OWNER shall provide to BIDDERS prior to BIDDING, all information which is pertinent to, and delineates and describes, the land owned and rights-of-way acquired or to be acquired.

The CONTRACT DOCUMENTS contain the provisions required for the construction of the PROJECT. Information obtained from an officer, agent, or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve the CONTRACTOR from fulfilling any of the conditions of the CONTRACT.

The NOTICE TO PROCEED shall be issued within ten (10) days of the execution of the AGREEMENT by the OWNER. Should there be reasons why the NOTICE TO PROCEED cannot be issued within such period; the time may be extended by mutual agreement between the OWNER AND CONTRACTOR. If the NOTICE TO PROCEED has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the AGREEMENT without further liability on the part of either party.

The OWNER may make such investigations as deemed necessary to determine the ability of the BIDDER to perform the WORK, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any BID if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the OWNER that such BIDDER is properly qualified to carry out the obligations of the AGREEMENT and to complete the WORK contemplated therein.

A conditional or qualified BID will not be accepted.

Award will be made to the lowest responsible BIDDER as determined by the total of the base bid.

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

Each BIDDER is responsible for inspecting the site and for reading and being thoroughly familiar with the CONTRACT DOCUMENTS. The failure or omission of any BIDDER to do any of the foregoing shall in no way relieve any BIDDER from any obligation in respect to its BID.

BIDDERS are hereby notified that they are encouraged, to the greatest extent feasible, to purchase American-made equipment and products with funding provided under this award.

The ENGINEER is Monarch Engineering, Inc. The ENGINEER'S address is 556 Carlton Drive, Lawrenceburg, KY 40342

SPECIAL NOTES FOR CONTRACTORS

The Contract shall be awarded based on the lowest Base Bid.

Each Bidder must accompany his bid with a list of at least three projects, similar in scope and cost to this project, with references in which his company has performed work. The company which performed the work as shown on the list of references must be the same company submitting the bid. The references shall include the name of the job, approximate date the job was completed, name of the utility company including contact person, and the name of the engineer including contact person.

The Contract Documents specify that the Contract shall be completed within 90 calendar days.

A complete bid package consist of the Bid Form and the Bid Submittal Reference List. Any other documents or forms shall be requested at a later date.

The Owner reserves the right to request and obtain information regarding the Contractor's financial status such as a financial statement or any other information relative to the financial capability of the Contractor to perform the work.

The complete Bid Schedule including Unit Price and Total Cost items shall be the basis for payment.

BID SUBMITTAL REFERENCE LIST
RATTLESNAKE RIDGE PUMP STATION UPGRADE
McCREARY COUNTY WATER DISTRICT
BID OPENING: DECEMBER 19, 2014, 11:00 AM, LOCAL TIME

JOB NAME	APPROXIMATE DATE OF COMPLETION	APPROXIMATE COST	NAME OF UTILITY & CONTACT PERSON	NAME OF ENGINEER & CONTACT PERSON
JOB NO. 1				
JOB NO. 2				
JOB NO. 3				

BID

Proposal of_____(hereinafter called "BIDDER"), to the McCreary County Water District, Kentucky (hereinafter called "OWNER"). The BIDDER proposes to furnish the materials as shown on the Bid Schedule within 90 days and at the prices stated on the Bid Schedule.

BIDDER acknowledges receipt of the following ADDENDUM:

_____

BIDDER agrees to provide all the materials for the following unit prices.

BID SCHEDULE

Note: BIDS shall include sales tax and all other applicable taxes and fees.

The CONTRACT shall be awarded based on the lowest BASE BID.

MATERIAL LIST

Item No.	Description	Quantity		Total Cost
1	Skid-Mounted Booster Pump Station Rated at 80 GPM at 575 TDH, piping and valves, automatic central control panel(s) with breakers, variable frequency drives (VFDs), and all internal wiring.	LS	$	_____
	TOTAL MATERIAL BID		$	_____

Proposals must be submitted at least no later than 11:00 am local time on December 19, 2014. Proposals must be sealed and labeled as “Bid for Rattlesnake Ridge Pump Station Upgrade” and addressed to the McCreary County Water District, 19 Crit King Road US 27 / PO Box 488, Whitley City, Kentucky 42653.

BIDDER understands that the OWNER reserves the right to reject and or all bids and to waive any informalities on the bidding.

The BIDDER agrees that this bid shall be good and may not be withdrawn for a period of 90 calendar days after the scheduled closing time for receiving bids.

Respectfully submitted,

_____	_____
Signature	Address
_____	_____
Title	Date

NOTICE OF AWARD

TO: _____
_____
_____

PROJECT Description: Rattlesnake Ridge Pump Station Upgrade.

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids dated _____, 2014, and Information for Bidders.

You are hereby notified that your BID has been accepted for items in the amount of $_____.

You are required by the Information for Bidders to execute the Agreement.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this_____ day of_____, 2015.

_____
Owner
By_____

Title_____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

by _____, this the_____ day

of _____, 2015.

By_____

Title _____

AGREEMENT

THIS AGREEMENT, made this_____ day of _____, 2015, by and between the McCreary County Water District, Whitley City, Kentucky, hereinafter called "OWNER" and _____ doing business as a corporation hereinafter called "CONTRACTOR". WITNESSETH: That for and in consideration of the payments and agreements herein after mentioned:

1. The CONTRACTOR will commence and furnish the materials for the Rattlesnake Ridge Pump Station Upgrade.

2. The CONTRACTOR will furnish all of the materials, supplies, tools, equipment, and other services necessary for the completion of the PROJECT described herein.

3. The CONTRACTOR will commence the work required by the CONTRACT DOCUMENTS within 10 calendar days after the date of the NOTICE TO PROCEED and will complete the same within 90 calendar days unless the period for completion is extended otherwise by the CONTRACT DOCUMENTS.

4. The CONTRACTOR agrees to furnish all of the MATERIALS described in the CONTRACT DOCUMENTS and comply with the terms therein for the sum of $_____ or as shown in the BID schedule.

5. The term "CONTRACT DOCUMENTS" means and includes the following:

(A) ADVERTISEMENT FOR BIDS

(B) INFORMATION FOR BIDDERS

(C) BID

(D) AGREEMENT

(E) GENERAL CONDITIONS

(F) NOTICE OF AWARD

(G) NOTICE TO PROCEED

(H) CHANGE ORDER

(I) DRAWINGS prepared by Monarch Engineering, Inc., dated December 2014.

(J) SPECIFICATIONS prepared or issued by Monarch Engineering, Inc., dated December 2014.

(O) ADDENDA:

No. _____, dated_____, 20 _____

_____, _____, _____

_____, _____, _____

6. The OWNER will pay to the CONTRACTOR in the manner and at such times as set forth in the GENERAL CONDITIONS such amounts as required by the CONTRACT DOCUMENTS.

7. This AGREEMENT shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF, the parties hereto have executed or caused to be executed by their duly authorized official, this AGREEMENT in six copies each of which shall be deemed an original on the date first above written.

OWNER:

McCreary County Water District, Whitley City, Kentucky

By:_____
Chairman

(SEAL)

ATTEST:

_____

CONTRACTOR:

By:_____
Name:_____
(Please Type)

Address: _____
_____
_____

Employer Identification Number_____
(SEAL)

ATTEST:

_____

Name: _____
(Please Type)

NOTICE TO PROCEED

TO: _____ DATE: _____

_____ Project: Rattlesnake Ridge Pump Station

_____ Upgrade

_____ _____

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20_____, on or before _____, 20_____, and you are to complete the WORK within 90 consecutive calendar days thereafter. The date of completion of all WORK is therefore _____, 20_____.

_____
Owner

By _____

Title_____

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by _____

_____,

this the_____, 20_____

_____

By_____

Title_____

Employer Identification Number_____

CONTRACT CHANGE ORDER

ORDER NO.
DATE
STATE KENTUCKY
COUNTY PULASKI

CONTRACT FOR
KENTUCKY HIGHWAY 196 WATER LINE RELOCATION

OWNER
WESTERN PULASKI COUNTY WATER DISTRICT

TO

.....
(Contractor)

You are hereby requested to comply with the following changes in the contract plans and specifications:

Description of Changes (Supplemental Plans and Specifications Attached)	DECREASE in Contract Price	INCREASE in Contract Price
TOTALS		
NET CHANGE IN CONTRACT PRICE		

JUSTIFICATION:

The amount of the Contract will be (Increased)(Decreased) By the Sum of: _____

_____ Dollars _____

The Contract Total Including this and previous Change Orders will be: _____

_____ Dollars _____

This document will become a supplement to the contract and all provisions will apply hereto.

Requested _____ _____
(Western Pulaski County Water District) (Date)

Recommended _____ _____
(Monarch Engineering, Inc.) (Date)

Accepted _____ _____
(Contractor) (Date)

This information will be used as a record of any changes to the original construction contract.

GENERAL CONDITIONS

1. DEFINITIONS

1.1 Wherever used in the CONTRACT DOCUMENTS, the following terms shall have the meanings indicated and shall be applicable to both the singular and plural thereof:

1.2 ADDENDA - Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the CONTRACT DOCUMENTS, DRAWINGS and SPECIFICATIONS, by additions, deletions, clarifications, or corrections.

1.3 BID - The offer or proposal of the BIDDER submitted on the prescribed form setting forth the prices for the WORK to be performed.

1.4 BIDDER - Any person, firm, or corporation submitting a BID for the WORK.

1.5 BONDS - Bid, Performance, and Payment Bonds and other instruments of surety, furnished by the CONTRACTOR and the CONTRACTOR'S surety in accordance with the CONTRACT DOCUMENTS.

1.6 CHANGE ORDER - A written order to the CONTRACTOR authorizing an addition, deletion, or revision in the WORK within the general scope of the CONTRACT DOCUMENTS, or authorizing an adjustment in the CONTRACT PRICE or CONTRACT TIME.

1.7 CONTRACT DOCUMENTS - The contract, including Advertisement For BIDS, Information For BIDDERS, BID, BID BOND, Agreement, Payment BOND, Performance BOND, NOTICE OF AWARD, NOTICE TO PROCEED, CHANGE ORDER, DRAWINGS, SPECIFICATIONS, and ADDENDA.

1.8 CONTRACT PRICE - The total monies payable to the CONTRACTOR under the terms and conditions of the CONTRACT DOCUMENTS.

1.9 CONTRACT TIME - The number of calendar days stated in the CONTRACT DOCUMENTS for the completion of the WORK.

1.10 CONTRACTOR - The person, firm, or corporation with whom the OWNER has executed the Agreement.

1.11 DRAWINGS - The parts of the CONTRACT DOCUMENTS which show the characteristics and scope of the WORK to be performed and which have been prepared or approved by the ENGINEER.

1.12 ENGINEER - The person, firm, or corporation named as such in the CONTRACT DOCUMENTS.

1.13 FIELD ORDER - A written order effecting a change in the WORK not involving an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, issued by the ENGINEER to the CONTRACTOR during construction.

1.14 NOTICE OF AWARD - The written notice of the acceptance of the BID from the OWNER to the successful BIDDER.

1.15 NOTICE TO PROCEED - Written communication issued by the OWNER to the CONTRACTOR authorizing him/her to proceed with the WORK and establishing the date for commencement of the WORK.

1.16 OWNER - A public or quasi-public body or authority, corporation, association, partnership, or an individual for whom the WORK is to be performed.

1.17 PROJECT - The undertaking to be performed as provided in the CONTRACT DOCUMENTS.

1.18 RESIDENT PROJECT REPRESENTATIVE - The authorized representative of the OWNER who is assigned to the PROJECT site or any part thereof.

1.19 SHOP DRAWINGS - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the CONTRACTOR, a SUBCONTRACTOR, manufacturer, SUPPLIER or distributor, which illustrate how specific portions of the WORK shall be fabricated or installed.

1.20 SPECIFICATIONS - A part of the CONTRACT DOCUMENTS consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.

1.21 SUBCONTRACTOR - An individual, firm, or corporation having a direct contract with CONTRACTOR or with any other SUBCONTRACTOR for the performance of a part of the WORK at the site.

1.22 SUBSTANTIAL COMPLETION - That date certified by the ENGINEER when the construction of the PROJECT or a specified part thereof is sufficiently completed, in accordance with the CONTRACT DOCUMENTS, so that the PROJECT or specified part can be utilized for the purposes for which it is intended.

1.23 SUPPLEMENTAL GENERAL CONDITIONS - Modifications to General Conditions required by a Federal agency for participation in the PROJECT and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such requirements that may be imposed by applicable state laws.

1.24 SUPPLIER - Any person or organization who supplies materials or equipment for the WORK, including that fabricated to a special design, but who does not perform labor at the site.

1.25 WORK - All labor necessary to produce the construction required by the CONTRACT DOCUMENTS, and all materials and equipment incorporated or to be incorporated in the PROJECT.

1.26 WRITTEN NOTICE - Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at their last given address, or delivered in person to said party or their authorized representative on the WORK.

2. ADDITIONAL INSTRUCTIONS AND DETAIL DRAWINGS

2.1 The CONTRACTOR may be furnished additional instructions and detail drawings, by the ENGINEER, as necessary to carry out the WORK required by the CONTRACT DOCUMENTS.

2.2 The additional drawings and instructions thus supplied will become a part of the CONTRACT DOCUMENTS. The CONTRACTOR shall carry out the WORK in accordance with the additional detail drawings and instructions.

3. SCHEDULES, REPORTS AND RECORDS

3.1 The CONTRACTOR shall submit to the OWNER such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data where applicable as are required by the CONTRACT DOCUMENTS for the WORK to be performed.

3.2 Prior to the first partial payment estimate the CONTRACTOR shall submit construction progress schedules showing the order in which the CONTRACTOR proposes to carry on the WORK, including dates at which the various parts of the WORK will be started, estimated date of completion of each part and, as applicable:

3.2.1 The dates at which special detail drawings will be required; and

3.2.2 Respective dates for submission of SHOP DRAWINGS, the beginning of manufacture, the testing and the installation of materials, supplies and equipment.

3.3 The CONTRACTOR shall also submit a schedule of payments that the CONTRACTOR anticipates will be earned during the course of the WORK.

4. DRAWINGS AND SPECIFICATIONS

4.1 The intent of the DRAWINGS and SPECIFICATIONS is that the CONTRACTOR shall furnish all labor, materials, tools, equipment, and transportation necessary for the proper execution of the WORK in accordance with the CONTRACT DOCUMENTS and all incidental work necessary to complete the PROJECT in an acceptable manner, ready for use, occupancy or operation by the OWNER.

4.2 In case of conflict between the DRAWINGS and SPECIFICATIONS, the SPECIFICATIONS shall govern. Figure dimensions on DRAWINGS shall govern over general DRAWINGS.

4.3 Any discrepancies found between the DRAWINGS and SPECIFICATIONS and site conditions or any inconsistencies or ambiguities in the DRAWINGS or SPECIFICATIONS shall be immediately reported to the ENGINEER, in writing, who shall promptly correct such inconsistencies or ambiguities in writing. WORK done by the CONTRACTOR after discovery of such discrepancies, inconsistencies or ambiguities shall be done at the CONTRACTOR'S risk.

5. SHOP DRAWINGS

5.1 The CONTRACTOR shall provide SHOP DRAWINGS as may be necessary for the prosecution of the WORK as required by the CONTRACT DOCUMENTS. The ENGINEER shall promptly review all SHOP DRAWINGS. The ENGINEER'S approval of any SHOP DRAWING shall not release the CONTRACTOR from responsibility for deviations from the CONTRACT DOCUMENTS. The approval of any SHOP DRAWING which substantially deviates from the requirement of the CONTRACT DOCUMENTS shall be evidenced by a CHANGE ORDER.

5.2 When submitted for the ENGINEER's review, SHOP DRAWINGS shall bear the CONTRACTOR'S certification that he has reviewed, checked and approved the SHOP DRAWINGS and that they are in conformance with the requirements of the CONTRACT DOCUMENTS.

5.3 Portions of the WORK requiring a SHOP DRAWING or sample submission shall not begin until the SHOP DRAWING or submission has been approved by the ENGINEER. A copy of each approved SHOP DRAWING and each approved sample shall be kept in good order by the CONTRACTOR at the site and shall be available to the ENGINEER.

6. MATERIALS, SERVICES AND FACILITIES

6.1 It is understood that, except as otherwise specifically stated in the CONTRACT DOCUMENTS, the CONTRACTOR shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete, and deliver the WORK within the specified time.

6.2 Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the WORK. Stored materials and equipment to be incorporated in the WORK shall be located so as to facilitate prompt inspection.

6.3 Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

6.4 Materials, supplies, and equipment shall be in accordance with samples submitted by the CONTRACTOR and approved by the ENGINEER.

6.5 Materials, supplies, or equipment to be incorporated into the WORK shall not be purchased by the CONTRACTOR or the SUBCONTRACTOR subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

7. INSPECTION AND TESTING

7.1 All materials and equipment used in the construction of the PROJECT shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the CONTRACT DOCUMENTS.

7.2 The OWNER shall provide all inspection and testing services not required by the CONTRACT DOCUMENTS.

7.3 The CONTRACTOR shall provide at the CONTRACTOR'S expense the testing and inspection services required by the CONTRACT DOCUMENTS.

7.4 If the CONTRACT DOCUMENTS, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any WORK to specifically be inspected, tested, or approved by someone other than the CONTRACTOR, the CONTRACTOR will give the ENGINEER timely notice of readiness. The CONTRACTOR will then furnish the ENGINEER the required certificates of inspection, testing or approval.

7.5 Inspections, tests, or approvals by the engineer or others shall not relieve the CONTRACTOR from the obligations to perform the WORK in accordance with the requirements of the CONTRACT DOCUMENTS.

7.6 The ENGINEER and the ENGINEER'S representatives will at all times have access to the WORK. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all work, materials, payrolls, records or personnel, invoices of materials, and other relevant data and records. The CONTRACTOR will provide proper facilities for such access and observation of the WORK and also for any inspection or testing thereof.

7.7 If any WORK is covered contrary to the written instructions of the ENGINEER it must, if requested by the ENGINEER, be uncovered for the ENGINEER'S observation and replaced at the CONTRACTOR'S expense.

7.8 If the ENGINEER considers it necessary or advisable that covered WORK be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request, will uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the WORK in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such WORK is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction, if, however, such WORK is not found to be defective, the CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate CHANGE ORDER shall be issued.

8. SUBSTITUTIONS

8.1 Whenever a material, article, or piece of equipment is identified on the DRAWINGS or SPECIFICATIONS by reference to brand name or catalogue numbers, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The CONTRACTOR may recommend the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the CONTRACT DOCUMENTS by reference to brand name or catalogue number, and if, in the opinion of the ENGINEER, such material, article, or piece of equipment is of equal substance and function to that specified, the ENGINEER may approve its substitution and use by the CONTRACTOR. Any cost differential shall be deductible from the CONTRACT PRICE and the CONTRACT DOCUMENTS shall be appropriately modified by CHANGE ORDER. The CONTRACTOR warrants that if substitutes are approved, no major changes in the function or general design of the PROJECT will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the CONTRACTOR without a change in the CONTRACT PRICE or CONTRACT TIME.

9. PATENTS

9.1 The CONTRACTOR shall pay all applicable royalties and license fees, and shall defend all suits or claims for infringement of any patent rights and save the OWNER harmless from loss on account thereof, except that the OWNER shall be responsible for any such loss when a particular process, design, or product of a particular manufacturer or manufacturers is specified, however, if the CONTRACTOR has reason to believe that the design, process or product specified is an infringement of a patent, the CONTRACTOR shall be responsible for such loss unless the CONTRACTOR promptly gives such information to the ENGINEER.

10. SURVEYS, PERMITS, REGULATIONS

10.1 The OWNER shall furnish all boundary surveys and establish all base lines for locating the principal component parts of the WORK together with a suitable number of bench marks adjacent to the WORK as shown in the CONTRACT DOCUMENTS. From the information provided by the OWNER, unless otherwise specified in the CONTRACT DOCUMENTS, the CONTRACTOR shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pipe locations and other working points, lines, elevations and cut sheets.

10.2 The CONTRACTOR shall carefully preserve bench marks, reference points and stakes and, in case of willful or careless destruction, shall be charged with the resulting expense and shall be responsible for any mistake that may be caused by their unnecessary loss or disturbance.

10.3 Permits and licenses of a temporary nature necessary for the prosecution of the WORK shall be secured and paid for by the CONTRACTOR unless otherwise stated in the SUPPLEMENTAL GENERAL CONDITIONS. Permits, licenses and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the OWNER, unless otherwise specified. The CONTRACTOR shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the WORK as drawn and specified. If the CONTRACTOR observes that the CONTRACT DOCUMENTS are at variance therewith, the CONTRACTOR shall promptly notify the ENGINEER in writing, and any necessary changes shall be adjusted as provided in Section 13, CHANGES IN THE WORK.

11. PROTECTION OF WORK, PROPERTY, AND PERSONS

11.1 The CONTRACTOR will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR will take all necessary precautions for the safety of, will provide the necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the WORK and other persons who may be affected thereby, all the WORK and all materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

11.2 The CONTRACTOR will comply with all applicable laws, ordinances, rules, regulations and orders of any public body having jurisdiction. The CONTRACTOR will erect and maintain, as required by the conditions and progress of the WORK, all necessary safeguards for safety and protection. The CONTRACTOR will notify owners of adjacent utilities when prosecution of the WORK may affect them. The CONTRACTOR will remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or part, by the CONTRACTOR, any SUBCONTRACTOR or anyone directly or indirectly employed by any of them or anyone directly or indirectly employed by any of them or anyone of whose acts any of them be liable, except damage or loss attributable to the fault of the CONTRACT DOCUMENTS or to the acts or omissions of the OWNER, of the ENGINEER or anyone employed by either of them or anyone for whose acts either of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of the CONTRACTOR.

11.3 In emergencies affecting the safety of persons or the WORK or property at the site or adjacent thereto, the CONTRACTOR, without special instructions or authorization from the ENGINEER or OWNER, shall act to prevent threatened damage, injury or loss. The CONTRACTOR will give the ENGINEER prompt WRITTEN NOTICE of any significant changes in the WORK or deviations from the CONTRACT DOCUMENTS caused thereby, and a CHANGE ORDER shall thereupon be issued covering the changes and deviations involved.

12. SUPERVISION BY CONTRACTOR

12.1 The CONTRACTOR will supervise and direct the WORK. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The CONTRACTOR will employ and maintain on the WORK a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CONTRACTOR and all communications given to the supervisor shall be as binding as if given to the CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the WORK.

13. CHANGES IN THE WORK

13.1 The OWNER may at any time, as the need arises, order changes within the scope of the WORK without invalidating the Agreement. If such changes increase or decrease the amount due under the CONTRACT DOCUMENTS, or in the time required for performance of the WORK, an equitable adjustment shall be authorized by CHANGE ORDER.

13.2 The ENGINEER, also, may at any time, by issuing a FIELD ORDER, make changes in the details of the WORK. The CONTRACTOR shall proceed with the performance of any changes in the WORK so ordered by the ENGINEER unless the CONTRACTOR believes that such FIELD ORDER entitles the CONTRACTOR to a change in CONTRACT PRICE or TIME, or both, in which event the CONTRACTOR shall give the ENGINEER WRITTEN NOTICE thereof within seven (7) days after the receipt of the ordered change. Thereafter the CONTRACTOR shall document the basis for the change in CONTRACT PRICE or TIME within thirty (30) days. The CONTRACTOR shall not execute such changes pending the receipt of an executed CHANGE ORDER or further instruction from the OWNER.

14. CHANGES IN CONTRACT PRICE

14.1 The CONTRACT PRICE may be changed only by a CHANGE ORDER. The value of any WORK covered by a CHANGE ORDER or of any claim for increase or decrease in the CONTRACT PRICE shall be determined by one or more of the following methods in the order of precedence listed below:

a. Unit prices previously approved.

b. An agreed lump sum.

15. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

15.1 The date of beginning and the time for completion of the WORK are essential conditions of the CONTRACT DOCUMENTS and the WORK embraced shall be commenced on a date specified in the NOTICE TO PROCEED.

15.2 The CONTRACTOR will proceed with the WORK at such rate of progress to insure full completion within the CONTRACT TIME. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the CONTRACT TIME for the completion of the WORK described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the WORK.

15.3 If the CONTRACTOR shall fail to complete the WORK within the CONTRACT TIME, or extension of time granted by the OWNER, then the CONTRACTOR will pay to the OWNER the amount for liquidated damages as specified in the BID for each calendar day that the CONTRACTOR shall be in default after the time stipulated in the CONTRACT DOCUMENTS.

15.4 The CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the WORK is due to the following and the CONTRACTOR has promptly given WRITTEN NOTICE of such delay to the OWNER or ENGINEER.

15.4.1 To any preference, priority or allocation order duly issued by the OWNER.

15.4.2 To unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

15.4.3 To any delays of SUBCONTRACTORS occasioned by any of the causes specified in paragraphs 15.4.1 and 15.4.2 of this article.

16. CORRECTION OF WORK

16.1 The CONTRACTOR shall promptly remove from the premises all WORK rejected by the ENGINEER for failure to comply with the CONTRACT DOCUMENTS, whether incorporated in the construction or not, and the CONTRACTOR shall promptly replace and reexecute the WORK in accordance with the CONTRACT DOCUMENTS and without expense to the OWNER and shall bear the expense of making good all WORK of other CONTRACTORS destroyed or damaged by such removal or replacement.

16.2 All removal and replacement WORK shall be done at the CONTRACTOR'S expense. If the CONTRACTOR does not take action to remove such rejected WORK within ten (10) days after receipt of WRITTEN NOTICE, the OWNER may remove such WORK and store the materials at the expense of the CONTRACTOR.

17. SUBSURFACE CONDITIONS

17.1 The CONTRACTOR shall promptly, and before such conditions are disturbed, except in the event of an emergency, notify the OWNER by WRITTEN NOTICE of:

17.1.1 Subsurface or latent physical conditions at the site differing materially from those indicated in the CONTRACT DOCUMENTS; or

17.1.2 Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in WORK of the character provided for in the CONTRACT DOCUMENTS.

17.2 The OWNER shall promptly investigate the conditions, and if it is found that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the WORK, an equitable adjustment shall be made and the CONTRACT DOCUMENTS shall be modified by a CHANGE ORDER. Any claim of the CONTRACTOR for adjustment hereunder shall not be allowed unless the required WRITTEN NOTICE has been given; provided that the OWNER may, if the OWNER determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

18. SUSPENSION OF WORK, TERMINATION, AND DELAY

18.1 The OWNER may suspend the WORK or any portion thereof for a period of not more than ninety days or such further time as agreed upon by the CONTRACTOR, by WRITTEN NOTICE to the CONTRACTOR and the ENGINEER which shall fix the date on which WORK shall be resumed. The CONTRACTOR will resume that WORK on the date so fixed. The CONTRACTOR will be allowed an increase in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, directly attributable to any suspension.

18.2 If the CONTRACTOR is adjudged a bankrupt or insolvent, or makes a general assignment for the benefit of its creditors, or if a trustee or receiver is appointed for the CONTRACTOR or for any of its property, or if CONTRACTOR files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or repeatedly fails to make prompt payments to SUBCONTRACTORS or for labor, materials or equipment or disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the WORK or disregards the authority of the ENGINEER, or otherwise violates any provision of the CONTRACT DOCUMENTS,

then the OWNER may, without prejudice to any other right or remedy and after giving the CONTRACTOR and its surety a minimum of ten (10) days from delivery of a WRITTEN NOTICE, terminate the services of the CONTRACTOR and take possession of the PROJECT and of all materials, equipment, tools, construction equipment and machinery thereon owned by the CONTRACTOR, and finish the WORK by whatever method the OWNER may deem expedient. In such case the CONTRACTOR shall not be entitled to receive any further payment until the WORK is finished. If the unpaid balance of the CONTRACT PRICE exceeds the direct and indirect costs of completing the PROJECT, including compensation for additional professional services, such excess SHALL BE PAID TO THE CONTRACTOR. If such costs exceed such unpaid balance, the CONTRACTOR will pay the difference to the OWNER. Such costs incurred by the OWNER will be determined by the ENGINEER and incorporated in a CHANGE ORDER.

18.3 Where the CONTRACTOR'S services have been so terminated by the OWNER, said termination shall not affect any right of the OWNER against the CONTRACTOR then existing or which may thereafter accrue. Any retention or payment of monies by the OWNER due the CONTRACTOR will not release the CONTRACTOR from compliance with the CONTRACT DOCUMENTS.

18.4 After ten (10) days from delivery of a WRITTEN NOTICE to the CONTRACTOR and the ENGINEER, the OWNER may, without cause and without prejudice to any other right or remedy, elect to abandon the PROJECT and terminate the CONTRACT. In such case the CONTRACTOR shall be paid for all WORK executed and any expense sustained plus reasonable profit.

18.5 If, through no act or fault of the CONTRACTOR, the WORK is suspended for a period of more than ninety (90) days by the OWNER or under an order of court or other public authority, or the ENGINEER fails to act on any request for payment within thirty (30) days after it is submitted, or the OWNER fails to pay the CONTRACTOR substantially the sum approved by the ENGINEER or awarded by arbitrators within thirty (30) days of its approval and presentation, then the CONTRACTOR may, after ten (10) days from delivery of a WRITTEN NOTICE to the OWNER and the ENGINEER terminate the CONTRACT and recover from the OWNER payment for all WORK executed and all expenses sustained. In addition and in lieu of terminating the CONTRACT, if the ENGINEER has failed to act on a request for payment or if the OWNER has failed to make any payment as aforesaid, the CONTRACTOR may upon ten (10) days written notice to the OWNER and the ENGINEER stop the WORK until paid all amounts then due, in which event and upon resumption of the WORK CHANGE ORDERS shall be issued for adjusting the CONTRACT PRICE or extending the CONTRACT TIME or both to compensate for the costs and delays attributable to the stoppage of the WORK.

18.6 If the performance of all or any portion of the WORK is suspended, delayed, or interrupted as a result of a failure of the OWNER or ENGINEER to act within the time specified in the CONTRACT DOCUMENTS, or if no time is specified, within a reasonable time, an adjustment in the CONTRACT PRICE or an extension of the CONTRACT TIME, or both, shall be made by CHANGE ORDER to compensate the CONTRACTOR for the costs and delays necessarily caused by the failure of the OWNER or ENGINEER.

19. PAYMENT TO CONTRACTOR

19.1 At least ten (10) days before each progress payment falls due (but not more often than once a month), the CONTRACTOR will submit to the ENGINEER a partial payment estimate filled out and signed by the CONTRACTOR covering the WORK performed during the period covered by the partial payment estimate and supported by such data as the ENGINEER may reasonably require. If payment is requested on the basis of materials and equipment not incorporated in the WORK but delivered and suitably stored at or near the site, the partial payment estimate shall also be accompanied by such supporting data, satisfactory to the OWNER, as will establish the OWNER'S title to the material and equipment and protect the OWNER'S interest therein, including applicable insurance. The ENGINEER will, within ten (10) days after receipt of each partial payment estimate, either indicate in writing approval of payment, and present the partial payment estimate to the OWNER, or return the partial payment estimate to the CONTRACTOR indicating in writing the reasons for refusing to approve payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the partial payment estimate. The OWNER will, within ten (10) days of presentation of an approved partial payment estimate, pay the CONTRACTOR a progress payment on the basis of the approved partial payment estimate less the retainage. The retainage shall be an amount equal to 5% of said estimate. If at any time thereafter when the progress of the WORK is not satisfactory, additional amounts may be retained. Upon substantial completion of the work, any amount retained may be paid to the CONTRACTOR. When the WORK has been substantially completed except for WORK which cannot be completed because of weather conditions, lack of materials or other reasons which in the judgment of the OWNER are valid reasons for noncompletion, the OWNER may make additional payments, retaining at all times an amount sufficient to cover the estimated cost of the WORK still to be completed.

19.2 The request for payment may also include an allowance for the cost of such major materials and equipment which are suitably stored either at or near the site.

19.3 Prior to SUBSTANTIAL COMPLETION, the OWNER, with the approval of the ENGINEER and with the concurrence of the CONTRACTOR, may use any completed or substantially completed portions of the WORK. Such use shall not constitute an acceptance of such portions of the WORK.

19.4 The OWNER shall have the right to enter the premises for the purpose of doing work not covered by the CONTRACT DOCUMENTS. This provision shall not be construed as relieving the CONTRACTOR of the sole responsibility for the care and protection of the WORK, or the restoration of any damaged WORK except such as may be caused by agents or employees of the OWNER.

19.5 Upon completion and acceptance of the WORK, the ENGINEER shall issue a certificate attached to the final payment request that the WORK has been accepted under the conditions of the CONTRACT DOCUMENTS. The entire balance found to be due the CONTRACTOR, including the retained percentages, but except such sums as may be lawfully retained by the OWNER, shall be paid to the CONTRACTOR within thirty (30) days of completion and acceptance of the WORK.

19.6 The CONTRACTOR will indemnify and save the OWNER or the OWNER'S agents harmless from all claims growing out of the lawful demand of SUBCONTRACTORS, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, tools, and all supplies, incurred in the furtherance of the performance of the WORK. The CONTRACTOR shall, at the OWNER'S request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged, or waived. If the CONTRACTOR fails to do so the OWNER may, after having notified the CONTRACTOR, either pay unpaid bills or withhold from the CONTRACTOR'S unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to the CONTRACTOR shall be resumed in accordance with the terms of the CONTRACT DOCUMENTS, but in no event shall the provisions of this sentence be construed to impose any obligations upon the OWNER to either the CONTRACTOR, the CONTRACTOR'S Surety, or any third party. In paying any unpaid bills of the CONTRACTOR, any payment so made by the OWNER shall be considered as a payment made under the CONTRACT DOCUMENTS by the OWNER to the CONTRACTOR and the OWNER shall not be liable to the CONTRACTOR for any such payments made in good faith.

19.7 If the OWNER fails to make payment thirty (30) days after approval by the ENGINEER, in addition to other remedies available to the CONTRACTOR, there shall be added to each such payment interest at the maximum legal rate commencing on the first day after said payment is due and continuing until the payment is received by the CONTRACTOR.

20. ACCEPTANCE OF FINAL PAYMENT AS RELEASE

20.1 The acceptance by the CONTRACTOR of final payment shall be and shall operate as a release to the OWNER of all claims and all liability to the CONTRACTOR other than claims in stated amounts as may be specifically excepted by the CONTRACTOR for all things done or furnished in connection with this WORK and for every act and neglect of the OWNER and others relating to or arising out of this WORK. Any payment, however,

final or otherwise, shall not release the CONTRACTOR or its sureties from any obligations under the CONTRACT DOCUMENTS or the Performance and Payment BONDS.

21. INSURANCE

21.1 The CONTRACTOR shall purchase and maintain such insurance as will protect it from claims set forth below which may arise out of, or result from, the CONTRACTOR'S execution of the WORK, whether such execution be by the CONTRACTOR, any SUBCONTRACTOR, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

21.1.1 Claims under workmen's compensation, disability benefit and other similar employee benefit acts;

21.1.2 Claims for damages because of bodily injury, occupational sickness or disease, or death of employees;

21.1.3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than employees;

21.1.4 Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person; and

21.1.5 Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

21.2 Certificates of Insurance acceptable to the OWNER shall be filed with the OWNER prior to commencement of the WORK. These Certificates shall contain a provision that coverages afforded under the policies will not be canceled unless at least fifteen (15) days prior WRITTEN NOTICE has been given to the OWNER.

21.3 The CONTRACTOR shall procure and maintain, at the CONTRACTOR'S own expense, during the CONTRACT TIME, Liability insurance as hereinafter specified:

21.3.1 CONTRACTOR'S General Public Liability and Property Damage Insurance including vehicle coverage issued to the CONTRACTOR and protecting the CONTRACTOR from all claims for personal injury, including death, and all claims for destruction of or damage to property, arising out of or in connection with any operations under the CONTRACT DOCUMENTS, whether such operations be by the CONTRACTOR or by any SUBCONTRACTOR employed by the CONTRACTOR or anyone directly or indirectly employed by the CONTRACTOR or by a SUBCONTRACTOR employed by the CONTRACTOR. Insurance shall be written with a limit of liability of not less than $500,000 for all damages arising out of bodily injury,

including death, at any time resulting therefrom, sustained by any one person in any one accident; and a limit of liability of not less than $500,000 aggregate for any such damages sustained by two or more persons in any one accident. Insurance shall be written with a limit of liability of not less than $200,000 for all property damage sustained by any one person in any one accident; and a limit of liability of not less than $200,000 aggregate for any such damage sustained by two or more persons in any one accident.

21.3.2 The CONTRACTOR shall acquire and maintain, if applicable, Fire and Extended Coverage insurance upon the PROJECT to the full insurable value thereof for the benefit of the OWNER, the CONTRACTOR, and SUBCONTRACTORS as their interest may appear. This provision shall in no way release the CONTRACTOR or CONTRACTOR'S surety from obligations under the CONTRACT DOCUMENTS to fully complete the PROJECT.

21.4 The CONTRACTOR shall procure and maintain, at the CONTRACTOR'S own expense, during the CONTRACT TIME, in accordance with the provisions of the laws of the state in which the WORK is performed, Workmen's Compensation Insurance, including occupational disease provisions, for all of the CONTRACTOR'S employees at the site of the PROJECT and in case any WORK is sublet, the CONTRACTOR shall require such SUBCONTRACTOR similarly to provide Workmen's Compensation Insurance, including occupational disease provisions for all of the latter's employees unless such employees are covered by the protection afforded by the CONTRACTOR. In case any class of employees engaged in hazardous work under this contract at the site of the PROJECT is not protected under Workmen's Compensation statue, the CONTRACTOR shall provide, and shall cause each SUBCONTRACTOR to provide, adequate and suitable insurance for the protection of its employees not otherwise protected.

21.5 The CONTRACTOR shall secure, if applicable, "All Risk" type Builder's Risk Insurance for WORK to be performed. Unless specifically authorized by the OWNER, the amount of such insurance shall not be less than the CONTRACT PRICE totaled in the BID. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft, and smoke during the CONTRACT TIME, and until the WORK is accepted by the OWNER. The policy shall name as the insured the CONTRACTOR, and the OWNER.

22. CONTRACT SECURITY

22.1 The CONTRACTOR shall within ten (10) days after the receipt of the NOTICE OF AWARD furnish the OWNER with a Performance BOND and a Payment BOND in penal sums equal to the amount of the CONTRACT PRICE, conditioned upon the performance by the CONTRACTOR of all undertakings, covenants, terms, conditions and agreements of the CONTRACT DOCUMENTS, and upon the prompt payment by the CONTRACTOR to all persons supplying labor and materials in the prosecution of the WORK provided by the CONTRACT DOCUMENTS. Such BONDS shall be executed by the CONTRACTOR and a corporate bonding company licensed to transact such

business in the state in which the WORK is to be performed and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these BONDS shall be borne by the CONTRACTOR. If at any time a surety on any such BOND is declared a bankrupt or loses its right to do business in the state in which the WORK is to be performed or is removed from the list of Surety Companies accepted on Federal Bonds, CONTRACTOR shall within ten (10) days after notice from the OWNER to do so, substitute an acceptable BOND (or BONDS) in such form and sum and signed by such other surety or sureties as may be satisfactory to the OWNER. The premiums on such BOND shall be paid by the CONTRACTOR. No further payment shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable BOND to the OWNER.

23. ASSIGNMENTS

23.1 Neither the CONTRACTOR nor the OWNER shall sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof, or of any right, title or interest therein, or any obligations thereunder, without written consent of the other party.

24. INDEMNIFICATION

24.1 The CONTRACTOR will indemnify and hold harmless the OWNER and the ENGINEER and their agents and employees from and against all claims, damages, losses and expenses including attorney's fees arising out of or resulting from the performance of the WORK, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the CONTRACTOR, and SUBCONTRACTOR, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

24.2 In any and all claims against the OWNER or the ENGINEER, or any of their agents or employees, by any employee of the CONTRACTOR, any SUBCONTRACTOR, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the CONTRACTOR or any SUBCONTRACTOR under workmen's compensation acts, disability benefit acts or other employee benefits acts.

24.3 The obligation of the CONTRACTOR under this paragraph shall not extend to the liability of the ENGINEER, its agents or employees arising out of the preparation or approval of maps, DRAWINGS, opinions, reports, surveys, CHANGE ORDERS, designs or SPECIFICATIONS.

25. SEPARATE CONTRACTS

25.1 The OWNER reserves the right to let other contracts in connection with this PROJECT. The CONTRACTOR shall afford other CONTRACTORS reasonable opportunity for the introduction and storage of their materials and the execution of their WORK, and shall properly connect and coordinate the WORK with theirs. If the proper execution or results of any part of the CONTRACTOR'S WORK depends upon the WORK of any other CONTRACTOR, the CONTRACTOR shall inspect and promptly report to the ENGINEER any defects in such WORK that render it unsuitable for such proper execution and results.

25.2 The OWNER may perform additional WORK related to the PROJECT or the OWNER may let other contracts containing provisions similar to these. The CONTRACTOR will afford the other CONTRACTORS who are parties to such Contracts (or the OWNER, if the OWNER is performing the additional WORK) reasonable opportunity for the introduction and storage of materials and equipment and the execution of WORK, and shall properly connect and coordinate the WORK with theirs.

25.3 If the performance of additional WORK by other CONTRACTORS or the OWNER is not noted in the CONTRACT DOCUMENTS prior to the execution of the CONTRACT, written notice thereof shall be given to the CONTRACTOR prior to starting any such additional WORK. If the CONTRACTOR believes that the performance of such additional WORK by the OWNER or others involves it in additional expense or entitles it to an extension of the CONTRACT TIME, the CONTRACTOR may make a claim thereof as provided in Sections 14 and 15.

26. SUBCONTRACTING

26.1 The CONTRACTOR may utilize the services of specialty SUBCONTRACTS on those parts of the WORK which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.

26.2 The CONTRACTOR shall not award WORK to SUBCONTRACTOR(s), in excess of fifty (50%) percent of the CONTRACT PRICE, without prior written approval of the OWNER.

26.3 The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of its SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as the CONTRACTOR is for the acts and omissions of persons directly employed by the CONTRACTOR.

26.4 The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the WORK to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the CONTRACT DOCUMENTS insofar as applicable to

the WORK of SUBCONTRACTORS and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.

26.5 Nothing contained in this CONTRACT shall create any contractual relationship between any SUBCONTRACTOR and the OWNER.

27. ENGINEER'S AUTHORITY

27.1 The ENGINEER shall act as the OWNER'S representative during the construction period, shall decide questions which may arise as to quality and acceptability of materials furnished and WORK performed, and shall interpret the intent of the CONTRACT DOCUMENTS in a fair and unbiased manner. The ENGINEER will make visits to the site and determine if the WORK is proceeding in accordance with the CONTRACT DOCUMENTS.

27.2 The CONTRACTOR will be held strictly to the intent of the CONTRACT DOCUMENTS in regard to the quality of materials, workmanship, and execution of the WORK. Inspections may be made at the factory or fabrication plant of the source of material supply.

27.3 The ENGINEER will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

27.4 The ENGINEER shall promptly make decisions relative to interpretation of the CONTRACT DOCUMENTS.

28. LAND AND RIGHTS-OF-WAY

28.1 Prior to issuance of NOTICE TO PROCEED, the OWNER shall obtain all land and rights-of-way necessary for carrying out and for the completion of the WORK to be performed pursuant to the CONTRACT DOCUMENTS, unless otherwise mutually agreed.

28.2 The OWNER shall provide to the CONTRACTOR information which delineates and describes the lands owned and rights-of-way acquired.

28.3 The CONTRACTOR shall provide at its own expense and without liability to the OWNER any additional land and access thereto that the CONTRACTOR may desire for temporary construction facilities, or for storage of materials.

29. GUARANTEE

29.1 The CONTRACTOR shall guarantee all materials and equipment furnished and WORK performed for a period of one (1) year from the date of SUBSTANTIAL COMPLETION. The CONTRACTOR warrants and guarantees for a period of one (1) year from the date of SUBSTANTIAL COMPLETION of the system that the completed system is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any damage to other parts of the system resulting from such defects. The OWNER will give notice of observed defects with reasonable promptness. In the event that the CONTRACTOR should fail to make such repairs, adjustments, or other WORK that may be made necessary by such defects, the OWNER may do so and charge the CONTRACTOR the cost thereby incurred. The Performance BOND shall remain in full force and effect through the guarantee period.

30. ARBITRATION BY MUTUAL AGREEMENT

30.1 All claims, disputes, and other matters in question arising out of, or relating to, the CONTRACT DOCUMENTS or the breach thereof, except for claims which have been waived by making an acceptance of final payment as provided by Section 20, may be decided by arbitration if the parties mutually agree. Any agreement to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

30.2 Notice of the request for arbitration shall be filed in writing with the other party to the CONTRACT DOCUMENTS and a copy shall be filed with the ENGINEER. Request for arbitration shall in no event be made on any claim, dispute, or other matter in question which would be barred by the applicable statute of limitations.

30.3 The CONTRACTOR will carry on the WORK and maintain the progress schedule during any arbitration proceedings, unless otherwise mutually agreed in writing.

31. TAXES

31.1 The CONTRACTOR will pay all sales, consumer, use, and other similar taxes required by the laws of the place where the WORK is performed.

32. ENVIRONMENTAL REQUIREMENTS

The CONTRACTOR, when constructing a project involving trenching and/or other related earth excavation, shall comply with the following environmental constraints.

32.1 WETLANDS - The CONTRACTOR, when disposing of excess, spoil, or other construction materials on public or private property, WILL NOT FILL IN or otherwise CONVERT WETLANDS.

32.2 FLOODPLAINS - The CONTRACTOR, when disposing of excess, spoil, or other construction materials on public or private property, WILL NOT FILL IN or otherwise CONVERT 100 YEAR FLOODPLAIN areas delineated on the latest FEMA Floodplain Maps.

32.3 HISTORIC PRESERVATION - Any excavation by the Contractor that uncovers an historical or archaeological artifact shall be immediately reported to the PROJECT ENGINEER. Construction shall be temporarily halted pending the notification process and further directions issued by the PROJECT ENGINEER after consultation with the State Historic Preservation Officer (SHPO).

32.4 ENDANGERED SPECIES - The CONTRACTOR shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of the CONTRACTOR, the CONTRACTOR will immediately report this evidence to the PROJECT ENGINEER. Construction shall be temporarily halted pending the notification process and further directions issued by the PROJECT ENGINEER after consultation with the U.S. Fish and Wildlife Service.

Form RD 1924-7
(Rev. 2/97)

FORM APPROVED
OMB NO.0575-0042

UNITED STATES DEPARTMENT OF AGRICULTURE
RURAL DEVELOPMENT AND
FARM SERVICE AGENCY

CONTRACT CHANGE ORDER

ORDER NO.	1
DATE	
STATE	KY
COUNTY	McCREARY

CONTRACT FOR: RATTLESNAKE RIDGE PUMP STATION UPGRADE

OWNER: McCREARY COUNTY WATER DISTRICT

TO:

(Contractor)

You are hereby requested to comply with the following changes in the contract plans and specifications:

Description of Changes (Supplemental Plans and Specifications Attached)	DECREASE in Contract Price	INCREASE in Contract Price
TOTALS		
NET CHANGE IN CONTRACT PRICE		

JUSTIFICATION:

The amount of the Contract will be (Decreased) (Increased) By the Sum of: _____

_____ Dollars _____

The Contract Total Including this and previous Change Orders will be: _____

_____ Dollars _____

The Contract Period Provided for Completion will be (Increased) (Decreased) (Unchanged): _____ Days

This document will become a supplement to the contract and all provisions will apply hereto.

Requested _____ _____
(McCreary County Water District) (Date)

Recommended _____ _____
(Monarch Engineering, Inc.) (Date)

Accepted _____ _____
(Contractor) (Date)

This information will be used as a record of any changes to the original construction contract.

TECHNICAL SPECIFICATIONS

MCCREARY COUNTY WATER DISTRICT
MCCREARY COUNTY, KENTUCKY

RATTLESNAKE RIDGE BOOSTER PUMP STATION

PROJECT NO. 1013

DECEMBER 2014

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SECTION 1 – BOOSTER PUMP STATION

1.0 Scope of Work. The contractor shall furnish the materials only for the skid-mounted water booster pumping system as shown on the plans. The system shall include a skid-mounted booster pump station consisting of two pumps and motors, piping and valves, automatic central control panel(s) with breakers, variable frequency drives (VFDs), and all internal wiring.

In the event the contractor obtains engineer's approval on equipment other than that which was specified, contractor shall, at his own expense, make any changes in structures or piping necessary to accommodate equipment.

1.1 Booster Pumps. Two vertical multi-stage centrifugal water pumps shall be installed on a skid that will be installed in a building (Building By Others). Each pump shall be capable of delivering 80 gallons per minute of water against a total dynamic head of 575 feet. The pumps shall have a maximum allowable speed of 3500 R.P.M., and the minimum rated horsepower of each motor shall be 20. Minimum pump efficiency shall be 60%, and the maximum net positive suction head required (NPSHR) shall be 6 feet. The pumps are to be Grundfos CR 15-10, or approved equal.

Pump suction/discharge chambers, motor stools and pump shaft couplings shall be constructed of close-grained cast iron. The impellers, pump shafts, diffuser chambers, outer discharge sleeves and impeller seal rings or seal ring retainers shall be constructed of stainless steel. The impellers shall be secured directly to the pump shaft by means of a stainless steel tapered split cone and locking nut or by a splined shaft arrangement. Intermediate and lower shaft bearings shall be bronze or tungsten carbide and ceramic. Pumps shall be equipped with a high temperature mechanical seal assembly with tungsten carbide seal faces mounted in stainless steel seal components. 300# ANSI suction and discharge flanges shall be supplied on the pumps.

Each pump shall be direct coupled to a 20 HP, 3500 RPM, 1 phase, 60 hertz, 210 volt, TEFC, standard vertical NEMA C face electric motor, with a service factor of 1.15. Motor shall be of such size that it will operate continuously without exceeding its horsepower rating, exclusive of its service factor, over the entire performance curve.

The pump/motor assembly shall be mounted to a fabricated steel base built specifically for the pump/motor to be mounted. Each mounting or attachment point shall be complete with a vibration isolation pad. The pad will be in two (2) parts, a 1/1" base layer followed by a 5/8" upper layer and be a nominal 2" x 2" square size for pump/motor combinations weighing up to 1500 pounds.

1.2 Piping. The pipe used in the booster system shall be flanged ductile iron class 350 pipe, manufactured in accordance with the dimensional tolerances and material specifications of current ASTM standards for flanged ductile iron piping.

All piping and equipment shall be equipped with ANSI Standard B16.12, Class 300 flanges. Toruseal or other high pressure gaskets shall be used at all flange connections.

After the station piping and valves have been constructed, the station piping system, including pumps, piping, fittings and all valves that make up the entire station piping shall be tested with

high-pressure air to test for leaks. High-pressure air shall be pumped into the piping system and a soap solution shall then be sprayed on any joints for leak indication. After final assembly of the pumps, piping and valves, the entire system shall be hydrostatically tested to test for leaks at all joints, connections and weld seams. Any deficiencies found during the air test or the hydrostatic test shall be repaired and the system shall be retested.

1.3 Butterfly Valves. Butterfly Valves shall be wafer style and meet ANSI Class 300 flange standards. Metal reinforced dovetail seat shall ensure drop tight, bi-directional shutoff. The stem shall be one piece. The disc and stem shall be connected by a stainless steel torque plug which shall provide positive engagement. The valve shall have upper and lower RTFE inboard stem bearings, isolated from the line media, and a heavy-duty upper stem bushing.

The valve body shall be cast iron; aluminum bronze disc; stainless steel stem; EPDM seat; acetal upper stem bushing; BUNA-N V-cup stem seal.

Valve sized six (6) inches and smaller shall be equipped with lever operator and 10 degree increment throttling plate. Valve sized eight (8) inches and larger shall be equipped with a weather-proof, heavy-duty, gear operator complete with a position indicator.

The butterfly valves shall be manufactured by Keystone, Series 37

1.4 Check Valve. Each pump discharge pipe run shall include a wafer-type, non-slam check valve meeting ANSI Class 300 flange standards. The body of the check valve shall be C. The seat shall contain a TFE seal to provide zero leakage. The seal design shall provide zero leakage at both low and high pressure without over-loading or damaging the TFE seal. The guide bushings shall be bronze copper alloy and conform to ASTM Designation B-581. The valve spring and seat retainers shall be stainless steel and conform to ASTM Designation A-313. The valve plug shall be guided at both ends by a center shaft integral with the valve plug. Alignment of the center shaft shall be provided by guide bushings.

Check valves shall be manufactured by Price, Figure 809.

1.5 Relief Valve. The relief valve shall be pilot controlled, hydraulically operated, diaphragm type automatic control valve. The main valve shall be furnished with a resilient, replaceable seat. The control pilot shall be a direct acting, adjustable, spring loaded, normally closed pilot designed to close the main valve whenever the sensed pressure is below the pilot spring setting. The relief valve shall function to limit the discharge header pressure to the value set into the control pilot. The valve shall be sized as shown on the plan and be globe pattern, equipped with stainless steel trim and flanged to meet ANSI Class 300 and have a maximum pressure rating of 100 psi. The pilot shall be adjustable from 250 to 600 psi and be set at the factory at 350 psi.

The Relief Valve shall be manufactured by Cla-Val, Model 50-01.

1.6 Gate Valve. The meter inlet isolating valve where shown and as sized on the plan sheet covering this item shall be a gate valve meeting or exceeding AWWA Standard C-500. The gate valve will be cast iron body, bronze mounted, resilient seat, NRS (non-rising stem). The valve will be flanged pattern with flange and drilling complying to ANSI B16.12, Class 300. The valve will be complete with handwheel operator and shall be constructed so as to open left (counter-

clockwise). Maximum working pressure shall be 250 psi.

The gate valve shall be manufactured by Mueller Co., model 2360.

1.7 Magnetic Flow Meter. The magnetic flowmeter shall be microprocessor-based, and flanged. It shall indicate, totalize, and transmit flow in full pipes. The magnetic flowmeter shall utilize DC bi-polar pulsed coil excitation, automatically re-zeroing after every cycle. The accuracy shall be at least 0.5% of flow rate over a 33:1 turndown at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the NIST.

The flow sensor liner shall be Tefzel as approved by both the EPA and the FDA. The housing shall be steel. The integrally-mounted flow sensor and transmitter shall be FM approved and CSA approved. The electronics shall be remote mounted in a Nema 1X enclosure as shown on the plans.

The meter shall incorporate HI-Z circuitry. The preamplifier input impedance shall not be less than 10^{12} ohms. External ultrasonic electrode cleaners shall not be acceptable. Isolated outputs shall be 1-20 mA dc. Low flow cutoff shall be adjustable from 0-9% FS and there shall be two flow alarms settable from 0-99% of span.

The 2-line, 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display. The flowmeter shall incorporate the MAG-COMMAND feature allowing menu selection and changes to be made from outside the housing via Hall-effect sensors. It shall not be necessary to remove covers, panels or fasteners to accomplish calibration or program changes. The meter software shall incorporate a password feature preventing inadvertent program changes. All printed circuit boards shall be contained in a plug-in module and be interchangeable for any size without requiring test equipment. Totalized flow and programmed configuration shall be maintained in memory for the meters lifetime.

The flow meter shall be manufactured by Sparling Instruments, Inc., model FM656 TIGERMAGEP.

1.8 Flange Coupling Adapter. Uni-Flange or a flanged coupling adapter (FCA) shall be used as shown on the plans. They shall be rated at a working pressure of at least 350 psi.

1.9 Combination Pressure Gauges. Combination pressure gauges shall have a built-in pressure snubber and 1-1/2 inch minimum diameter faces and be turret style, black phenolic case with clear glass face. The movement shall be rotary, of 100 Series stainless steel with teflon coated pinion gear and segment. The gauge shall be bottom connected & accept a 1/1" NPT female thread. Combination pressure gauge range and scale graduations shall be in psi and feet of water as follows:

Suction Pressure - 0 to 200 psi, 20 psi figure intervals, with graduating marks every 2 psi

Discharge Pressure - 0 to 100 psi, 25 psi figure intervals, with graduating marks every 5 psi

All gauges will be panel mounted off the pipeline and be rigidly connected to their respective sensing point with piping with a pressure class of at least 350 psi. The gauge trim tubing shall be complete with both isolating and vent valves and the tubing shall be so arranged as to easily vent air

and facilitate gauge removal. Gauges mounted directly to the pipeline or at the sensing point will not be accepted.

Gauges shall be manufactured by WIKA Model 212.31.

1.10 Hose Bibb with Vacuum Breaker. There shall be provided a standard hose bibb with valve and vacuum breaker on the suction piping.

1.11 Electrical Service. The 120/210 volt, 1 phase, 60 cycle, electrical service for this station shall be provided by others.

1.12 Electrical & Control System. The power distribution center and electrical controls shall be mounted in common NEMA Type 1 gasketed fabricated steel enclosures. The enclosure shall have a full opening door, mounted on heavy piano hinges. Suitable type latching devices shall be provided on the door. Starters, breakers, relays, timers and wiring raceway shall be neatly arranged on a removable steel back plate. All circuit breaker operators, selector switches, indicating lights, and single phase items shall be mounted on or through die cut openings in the enclosure door. It shall not be necessary to open this enclosure, except for adjustment of controls.

Metal framing channel shall be used exclusively for mounting of all electrical panels and electrical components except for those specifically designated otherwise.

Properly sized, heavy duty, molded case thermal-magnetic air circuit breakers shall be provided for branch circuit disconnect service and for over-current protection of all control, motor and auxiliary circuits. The power distribution center shall include circuit breakers as follows:

One (1) Main Breaker,
Two (2) Branch Breakers, one each per pump,
One (1) Phase Monitor Breaker,
One (1) HVAC

Eight (8) Auxiliary Circuit Breakers, as follows:

1. Controls
2. Lights
3. Convenience Outlets
1. Dehumidifier
5. Spare
6. Spare
7. Spare
8. Spare

The control panel shall conform to the National Electrical Code specifications and shall be UL listed and labeled in accordance with UL standards No. 508 for Industrial Control Panels. In accordance with U.L. procedures, a U.L. label shall be affixed to the control panel.

Pump alternation, running time meters and time delay relays shall be internal to the pump controller.

Six digit, non-resettable elapsed time meters shall be provided to record the running time of each pump motor. The meter shall be enclosed in a dust and moisture proof molded plastic case, suitable for flush mounting on the main control panel. These devices shall be mounted in die cut openings in the enclosure door.

Adjustable snap action diaphragm type pressure switches shall provide low suction and high discharge control of the booster pumps. Set points shall be easily adjusted after removing the weatherproof cast aluminum case cover. The repeatability shall be plus or minus .5% of range span. Two switches shall be provided for the following operations:

1. Low suction pressure cut out, 0 to 20 psi.
2. High discharge pressure, 310 to 360 psi.

Eight (8) solid state time delay relays shall be provided to perform the following functions:

1. Low Suction Timer
2. High Discharge Timer
3. Start Control Timer Pump #1
1. Stop Control Timer Pump #1
5. Start Control Timer Pump #2
6. Stop Control Timer Pump #2
7. Parallel Start Pump #1
8. Parallel Start Pump #2

The solid state time delay relay shall have an adjustable time range of 10 seconds to 10 minutes. The relays shall be constructed to use a DIN rail mount socket so that the relays can be replaced without disturbing the wiring. The relay shall be complete with LED indicators for output and power.

Hand-Off-Automatic switches shall be oil tight, 2 or 3 position, and grouped conveniently with oil tight, full voltage indicating lights, on the panel door.

1. Pump #1
2. Pump #2

Indicating lights shall identify the following functions:

1. Red - Low suction pressure.
2. Red - High discharge pressure.
3. Green - Pump #1 running.
1. Green - Pump #2 running.

Nameplates shall be furnished on all panel front mounted switches and lights.

The control panel door shall be complete on the interior with a stick-on transparency containing an "as-built" reproduction of the electrical control panel schematic. The wiring diagram shall be a corrected "as-built" copy & contain individual wire numbers, circuit breaker number, switch designations & control function explanations.

The pump manufacturer shall furnish and install a complete Adjustable Frequency Controller System. The Adjustable Frequency Controller shall be furnished by a single vendor who has actively been manufacturing Adjustable Frequency Controllers for a period of at least five (5) years. The Adjustable Frequency Controller shall be UL and CSA certified and shall comply with the latest applicable standards of ANSI, IEEE and NEMA. The controllers shall be rated as shown on drawings. As a minimum the full load output current of the controller shall be equal to the equivalent motor horsepower as listed by National Electrical Code Table 130-150. The Adjustable Frequency Controller manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project, to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and troubleshooting training of customer personnel.

There shall be provided two (2) Variable Frequency Drive (VFD) units for the following motor loads:

1. 20 horsepower HP
2. 20 horsepower HP

The VFD(s) shall be rated for operation at 180 volts. The unit(s) shall tolerate a 10% overvoltage and 15% undervoltage, a line frequency between 57-63 Hz, and have a 100% load rating. The VFD shall operate at 100% rated capacity, without derating, up to 3,300 feet MSL. The unit shall operate in environments of 5%-95% noncondensing humidity, at an ambient temperature between -10E and +10EC (+11EF to +122EF). The VFD shall have a displacement power factor of no less than 95%. The drive shall have a 98% efficiency at FLA.

The VFD shall output a coded pulse width modulation power output to the load over a frequency range of 0-100 Hz, 1Hz stop settings. The drive shall have a frequency regulation of ±0.2% of maximum output frequency.

The drive shall have the following protective features: overcurrent, ground fault, undervoltage, overvoltage, input phase loss, overheating of heatsink, external alarm, overheating internally, overheating of braking resistor, motor 1 overload, motor 2 overload, inverter overload, blown fuse, memory error, keypad panel communication error, CPU error, option error, operating error, output wiring error, and modbus RTU error. The drive shall have a keypad through which operator personnel can manually start/stop drive, manual control speed, job drive motor, and adjust drive parameters.The drive shall have a bypass/load isolation contactor set which will isolate the load side of the drive and allow across-the-line starting of load by manual selection. Bypass will have thermal overload protection. The drive shall be manufactured by Fuji Frenic Model FRN050P11S-1UX.

A phase monitor shall be supplied to protect three-phase equipment against phase loss, undervoltage and phase reversal conditions. When a fault is sensed, the monitor output relay opens

within two seconds or less to turn the equipment off and/or cause an audio or visual alarm. Both Delta and Wye systems may be monitored. The monitor shall have an automatic reset and shall also include an adjustable voltage delay. The monitor shall have an indicator LED (glows when all conditions are normal and shall monitor phase sequence: ABC operate (will not operate CBA). The phase monitor shall be UL approved and CSA certified.

To protect the electrical system and equipment from damage due to excessive line surges caused by lightning or other circuit disturbances, a secondary surge arrester shall be supplied with the pump station controls. The arrester shall comply with ANSI standard C62.11-1987. The arrester shall be available in a one-pole, two-pole or three-pole version, and be suitable for both indoor and outdoor use. The arrester shall be permanently sealed in a LEXAN housing. The arrester shall have a maximum continuous operating voltage rating of 650 volts rms. The permissible line-to-line voltage of the system to which the arrester is applied depends on the circuit configuration, grounding, and voltage regulation. The secondary surge arrester shall be a Tranquell as manufactured by General Electric.

It will be the responsibility of the booster station manufacturer to provide the following as an adjunct to the supplied telemetry equipment.

1. 3/1" telemetry entrance conduit complete to telemetry panel.
2. Size 12" x 12" NEMA 1 telemetry interface panel.
3. Separate 120 volt single phase power circuit in conduit to the telemetry interface panel.
4. Telemetry control circuits made up and in conduit from main control panel to telemetry interface panel terminal strip.
5. Metal framing channel to mount telemetry equipment.

1.13 Station Wiring. Power service to the water booster system shall be three wire, single phase, 60 hertz, 120/210 volt. Wiring of the station shall be in accordance with the National Electrical Code. All motor wiring shall be installed in conduit.

The service entrance conduits shall be rigid steel conduit, individually sized to accept the inbound service conductors and telemetry/telephone/radio cables, and shall be installed from the main power or control panel through the equipment capsule side sheet and terminate exterior to the equipment capsule. The service entrance exterior conduit connection points shall be capped or plugged for shipment.

All wiring within the equipment capsule and outside of the control panel or panels shall be run in conduit except for the watertight flexible conduit and fittings used to connect pump drivers, fan motors, solenoid valves, limit switches, etc., where flexible connections are best utilized, in accordance with the National Electrical Code. Only the dehumidifier (By Others), where furnished by the original manufacturer with a UL approved rubber cord and plug, may be plugged into a receptacle.

Conduit shall be rigid, heavy wall, Schedule 10 PVC with solvent weld moisture-proof connections adequately sized to handle the type, number and size of equipment conductors to be carried - in

compliance with Article 317 of the National Electrical Code and NEMA TC-2, Federal WC-1091A and UL-651 Underwriters Laboratory Specifications.

Where flexible conduit connections are necessary, the conduit used shall be liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 351 of the National Electrical Code.

Motor Circuit Conductors shall be sized for load. All branch circuit conductors supplying a single motor of one (1) horsepower or more shall have an ampacity of not less than 125 percent of the motor full load current rating, dual rated type THHN/THWN, as set forth in Article 310 and 130-B of the National Electrical Code (NEC), Schedule 310-13 for flame retardant, heat resistant thermoplastic, copper conductors in a nylon or equivalent outer covering.

Control and accessory wiring shall be sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code, Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NMTBA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

Receptacles (**By Others**) shall be duplex, ground fault circuit interrupter type receptacles shall be furnished about the periphery of the equipment capsule, with one (1) receptacle adjacent to the main control panel. One (1) additional receptacle, three-wire grounded type, shall be installed and dedicated solely to dehumidifier auxiliary service only.

Lighting (**By Others**) shall included three or more two tube, 10 watt per tube, rapid start, enclosed and gasketed, forty-eight (18) inch minimum length fluorescent light fixtures installed within the equipment capsule, as shown on the plan for this item. One (1) light fixture shall be located directly over the main control panel. The light switch shall be of the night glow type and be located within the hatch periphery. The light switch shall be wired to operate the exhaust fan equipment whenever the equipment capsule lights are on. Open fluorescent or incandescent fixtures will not be accepted.

1.14 Heating/Cooling/Exhaust Fan (**By Others**). The unit shall be one piece, wall mounted, factory assembled, precharged, prewired, tested and ready to operate. The unit shall have a limited warranty of five years on parts and five years on the compressor. The unit shall be approved and listed by Underwriters' Laboratories, Inc., and Canadian Underwriters' Laboratories (CUL). Unit performance shall be certified in accordance with Air Conditioning and Refrigeration Institute Standard 210/210-89 for Unitary Air-Source air conditioners or latest standard.

1. One (1) each exterior wall mounted, hard-wired as shown;
2. Enclosed weatherproof casing constructed of 20 gauge galvanized steel, finished with baked-on polyester enamel paint;
3. One (1) washable filter;
4. Remote adjustable thermostat;
5. Cooling capacity in tons: 1;

6. Cooling Capacity: 10,800 BTUH at 115 volts, 1 phase;
7. Amps: 20;
8. Twin indoor blowers, SCFM maximum/minimum: 110/365 at 0.2" static pressure;
9. Electrical supplemental heater: 2.2 kW;

1.15 Dehumidifier (**By Others**).

1. One (1) each, installed as shown.
2. Capacity 30 pints per 21 hours.
3. Compressor rated 115 volts, 60 Hz, 3.1 operating amps.
4. 26 CFM fan, 2 fan speed.
5. Humidity range 35 to 90% RH, ambient temperature range of 12 to 105 F, Type R22 refrigerant.
6. Washable filter.
7. Condensate piped direct to drain
8. UL listed rubber cord.
9. EPA compliant.

1.16 Installation and Service Instructions. Construction of the water booster system shall be in accordance with the written instructions furnished by the equipment manufacturer, and as recommend by the Engineer. In addition to the installation instructions, the manufacturer shall furnish six complete and detailed Operating Instructions, Service and Repair Sheets in a bound manual. This manual shall cover the initial start-up, operating procedures, maintenance and servicing procedures on the major component parts provided in the pump system. One manual shall be shipped with the system, the rest shall be sent direct.

1.17 Start-up. The equipment manufacturer or supplier shall provide the services of a factory-trained representative for a maximum period of one day, to assist the contractor and owner with the initial start-up of the pump system. It shall be the responsibility of the contractor to inform all parties of this initial start-up, and to insure their attendance. The manufacturer's representative shall instruct all personnel attending the start-up in the correct and required operation, maintenance and service procedures for the water booster system.

1.18 Shop Drawings. Shop drawing submittals shall be bound and in six (6) copies. The submittals shall contain a minimum of two (2) full size drawings, 21" by 36", and one (1) each covering the hydropneumatic booster pump station. The submittal booklets shall be complete with data sheets covering all individual components that make up the booster pump station expansion and the UL file number under which the manufacturer is listed.

1.19 Warranty. The contractor shall guarantee the booster station to be free from defects in materials and workmanship for a period of one year from the date of start-up or for a period of eighteen months from the date of shipment. All consumable parts such as pump seals, oil, grease, etc., shall be considered part of routine maintenance and shall not be covered under the terms of the manufacturer's warranty.

1.20 General. The contractor is hereby notified that responsibility for the complete and satisfactory operation or function of all equipment and material is definitely a part of this contract, regardless of the manufacturer's guarantee on any item furnished by him.

1.21 Payment. The unit price bid shall constitute full compensation for the complete and functioning skid-mounted booster pump station.

TECHNICAL SPECIFICATIONS
FOR THE
MCCREARY COUNTY WATER DISTRICT
MCCREARY COUNTY, KENTUCKY

WATER & SEWER SYSTEM IMPROVEMENTS 2014
TREATMENT PLANT NO. 1-PHASE 2 IMPROVEMENTS
MARSHES SIDING WATER BOOSTER PUMP STATION
WASTEWATER TREATMENT PLANT IMPROVEMENTS

PROJECT NO. 1314

SEPTEMBER 2014

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SECTION 1 - SITEWORK

1.0 Work Included. Under this section the Contractor shall provide all labor, tools, equipment and materials to perform the sitework which consists of topsoil removal, excavation, the removal and proper utilization or disposal of all excavated materials, necessary borrow, fill requirements, the shaping and finishing of all excavation work to the required lines and grades, preparation of subgrade for tanks, basins, building slabs, walks and pavements, engineered fill for support of building or basin slabs, backfilling of tanks, basins, basements, and trenches within building lines, pavement replacements, and seeding and mulching.

1.1 Geotechnical Data. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn therefrom by the Contractor. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

1.2 Existing Utilities. Prior to commencement of work, the Contractor shall locate existing underground utilities in areas of the work. If utilities are to remain in place, the Contractor shall provide adequate means of protection during earthwork operations.

1.3 Use of Explosives. The Contractor (or any of his subcontractors) shall not bring explosives onto the site or use in the work without prior written permission from the Owner. The Contractor shall present a blasting plan to the Owner and Engineer and not commence blasting operations until such plan is approved by the Engineer and Owner. All activities involving explosives shall be in compliance with all the Federal, State and Local laws and regulations pertaining to blasting and use of explosives. The Contractor is solely responsible for handling, storage, and the use of explosive materials and the safety of others in the area when their use is permitted. The Contractor shall review all blasting procedures with the Owner and Engineer prior to commencement of all blasting work. The Contractor is responsible for all blasting procedures. The particle velocity of all affected, adjacent structures shall be monitored with a seismograph located at that structure. The peak particle velocity shall not exceed two inches per second at a distance of 50 feet, or any velocity that may cause damage to adjacent structures. The Contractor is responsible for repair of any damaged structure.

No blasting shall be performed in areas where structural concrete is less than seven days old without the express written consent of the Engineer.

Protective material covering shall be used at all times to prevent flying rocks from damaging property or injuring personnel.

A copy of the required blasting log shall be available to the Owner and Engineer.

1.4 Excavation. Excavation includes excavation to subgrade elevations including excavation of earth, rock, bricks, wood, cinders and other debris. All excavation of materials shall be included in the lump sum portion of the work and will be unclassified and no additional payment will be made regardless of type of material encountered.

Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at Contractor's expense.

1.4.1 Clearing & Grubbing. The Contractor shall cut and remove designated trees, stumps, brush, logs, fences, or other materials such as stumps, roots and other natural obstructions. No cleared or grubbed materials shall be used in backfills or embankment fills.

All stumps, roots and other objectionable material shall be grubbed up so that no roots larger than three inches in diameter remain less than 18 inches below the ground surface.

All holes and depressions left by grubbing operations shall be filled with suitable material and compacted to grade.

The Contractor shall remove from the site and satisfactorily dispose of all miscellaneous rubbish including, but not limited to, masonry, scrap metal, rock, pavement, etc. that is under the fill or to be removed as shown on the Drawings, specified herein, or directed by the Engineer.

All materials removed from the cleared and grubbed areas shall be burned or removed from the site as directed by the Engineer. It shall be the Contractor's responsibility to seek necessary permits from the State and local authorities before burning any materials.

Existing improvements, adjacent property, utility and other facilities, and trees, plants and brush that are not to be removed shall be protected from injury or damage.

Trees and shrubs designated to remain or that are beyond the clearing and grubbing limits which are injured or damaged during construction operations shall be treated at the Contractor's expense by experienced tree surgery personnel.

1.4.2 Excavation for Structure. Excavation for structures shall conform to the elevations and dimensions shown within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection. All loose material shall be removed from the excavation just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

Protruding rock formations that would interfere with uniform footing bearing shall be removed such that the structure will bear upon uniform engineered fill at least 24 inches thick where the structure foundations noted to be soil bearing.

No slab shall bear directly upon rock. All excavations shall extend to a depth that allows a minimum of four-inches crushed stone base, No. 57, under slab.

All necessary precautions shall be taken to preserve the material below and beyond the lines of all excavation in the soundest possible condition. Any damage to the work due to the Contractor's operations, including shattering of the material beyond the required excavation lines, shall be repaired at the expense of and by the Contractor. Any and all excess excavation for the convenience of the Contractor for any purpose or reason, except as may be ordered in writing by the Engineer and whether or not due to the fault of the Contractor, shall be at the expense of the Contractor. Where required to complete the work, all such excess excavation and over excavation shall be refilled with materials furnished and placed at the expense of and by the Contractor. Slopes shattered or loosened by blasting shall be taken down at the expense of and by the Contractor.

All excavation for embankment and structure foundations shall be performed in dry weather conditions. No excavation shall be made in wet weather or where frozen materials exist without written approval.

1.5 Disposal of Material. All surplus excavated material and/or waste materials shall be disposed of outside the floodplain in an area provided by the Contractor and approved by the Engineer. The material shall be compacted to a smooth condition and sloped to provide positive drainage.

Any material removed from an impoundment, river, stream or shore shall be removed from the area and disposed of outside of the floodplain as described above. Where shore areas are excavated and/or disturbed, the final contours shall be established by using rip-rap stone or other materials as shown on the Drawings.

1.6 Sheeting and Bracing. Sheeting and bracing as may be required to safely support the sides of excavations while maintaining the required side slopes shall comply with the safety precautions as outlined in current and accepted safety manuals, such as "Associated General Contractors Manual of Accident Prevention in Construction". Where sheeting and bracing are necessary to prevent caving of the walls of excavations and to safeguard the workmen, the excavations shall be dug to such widths that proper allowance is made for the space occupied by the sheeting and bracing. The Contractor shall perform the additional excavation required and furnish and put in place the necessary sheeting and bracing and shall remove the same as the excavation is filled, at his own expense.

1.7 Removal of Water. The Contractor shall construct and maintain all necessary channels, flumes, and/or other temporary diversion and protective works; shall furnish all

materials required therefore; and shall furnish, install, maintain and operate all well points, casings, pumps and other equipment for dewatering the various parts of the work and for maintaining the foundations, trenches and other parts of the work free from water as required for constructing each part of the work. After having served their purpose, all temporary protective works shall be removed, or leveled, to give a sightly appearance and so as not to interfere in any way with the operation, usefulness or stability of the permanent structures.

1.8 Backfill and Fill Material. All material to be used as backfill material shall be approved by the Geotechnical Engineer prior to backfilling excavations. With the exception of the organic debris, existing fill material, and topsoil, the on-site soil removed from the excavations may be used as fill or backfill material subjected to approval by the Geotechnical Engineer.

After clearing and stripping operations have been completed, all structure locations shall be proofrolled with a loaded pan or heavy pneumatic tired vehicle to densify upper soils and to locate possible areas which will require undercutting, removal and/or recompaction. This operation shall be conducted under the surveillance of the Geotechnical Engineer.

Before initiating filling operations, the Contractor shall receive approval of fill material by the Engineer. Proctor density tests shall be run on representative samples obtained from the proposed borrow material.

Where structures or other appurtenances are constructed on fill, the fill shall be placed in layers not over eight inches deep, as measured before compaction and be thoroughly compacted. Compaction may be obtained by use of a sheeps foot roller or pneumatic-tired roller. Water shall be applied as directed to obtain close adhesion between layers and all parts of the material. Fill shall be compacted to a minimum of 100% of the Standard Proctor maximum dry density (ASTM Specifications D-698). A minimum of two compaction tests per each two feet of fill on a structure location shall be performed by a geotechnical engineer.

Only suitable material approved by the Engineer shall be used for backfilling around structures. Backfilling around structures shall have material placed in layers of eight inch depth and compacted by pneumatic tools or other small equipment operated by hand. In no case shall the backfilling be allowed to obtain an elevation of one foot above any other area. It shall be uniformly compacted within an approximate range of 85 to 90 percent of Standard Proctor maximum dry density unless indicated otherwise, throughout the structure depth. Any deviation shall be cause for the Engineer to require the material deposited to be removed and recompacted at the Contractor's expense.

All backfilling shall be done in such a manner that the pipe or structure over or against which it is being placed will not be disturbed. Any pipe or structure damaged or moved

from its proper line or grade during backfilling operations shall be removed or repaired to the satisfaction of the Engineer and then backfilled.

1.9 Borrow Material. Borrow material shall consist of and include the required excavation and proper utilization of approved materials obtained from designated areas when sufficient quantities of suitable materials are not available from other required excavation.

The control of excavation in any borrow area and the selection of materials therefrom shall at all times be as directed by the Engineer. On completion of excavation, all borrow pits shall be left in a neat and sightly condition. Unless otherwise approved by the Engineer, all borrow pits shall be so graded and dressed that water will readily drain therefrom, and away from all embankments, berms and structures. When shown on the drawings, terraces or diversions shall be constructed to protect the slopes of the borrow areas from erosion and shall be considered a subsidiary of this specification.

1.10 Erosion Control. Temporary measures shall be applied throughout the construction permit to control and to minimize siltation to adjacent properties and waterways. Such measures shall include, but not be limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods. These temporary measures shall be applied to erodible material exposed by any activity associated with the construction of this project.

1.11 Finish Grading. Finish grading shall be to the finished elevations and grades shown, and shall be made to blend into conformation with remaining natural ground surfaces. All finish graded surfaces shall be left smooth and free to drain. Excess materials shall be spread and compacted as directed. Grading within the construction area and around the outside of building and structure lines shall be performed in a manner which will prevent accumulation of water within the area. Where necessary, or where shown, finish grading shall be extended to insure that water will be directed to drainage ditches, and the site area left smooth and free from depressions holding water.

1.12 Seeding and Mulching. All disturbed areas shall be seeded, fertilized and mulched. The application of materials shall be as follows:

1.12.1 Lime. Two tons of agricultural limestone per acre shall be required.

1.12.2 Fertilizer. The following amounts of fertilizer are required per acre:

(1) Nitrogen (N)	60 lbs.
(2) Phosphorous (P205)	120 lbs.
(3) Potash	120 lbs.

This requirement can be met by applying fertilizer having an analysis of 10-20-20 at the rate of 600 pounds per acre.

1.12.3 Seed. The following amounts of pure live seed are required per acre:

(1)	KY-31 Fescue	60 lbs.
(2)	Perennial Ryegrass	25 lbs.
(3)	Red Clover	10 lbs.

1.12.4 Mulch. Mulch shall consist of wood fiber applied at a rate of 1600 pounds per acre, bituminous treated straw applied at a rate of 2000 pounds per acre or other mulch subject to the advance approval of the Engineer.

1.12.5 Execution. The seeding shall be completed within two weeks after completion of the work or as soon thereafter as conditions are favorable. Immediately prior to seedbed preparation, the Contractor shall apply the agricultural lime and fertilizer uniformly over the area to be seeded. The seedbed shall be prepared by pulverizing and breaking up the soil to a minimum depth of two inches with a disk harrow, drag harrow, spike tooth harrow or similar tool. All rocks, clods, and undesirable material that would interfere with seeding operations shall be removed.

The seeding operations shall be performed immediately after, or as soon as practicable, after the seedbed has been prepared. The seed shall be drilled or broadcast uniformly over the seedbed with regular approved type of equipment or method acceptable to the Engineer. The seeded area shall be passed over with a harrow or cultipacker to help cover more seed and improve seedling establishment. Excessive tillage shall be avoided. After all construction work is complete, prior to final payment, all exposed areas shall be cleaned and left in a sightly manner. All unused material shall be removed from the site.

The Contractor may hydroseed and hydromulch if the following requirements are met.

1. The individual seed quantities shall be increased by 20%.

2. The mulch shall be a processed hay or straw applied at a rate of 3/4 ton per acre with 80 lbs. per acre of an organic tackifier.

3. The hydroseeder slurry shall not be allowed to drop below a pH of 5.0.

The Contractor shall be responsible for the maintenance of all work under this section until final acceptance. Adequate protection of exposed slopes shall be provided at all times to prevent excessive erosion. No work will be accepted unless there is evidence of healthy growth and sufficient cover to prevent erosion.

Work executed under this section shall be guaranteed for one year with the guarantee beginning on the date of final acceptance of all work under this Contract. Any seeded areas of the site which are found to not have an adequate growth of cover during the

guarantee period, shall be re-seeded as soon as weather conditions permit, at no cost to the Owner.

1.13 Bituminous Pavement. At the completion of construction, all roads shall be regraded and areas to be paved with bituminous shall be prepared for a prime coat of emulsified asphalt RS-2 applied at the rate of 0.35 gallon per square yard. A two-inch thick Class "I" Bituminous Concrete Binder shall be placed above the prime coat in accordance with the Kentucky Bureau of Highways Specifications. The three feet wide shoulders of dense graded aggregate shall be graded and rolled to the top of the binder course and shall slope out and away from pavement.

After roadway has been traveled for a period of at least 60 days and all plant construction and piping is complete, a 1 1/2-inch thick layer of Class "I" Bituminous Concrete shall be placed as a finished and complete roadway surface.

The roadways and parking areas shall be constructed in accordance with good paving practices. Problems due to unequal settlement shall be properly handled to prevent an uneven road surface. In any case, the Contractor is responsible for providing roads with neat lines and smooth surfaces throughout the plant site.

Damage to the existing paving caused by the Contractor will be patched to the full road width in the damaged area. All patching shall be to neat lines and even surfaces.

1.14 Drainage Culverts. Pipe will be made of such material as specified on Project Drawings as follows:

CPC - concrete pipe culvert
CMPC - corrugated metal pipe culvert
DI - ductile iron

Installation shall be in accordance with provisions of Section 02-B-05 as applies to drainage pipe. In general, no offset grade stakes will be required for culverts less than 100 feet in length but good horizontal and vertical alignment will be required.

1.15 Payment. Payment for all excavation and fill work shown on the Drawings and herein specified, that is required to complete the clearing, grubbing, site grading, roads, structural excavation, borrow excavation, backfill, sheeting, shoring, topsoil, crushed stone or gravel, drainage, pumping, embankment fills, pavement, seeding and mulching, and any other excavation and fills required to complete the work as shown on the Drawings shall be included in the work to which it is subsidiary in the Bid Schedule and no measurement of the quantities will be made. The contours and elevations of the present ground are believed to be reasonably correct but are not guaranteed. The Contractor shall satisfy himself by actual examination of the site of work as to the existing elevations and contours and the amount of work required under this section.

SECTION 2 - STRUCTURAL CONCRETE

2.0 Work Included. Under this section the Contractor shall provide all labor, tools, equipment and materials to place concrete at the locations as shown on the Drawings. This shall include formwork, concrete specifications, reinforcement, finishes and any work related to the placement of concrete. This section includes the following structures: water treatment plant clearwell, wastewater treatment plant chemical storage building, wastewater treatment plant flow meter vaults, Marshes Siding water booster pump station slab, slabs, support blocks and thrust blocks.

2.1 References. The Contractor shall obtain and have available in the field office at all times the latest revisions of the following references:

1. Specifications for Structural Concrete for Buildings ACI 301
2. Specifications for Structural Concrete for Buildings ACI Sp-15
3. Manual of Standard Practice - CRSI
4. Placing Reinforcing Bars - CRSI
5. Building Code Requirements for Reinforced Concrete ACI 318
6. Environmental Engineering Concrete Structures ACI-350R
7. Recommended Practice for Concrete Formwork ACI-347
8. Construction and Industrial Plywood PS-1
9. Field Reference Manual, ACI Publication SP-15

The following standards shall also apply to this work:

1.	ASTM C-143	Test Method for Slump of Hydraulic Cement Concrete
2.	ASTM C-150	Specification for Portland Cement
3.	ASTM C-33	Specification for Concrete Aggregates
4.	ASTM C-260	Specification for Air Entraining Admixtures for Concrete
5.	ASTM C-494	Specification for Chemical Admixtures for Concrete
6.	ASTM A-615	Specification for Deformed and Plain Billet
7.	ASTM C-94	Specification for Ready-Mixed Concrete
8.	ASTM C-31	Practice for Making and Curing Concrete Test Specimens in the Field
9.	ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens

10.	ASTM C42	Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
11.	ASTM A-616	Rail Steel Deformed and Plain Bars for Concrete Reinforcement
12.	ASTM A-617	Axle Steel Deformed and Plain Bars for Concrete Reinforcement
13.	ACI 315	Details and Detailing of Concrete Reinforcement
14.	ACI 315R	Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
15.	ASTM A-185	Welded Steel Wire Fabric for Concrete Reinforcement
16.	ACI 301	Specifications for Structural Concrete for Buildings.

2.2 Submittals. The Contractor shall submit the following data established per Section 3.9 of ACI 301.

1. Concrete mix designs, test results and curves plotted to establish water cement ratio if paragraph 3.9.3.3. of ACI 301 is used.

2. Proposed mix designs and all necessary substantiating data used to establish proposed mix designs if paragraph 3.9.1.1. or 3.9.1.2. of ACI 301 is used.

3. Mix designs for all mixes proposed or required to be used, including all mixes containing admixtures.

4. A certified copy of the control records of the proposed production facility establishing the standard deviation as defined in paragraph 3.9.1.1. of ACI 301.

5. Certification attesting that admixtures equal or exceeds the physical requirements of ASTM C-494 for Type A (water reducing) Type D (water reducing and retarding) and Type E (water reducing and accelerating) admixtures.

6. Drawings showing locations of all proposed construction joints.

7. Certification that the concrete aggregates comply with the provisions of ASTM C33.

8. Certification that the air-entraining admixture complies with ASTM C-260.

2.3 Quality Assurance.

2.3.1 Consistency. Concrete shall be of such consistency that it can be worked readily into all parts of the forms and around embedded work, without permitting the materials to segregate, or free water to collect on the surface.

2.3.2 Compression Tests. During the progress of work, at least one set of three compression test cylinders shall be made for each 50 cubic yards of structural concrete or major fraction thereof, and not less than one such set for each type of concrete for each days pouring. Cylinders made in the field shall be made and cured in accordance with the ASTM Standard Method of Making and Curing Concrete Test Specimens in the Field, designation C31, except that wherever possible molds shall be left on cylinders until they reach the laboratory.

One cylinder of each set shall be broken in accordance with ASTM C-39 at seven days and the other two at 28 days. Two copies of these test results shall be submitted to the Engineer on the same day of the tests.

Additional tests of the in-place concrete shall be made when test results indicate specified concrete strengths and other characteristics have not been attained in the structure. Cored cylinders used to test concrete adequacy shall comply with ASTM C42. All test procedures and results shall be subject to the review and approval of the Engineer. The Contractor shall pay for such tests when unacceptable concrete is verified. On evidence of these tests, any concrete that fails to meet the specified strength requirements shall be strengthened or replaced as directed by the Engineer at the Contractor's expense.

2.3.3 Inserts in Concrete. All castings, inserts, conduits, and other metalwork shall be accurately built into or encased in the concrete by the Contractor as directed and all necessary precautions shall be taken to prevent the metalwork from being displaced or deformed. The installation shall be inspected before concrete is placed. All anchor bolts shall be set by means of substantial templates.

2.3.4 Testings. Concrete testing shall be performed by a testing agency hired by the Contractor, at his expense.

The testing agency shall perform the following tests on the sampled concrete:

a. Slump
b. Air Content
c. Concrete Temperature
d. Compression Test of Cylinders

If, in the opinion of the Engineer, there is reasonable doubt that the concrete aggregates comply with ASTM C33, the testing agency shall test the fine aggregate and course aggregate for compliance with these specifications.

Upon completion of the tests, written reports shall be submitted to the Engineer clearly identifying the tests performed, the results, and the batch of concrete in which the tests were performed.

2.4 Concrete Mix. Structural concrete of the various classes required shall be proportioned by Section 3.9 of ACI 301 to produce the following 28-day compressive strengths:

Selection of Proportions for Class A Concrete:

1. 4,000 psi compressive for strength at 28 days.

2. Type II cement plus water reducing dispersing agent and air. Type I cement may be used if the C3A content of the cementitious material is less than 8 percent.

3. Maximum (water)/(cement and water reducing dispersing agent) ratio = 0.45.

4. Minimum cement content = 564 lbs. (6.0 bags)/cu. yd. concrete.

5. Nominal maximum size coarse aggregate = No. 67 (3/4" maximum).

6. Air content = 6% plus or minus 1% by volume.

7. Slump = 2" - 3" in accordance with ASTM C-143.

2.4.1 Optional Concrete Mix Using Fly Ash.

Selection of Proportions for Class A Concrete:

1. 4,000 psi compressive for strength at 28 days.

2. Type II cement plus water reducing dispersing agent and air. Type I cement may be used if the C3A content of the cementitious material is less than 8 percent.

3. Maximum (water)/(cement plus water reducing dispersing agent) ratio - 0.45.

4. Minimum cement content - 517 lbs. (5.5 bags)/cu. yd. concrete.

5. Maximum Fly Ash Content - 71 lbs./cu. yd.

6. Nominal maximum size coarse aggregate - No. 67 (3/4" maximum) or No. 57 (1" maximum).

7. Air content - 6% plus or minus 2% by volume.

8. Slump = 2" - 3" in accordance with ASTM C-143.

2.4.2 Grout. Provide the following grout mixture at locations noted on the plans to be grouted, such as fillets, tank and trough bottoms:

(1) Less than 2" in depth

Material	Volume
Cement	1 part
Sand	2 part

Water = 5 gals./100 lbs. cement

(2) From 2" to 12" in depth

Material	Volume
Cement	1 part
Pea Gravel	2.5 parts
Sand	2 parts

Water = 5 gals./100 lbs. cement

(3) Greater than 12" in depth

Material
Class A Concrete

The grout mixtures shown above are not to be used in areas that are to receive non-shrink grout.

Grout fill which is formed in place by using rotating equipment as a screed shall be mixed in proportions and consistencies as required by the manufacturer or supplier of the equipment.

2.4.3 Admixtures. An air entraining admixture shall be used on all concrete and shall be the Master Builders MB-VR, or MicroAir, Euclid Chemical Company AIR-MIX, W. R. Graces Darex, or equal. The admixture shall meet the requirements of ASTM C-260. Certification attesting to the percent of effective solids and compliance of the material with ASTM C-260 shall be furnished.

A water-reducing, admixture for concrete shall conform to ASTM C-494 for type A (water-reducing and normal setting admixtures) and shall be Master Builders Pozzolith 344N, Nox-Crete Plastiflow, Plastocrete 161 by Sika, or an approved equal. The water-reducing, set retarding mixture for concrete shall conform to ASTM C-494 for Type D (water-reducing and retarding admixtures) and shall be Master Builders, Pozzolith 100-XR, Daratard-17 by W. R. Grace, or an approved equal. Certification shall be furnished attesting that the admixture exceeds the physical requirements of ASTM C-494, Type A, water-reducing and normal setting admixture, and when required, for ASTM C-494, Type D, water reducing and retarding admixture when used with local materials with which the subject concrete is composed. The admixture manufacturer shall provide a qualified concrete technician employed by the manufacturer to assist in proportioning concrete for optimum use. He also will be available to advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job conditions.

Where the Contractor finds it impractical to employ fully the recommended procedures for hot weather concreting, the Engineer may at his discretion require the use of a set retardant admixture for mass concrete 2.5 feet or more thick and for all concrete whenever the temperature at the time concrete is cast exceeds 80 degrees F. The admixture shall be selected by the Contractor subject to the review of the Engineer. The admixture and concrete containing the admixture shall meet all the requirements of these specifications. Preliminary tests of this concrete shall be required at the Contractor's expense.

When more than one admixture is used, all admixtures shall be compatible. They should preferably be by the same manufacturer.

Calcium chloride will not be permitted as an admixture in any concrete.

Water-reducing, non chloride, accelerators shall conform to ASTM C-494 Type E and shall be Accelguard 80 by the Euclid Chemical Company or Pozzolith High Early by Master Builders or an approved equal.

2.4.4 Water. The water for concrete shall be clean, fresh, and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

2.4.5 Aggregates. Fine aggregates shall be natural and having clean, hard, uncoated grains, and shall be free from injurious amounts of clay, dust, organic matter or other deleterious substances, and shall conform to ASTM C-33. Sand shall be graded as follows:

	Percent
Passing 3/8 Inch Sieve	100
Passing No. 4 Sieve.....	90-100
Passing No. 16 Sieve.....	45-80

Passing No. 50 Sieve.....	5-25
Passing No. 100 Sieve.....	0-8

Coarse aggregates shall be crushed stone having clean, hard, uncoated particles, and shall be free from injurious amounts of soft, friable, thin, elongated or laminated pieces.

Coarse aggregates shall conform to ASTM C-33 and shall be graded in accordance with the following:

	Percent by Weight	
	No. 57	No. 67
Passing 1-1/2 Inch Square Sieve.....	100	---
Passing 1-Inch Square Sieve.....	95-100	---
Passing 3/4-Inch Square Sieve.....	---	90-100
Passing 1/2-Inch Square Sieve.....	25-60	---
Passing 3/8-Inch Square Sieve.....	---	20-55
Passing No. 4 Square Sieve	0-10	0-10
Passing No. 8 Square Sieve	0-5	0-5

Refer to the Specification of ACI 301 for maximum size of coarse aggregate.

2.4.6 Aggregates and Determining Proportions. No concrete shall be used in the work until the materials and mix designs have been tested by the testing laboratory and accepted by the Engineer. The Engineer shall have the right to order changes as may be necessary to meet the specified requirements. If concrete of the required characteristics is not being produced as the work progresses, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure concrete of the specified quality. The Contractor shall make such changes at his own expense and no extra compensation will be allowed because of such changes.

2.4.7 Mixing. All central plant and rolling stock equipment and methods shall conform to the Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers' Bureau of the National Ready Mixed Concrete Assn., as well as the ACI Standards for Measuring, Mixing, Transporting, and Placing Concrete ACI 304R-89, and with the ASTM specification for Ready Mixed Concrete, Designation C94-89b.

2.5 Placing and Compacting Concrete. At least 20 hours before the Contractor plans to make any placement of concrete, he shall notify the Engineer of his intention and procedure. Unless otherwise planned, the work shall be so executed that a section begun on any day shall be completed during daylight of the same day.

Ready mixed concrete shall be transported to the site in watertight agitator or mixer trucks. The quantity of concrete to be mixed or delivered in any one batch shall not

exceed the rated capacity of the mixer or agitator for the respective conditions as stated on the nameplates.

Information necessary to calculate the total mixing water shall be recorded on the delivery slip for the Engineer's information. Total mixing water includes free water on the aggregates, water and ice batched at the plant, and water added by the truck operator. The Contractor may request permission to add water at the job site, and when the addition of water is permitted by the Engineer, the quantity added shall be the responsibility of the Contractor and in no case shall the total water per bag of cement exceed that determined by the designed mix. Mixing and discharge time shall be as recommended in ACI-304.

Concrete which has become compacted or segregated during transportation to or on the site of the work shall be satisfactorily remixed just prior to being placed in the forms.

Partially hardened concrete shall not be deposited in the forms. The retempering of concrete which has partially hardened (that is, the remixing of concrete with or without additional cement, aggregate, or water) will not be permitted.

The concrete shall be mixed only in the quantity required for immediate use. Concrete that has developed an initial set shall not be used. The Contractor shall have sufficient plant capacity and transporting apparatus to insure continuous delivery at the rate required.

The temperature of the concrete mixture immediately before placement shall be between 50 degrees F and 90 degrees F.

Concrete that is truck mixed or transported in truck mixers or truck agitators shall be delivered to the site of the work and discharge completed in the forms within 1 1/2 hours or before the drum has revolved 300 revolutions whichever comes first after the introduction of the mixing water to the cement and aggregates, or the introduction exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed in the forms within 15 minutes after discharge from the mixer at the job site.

If concrete is placed by pumping, no aluminum shall be used in any parts of the pumping system which contact or might contaminate the concrete. Aluminum chutes and conveyors shall not be used.

No concrete shall be placed on frozen subgrade or in water, or until the subgrade, forms, and preliminary work have been accepted. No concrete shall be placed until all materials to be built into the concrete have been set and have been accepted by the various trades and by the Engineer. All such materials shall be thoroughly clean and free from rust, scale, oil, or any other foreign matter.

Forms and excavations shall be free from water and all dirt, debris, and foreign matter when concrete is placed. Except as otherwise directed, wood forms and embedded wood called for or allowed shall be thoroughly wetted just prior to placement of concrete.

Chutes for conveying concrete shall be metal or metal lined and of such size, design and slope as to ensure a continuous flow of concrete without segregation. The slope of chutes shall have approximately the same slope. The discharge end of the chute shall be provided with a baffle, or if required, a spout and the end of the chute or spout shall be kept as close as practicable to, but in no event more than 5 feet above the surface of the fresh concrete. When the operation is intermittent, the chute shall discharge into a hopper.

In thin sections of considerable height (such as walls and columns), concrete shall be placed in such manner as will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the mass of concrete being placed. To achieve this end, suitable hopper spouts with restricted outlets, etc. shall be used as required or permitted unless the forms are provided with suitable openings.

Chutes, hoppers, spouts, etc. shall be thoroughly cleaned before and after each run and the water and debris shall not be discharged inside the form.

For any one placement, concrete shall be deposited continuously in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section, and so as to maintain until the completion of the unit, an approximately horizontal plastic surface.

No wooden spreaders shall be left in the concrete.

During and immediately after being deposited, concrete shall be thoroughly compacted by means of suitable tools and methods, such as internal type mechanical vibrators operating at not less than 5,000 rpm or other tool spading to produce the required density and quality of finish. Vibration shall be done only by experienced operators under close supervision and shall be carried in such manner and only long to produce homogeneity and optimum consolidation without permitting segregation of the solid constituents, “pumping” of air, or other objectionable results. All vibrators shall be supplemented by proper spade puddling approximately 2 to 3 inches away from forms to remove included bubbles and honeycomb. Excessive spading against the forms, causing the deposition of weak mortar at the surface shall be avoided.

The concrete shall be thoroughly rodded and tamped about embedded materials so as to secure perfect adhesion and prevent leakage. Care shall be taken to prevent the displacement of such materials during concreting.

The distance between construction joints shall not exceed 25 feet for all concrete construction and not less than 48 hours shall elapse between casting of adjoining units

unless these requirements are waived by the Engineer. Provision shall be made for jointing successive units as indicated or required. Where joints are not shown on the Drawings, they are required to be made at a spacing of approximately 25 feet. Additional construction joints required to satisfy the 25 foot spacing shall be located by the Contractor subject to the review of the Engineer. The Contractor shall submit for review Drawings separate from the steel reinforcing Drawings, showing the location of all proposed construction joints. All construction joints shall be prepared for bonding as specified in ACI 301 for Bonding Concrete at Construction Joints. Joints in walls and columns shall be maintained level.

The subgrades for slab on grade for the plant works building only shall be covered with a vapor barrier consisting of a 6 mil minimum thickness polyethylene sheet with joints lapped a minimum of 12 inches unless otherwise required or permitted.

2.6 Bonding Concrete at Construction Joints. In order to secure full bond at construction joints, the surface of the concrete previously placed (including vertical, inclined, and substantially horizontal areas) shall be thoroughly cleaned of foreign materials and laitance, if any. The previously placed concrete at the joint shall be damp but free of standing water. The surface shall be prepared as per ACI 301. The referenced cement grout shall be between one and two inches thick on all wall pours. Waterstops shall be used on all construction joints.

2.7 Sealing Concrete at Construction Joints. All Construction joint surfaces shall receive Sikaflex-2C NS Polyurethane Elastomeric sealant or approved equal. Surface preparation and manufacturer's specified primer shall be applied in accordance to the manufacturer's recommendations. Minimum joint size shall be 1/4" deep by 1/2" wide unless shown otherwise on the Drawings.

2.8 Epoxy Bonding Agent. The epoxy bond agent shall be provided as indicated on the Drawings and shall be applied per manufacturer's instructions. Epoxy bonding agent shall be Sikadur Hi-Mod LPL by Sika Corporation or Eucopoxy LPL by Euclid Company or approved equal.

2.9 Curing and Protection. All concrete, particularly slabs and including finished surfaces, shall be treated immediately after concreting or cement finishing is completed, to provide continuous moist curing for at least seven days, regardless of the adjacent air temperature. Walls and vertical surfaces may be covered with continuously saturated burlap, or kept moist by other acceptable means. Horizontal surfaces, slabs, etc. shall be ponded to a depth of 1/2" wherever practicable, or kept continuously wet by the use of lawn sprinklers, a complete covering of continuously saturated burlap, or by other acceptable means.

For at least seven days after having been placed, all concrete shall be so protected that the temperature at the surface will not fall below 45 degrees F. No manure, salt, or other chemicals shall be used for protection. The above mentioned seven day periods may be

reduced if compression tests, in accordance with ASTM C-39, on field cured cylinders indicate that expected seven day strength gain has been achieved, and approval is granted by the Engineer. Wherever practicable, finished slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

2.10 Trimming and Repair of Surface Defects. The Contractor shall use suitable forms, mixture of concrete, and workmanship so that concrete surfaces, when exposed, will require no patching. Concrete which, in the opinion of the Engineer has excessive honeycomb, aggregate pockets, or depressions will be rejected and the Contractor shall, at his own expense, remove the entire section containing such defects and replace it with acceptable concrete. As soon as the forms have been stripped and concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled and surface defects which do not impair structural strength shall be repaired.

Defective concrete shall be cut perpendicular to the surface until sound concrete is reached, but not less than 1" deep. The remaining concrete shall be thoroughly roughed and cleaned. Concrete in an area at least 6" wide surrounding the area to be patched shall be dampened. A bonding grout shall be prepared using a mix of approximately one part cement to one part fine passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface. The patching mixture shall be made of the same materials and approximately the same proportions as used for the concrete except that the course aggregate shall be omitted and the mortar shall consist of not more than one part cement to 2 1/2 parts sand by damp loose volume. White portland cement shall be substituted for a portion of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be kept damp for seven days. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

After being cleaned and thoroughly dampened, the tie holes shall be filed solid with patching mortar.

The use of mortar patching as above specified shall be confined to the repair of small defects in relatively green concrete. If substantial repairs are required, the defective portions shall be cut out to sound concrete and the defective concrete replaced by means

of gunite, or the structure shall be taken down and rebuilt, all as the Engineer may decide or direct.

2.11 Concrete Finishes. All concrete exposed to view in the completed structures shall be produced using materials and workmanship to such quality that only nominal finishing will be required. The provisions of paragraphs 13.3, 13.4 and 13.6 of ACI 301 shall apply to all exterior exposed to view concrete surfaces, including the outside surfaces of tanks.

All formed, exterior, exposed to view, concrete shall be prepared, then rubbed. Exterior vertical surfaces shall be rubbed to one foot below grade. Interior vertical surfaces of dry pits shall not be rubbed. Interior vertical surfaces of open topped liquid containers shall be rubbed to one foot below the minimum liquid level that will occur during normal operations. Walls inside a building shall not be rubbed. Overhead slabs (exterior or interior) shall not be rubbed.

All vertical surfaces below minimum liquid level in liquid containing structures and all other surfaces that are not to be rubbed shall have a smooth form finish.

All smooth form concrete vertical surfaces shall be true plane within 1/4" in 10 feet as determined by a 10 foot straight edge place anywhere on the surface in any direction. Abrupt irregularities shall not exceed 1/8". Basin, flume, conduit and tank floors shall have a "troweled" finish unless shown otherwise on Drawings. Weirs and overflow surfaces shall be given a troweled finish.

Exterior platforms, steps and landings shall be given a broom finish. Broom finish shall be applied to surfaces which have been steel troweled to an even smooth finish. The troweled surface shall then be broomed with a fiber bristle brush in the direction transverse to that of the main traffic.

Walking surfaces of slabs shall have a troweled finish unless shown otherwise on Drawings.

Nox-Crete Harbeton, Chem Hard by L & M Construction Chemicals, Lapidolith by Sonneborn hardener treatment, or an approved equal shall be applied to all exposed concrete floors in occupied spaces. The floors shall be thoroughly cured, cleaned, and perfectly dry with all work above them completed. The hardener shall be applied evenly and freely and in conformance with manufacturer's instructions, using not less than three coats, allowing 24 hours between coats. One gallon of hardener shall cover not more than 100 square feet. After the final coat is completed and dry, surplus hardener shall be removed from the surface of the concrete by scrubbing and mopping with water.

2.12 Watertightness. The structures which are intended to contain liquids and/or will be subjected to exterior hydrostatic pressures shall be so constructed that when completed and tested, there shall be no loss of water and no wet spots shall show. Liquid retaining

structures shall be tested for leakage in accordance with ACI-350R. As soon as practicable after the completion of the structures, the Contractor shall fill them with water and if leakages develop or wet spots develop, the Contractor shall empty such structures and correct the leakage in an approved manner. Any cracks which appear in the concrete shall be dug out and suitably repaired. Temporary bulkheads over pipe openings in walls shall be provided as required for the testing. After repairs, if any are required, the structures shall be tested again and further repaired if necessary until satisfactory results are obtained. All work in connection with these tests and repairs shall be at the expense of the Contractor.

Pipes shall not be poured or solidly grouted in concrete walls or floors unless fixations are indicated on the Project Drawings, for example as anchorage to resist pipe thrusts, unless otherwise required or permitted. At wall and slab penetrations, openings shall be formed approximately one inch greater than the OD of the pipe. For openings 10 inches and less in diameter, openings may be cored if permitted by the Engineer before pouring wall or slab so that extra reinforcing steel can be accurately located and referenced to avoid the subsequent core hole, unless otherwise required or permitted. After pipe placement and alignment adjustment, the annular space between opening and outside of pipe shall be packed with dry braided hemp (or unbraided where pipe does not center in openings) to within two inches of the wall or slab surface. The two-inch deep annular space shall be packed with non-shrink grout or caulked in strict accordance with the material manufacturer's instructions.

Sleeves shall be cast in floors and walls for penetrations of small pipe, cut and fitted on the job, such as steel, wrought iron, copper, plastic and rubber pipe and hoses. Unless otherwise required or permitted, sleeves shall be steel, cast iron or plastic or about one inch greater ID than the OD of the pipe and shall be flush with wall and slab surfaces. The annular space between sleeve and outside of pipe shall be packed and grouted or caulked as previously described, except the joint depth shall be one inch. Penetrations may be made by coring according to previously described requirements if permitted by the Engineer. Where openings larger than 10 inches in diameter are required for pipe penetrations in existing walls and slabs, the opening shall be made approximately two inches to four inches larger in diameter than the pipe OD. The pipe shall be wrapped with 1/2-inch braided hemp and positioned in the opening. The space between the hemp and the opening shall be solidly packed with non-shrink grout previously described, after application of a bonding adhesive to the opening surfaces. The grout shall be finished flush with wall and floor surfaces. After the grout has hardened sufficiently, hemp shall be removed to two-inch depths on each side of walls and slabs and the resulting annular spaces shall be packed with non-shrink grout or caulked as required or permitted, as previously described. All joints around pipe shall be watertight unless otherwise required or permitted.

The top surface of all concrete decks (except slabs on grade) shall be coated with Sikagard-70 water-repellent penetrating sealer as manufactured by the Sika Corporation,

Nox-Crete Stifel, or another approved equal. The manufacturer's recommendations shall be followed in all areas of application.

2.13 Equipment Pads. Unless otherwise shown or directed, all pumps, other equipment, and items such as lockers, motor control centers and the like, shall be installed on concrete bases. The bases shall be constructed to the dimensions shown on the plans or as required to meet plan elevations. Where no specific plan elevations are required, the bases shall be six inches thick and shall extend three inches outside the metal equipment base. In general, the concrete bases shall be placed up to one inch below the metal base. The equipment shall then be properly shimmed to grade and the one inch void filled with nonshrink grout. Prior to the final set of the grout, it shall be cut back and the edge plastered with 1:2 cement mortar.

2.14 Concrete Form Materials. Plywood shall be Douglas Fir species, medium density overlaid one side grade; sound, undamaged sheets with straight edges. Forms shall be sufficiently rigid to prevent displacement or sagging between supports, and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy. For surfaces to be given rubbed finish, the form in contact with the concrete shall be made of plywood, metal, metal framed plywood faced, or other acceptable panel-type materials, to provide continuous straight, smooth, exposed surfaces. Forms shall not be pieced out by use of material different from those in the adjacent form or in such manner as will detract from the uniformity of the finished surface. For surfaces other than those to be given rubbed finish, forms shall be made of wood, metal or other acceptable material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be in reasonably good condition. Metal forms shall be of an acceptable type for the work involved.

Form ties to be encased in concrete shall not be made of through bolts or common wire, but shall be of a well established type, so made and installed as to embody the following features:

1. After removal of the protruding part of the tie, there shall be no metal nearer than 1-1/2" to the face of the concrete.

2. That part of the tie which is to be removed shall be at least 1/2" in diameter, or if smaller, it shall be provided with a wood, metal, or plastic cone 1" long placed against the inside of the forms. Cones shall be carefully removed from the concrete after the forms have been stripped.

3. Ties which pass through walls of liquid retaining basins and all dry rooms below grade shall be provided with acceptable water stop, securely fastened to the ties.

The Form Release Agent shall be a colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for

use on concrete. Acceptable products include Nox-Crete Form Coating Release Agent, Debond Form Coating by L & M Construction Chemical, Inc., or approved equal.

Fillets for chamfered corners shall be wood strip type to the size and shape as shown on the Drawings.

Nails, spikes, lag bolts, through bolts and anchorages shall be sized as required of strength and character to maintain formwork in place while placing concrete.

Earth or rock forms shall not be permitted. The vertical surface of all footings shall be formed.

Forms for walls, columns, or piers shall have removable panels at the bottom for cleaning, and inspection. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete, unless special spouts are used to place concrete and so that construction joints can be properly keyed and treated. Forms for exposed surfaces shall be built with 3/4" chamfer strips attached to produce smooth, straight chamfers at all sharp edges of concrete.

Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged places repaired, and all projecting nails withdrawn.

2.14.1 Wetting and Oiling Forms. The inside surface of wood board forms shall be soaked with clean water and kept continuously wet for 12 hours before any concrete is placed. In case forms have been erected for some time and have become dry so that joints have opened, then the forms shall be thoroughly soaked at least twice each day for at least three days prior to placing concrete. If the forms cannot be tightened to the satisfaction of the Engineer, they shall be torn down and rebuilt. Plywood forms may be treated with a nonstaining form oil, mineral oil or lacquer. If oil is used, all excess oil shall be wiped off with rags to leave the surface of the forms just oily to the touch. In freezing weather oil shall be used.

Coatings of dust shall be removed from contact surfaces of forms before placing concrete. Concrete shall not be placed in any form until inspected by the Engineer and permission is given to start placing.

2.14.2 Removal. Forms shall not be removed without approval of the Engineer. All form removal shall be accomplished in such a manner as to prevent injury to the concrete.

Forms shall not be removed sooner than the following minimum times after the concrete is placed. These periods represent cumulative number of days and fractions of days, not necessarily consecutive, during which the temperature of the air adjacent to the concrete is above 50 degrees F.:

Element	Time
Beams, arches - supporting forms and shoring	14 days
Conduits, deck slabs - supporting (inside) forms and shoring	7 days
Conduits (outside forms), sides of beams, small structures	24 hours
Columns, walls, spillway risers - with side or vertical load	7 days
Columns, walls, spillway risers - with no side or vertical load	4 days
Concrete supporting more than 30 feet of wall in place above it	7 days
Concrete supporting 20 to 30 feet of wall in place above it*	4 days
Concrete supporting not more than 20 feet in place above it*	24 hours

*Age of stripped concrete shall be at least seven days before any load other than the weight of the column or wall itself is applied.

When conditions on the job are such as to justify the requirements, forms will be required to remain in place for longer periods. Forms for beams, girders, and flood slabs shall remain in place for at least seven days and shall only be removed when test cylinders used under the same conditions as the members break with a compressive strength as required in these specifications.

2.15 Construction Tolerance. The forms shall be constructed and rigidly braced in place within the following tolerances:

(1) Variation from true alignment as shown on the drawings in the lines and surfaces of walls:

In 10 feet	1/4 inch
In 20 feet maximum	3/8 inch
In 40 feet or more	3/4 inch

(2) Variation from the level or from the grades indicated on the drawings in floors or slabs:

In 10 feet	1/4 inch
In 20 feet maximum	3/8 inch
In 40 feet or more	3/4 inch

(3) Variation in sizes and/or locations of floor and/or wall openings:

1/4 inch

(4) Variation in thickness of slabs and walls and in cross-sectional dimensions of columns and beams:

Minus	1/4 inch
Plus	1/2 inch

(5) Variation in plan dimension of footings:

Minus	1/2 inch
Plus	2 inches

2.16 Expansion and Contraction/ Construction Joints. Unless otherwise shown, waterstops for construction and control joints shall be 4 inches wide, 3/16" minimum thickness, flat-ribbed, or dumbbell polyvinyl chloride (PVC), in accordance with Corps of Engineers Specifications CRD-C-572, latest revision, as manufactured by Vinylex Corp., W.R. Grace Company, Greenstreak, or equal. Split-ribbed waterstops may be used where appropriate.

Unless otherwise shown, waterstops for expansion joints shall be nine inches wide, 1/4" minimum thickness, ribbed with center bulb polyvinyl chloride (PVC) in accordance with Corps of Engineers Specifications CRD-C-572, latest revision as manufactured by Vinylex Corp., W.R. Grace Company, Greenstreak, or equal.

Only where indicated on the drawings, the Contractor shall install a self-expanding waterstop impregnated with sodium bentonite similar to Volclay Waterstop-RX. The manufacturer's recommended installation procedures shall be followed. Self expanding waterstops shall not be used at expansion joints and water containment structures.

Joint filler shall conform to ANSI/ASTM D994 and they shall be bituminous impregnated fiberboard, closed cell polyethylene or self-expanding cork; of the sizes detailed and in the locations indicated on the Drawings. Bituminous impregnated fiberboard shall not be used to fill joints in liquid retaining structures. Where the application requires cementing the joint filler into place, a pressure sensitive adhesive recommended by the filler manufacturer shall be used.

2.16.1 Waterstops. Waterstops shall be provided at all joints where indicated on the Drawings. Waterstops shall also be provided in all joints, vertical and horizontal up to 1'-0" minimum above finished grades and in water containment and subterranean structures. Install waterstops continuous without displacing reinforcement. All joints between adjacent continuing and intersecting sections of waterstop including butt joints, tee joints, and other angled joints shall be heat fused to form a watertight seal. Waterstops shall not be lapped. Waterstops shall be securely wired in place to maintain proper position during placement of concrete.

2.17 Reinforcing Steel. The Contractor shall place reinforcing steel at the location as shown on the Drawings.

2.17.1 Materials. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A-615, A-616, or A-617. All bar reinforcement shall be deformed. Smooth dowels shall be plain steel bars conforming to ASTM A-615, Grade 40. Welded wire fabric when specified shall conform to ASTM 185, welded steel wire fabric for concrete reinforcement. Reinforcements supports and other accessories in contact with the forms for members which will be exposed to view in the finished work shall have approved high density polyethylene tips so that the metal portion shall be at least one quarter of an inch from the form or surface. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast stone concrete blocks.

2.17.2 Fabrication. Reinforcement shall be bent cold. It shall be accurately to the dimensions and shapes shown on the plans and to within tolerance specified in the ACI code and the CRSI Manual of Standard Practice. Reinforcement shall be shipped with bars of the same size and shape, fastened securely with wire and with metal identification tags using size and mark.

2.17.3 Placing and Fastening. Before being placed in position, reinforcement shall be cleaned of loose mill and rust scale, dirt and other coatings that will interfere with development of proper bond. Reinforcement shall be accurately placed in positions shown on the drawings and firmly held in place during placement and hardening of concrete by using annealed wire ties. Bars shall be tied as required to prevent displacement under foot traffic and during casting operations, and shall be placed within tolerances allowed in Section 5.6.2 of ACI 301. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers or other approved supports. If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

Before any concrete is placed, the Engineer shall have inspected the placing of the steel reinforcement and given permission to deposit the concrete. Concrete placed in violation of this provision will be rejected and thereupon shall be removed.

Unless otherwise specified, reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the approval of the Engineer. Where splices are made, they shall be staggered insofar as possible.

Wire mesh reinforcement shall be continuous between expansion joints. Lamps shall be at least one full mesh plus two inches, staggered to avoid continuous lap in either direction and securely wired or clipped with standard clips.

Dowels shall be installed at right angles to construction joints and expansion joints. Dowels shall be accurately aligned parallel to the finished surface, and shall be rigidly held in place and supported during placing of the concrete. One end of dowels shall be oiled or greased or dowels shall be coated with high density polyethylene with a minimum thickness of 14 mils.

2.17.4 Shop Drawings. The Contractor shall submit a complete set of shop drawings including schedules and bending drawings for all reinforcement used in the work in accordance with ACI 315, and ACI 315R. Review of drawings by the Contractor and the Engineer is required before shipment can be made.

2.18 Measurement and Payment. Payment will be based on one of the following criteria as specified and described in the Contract Bid Item Descriptions and on the Drawings:

A. Cost shall be included in the work to which it is subsidiary and no separate measurement and payment will be made.

B. Payment will be based on Plan Quantities or a percentage of concrete installed to complete the structure as computed by the Engineer or as shown on the Drawings.

Payment as specified above shall be considered as full compensation for all labor, materials, equipment and incidentals necessary to perform the work as required.

Payment for concrete placed outside the lines shown on the Drawings due to over excavation or Contractor error will not be made. Where extra concrete is authorized by the Engineer in writing, payment will be made at a price agreed upon by the Contractor and the Engineer.

SECTION 3 - PROCESS PIPING

3.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to furnish and install the yard piping and interior piping as shown on the drawings, as specified herein and as directed by Engineer.

3.1 Water Pipe Materials. All pipe materials shall conform to the manufacturer's standard lengths and diameters. Testing when required by the Owner shall be done in accordance with the appropriate ASTM specifications for the material selected. The water main type shall be PVC, HDPE or ductile iron pipe.

3.1.1 Polyvinyl Chloride Pipe PVC SDR 17 or SDR 21. PVC pipe shall comply with ASTM D-1784 for material and shall be Class 250 (SDR 17) or Class 200 (SDR 21) as shown on the drawings or indicated on the bid form. All PVC pipe shall conform to the latest revisions of the following specifications:

ASTM D2241 (PVC Plastic Pipe SDR-PR and Class T)
National Sanitation Foundations Testing Laboratories (NSF)

The name of the manufacturer of the plastic pipe to be used must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, 12454-B (PVC 1120) published by ASTM. Rubber gaskets shall conform to ASTM D3139.

Wall thickness shall be in accordance with ASTM D-2241. Pipe ends shall be beveled to accept the coupling with gasket. The bell section shall be designed to be as strong as the pipe wall.

Samples of pipe physical and chemical data sheets shall be submitted to the Engineer for approval prior to the pipe being purchased.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color and shall have a ring painted around the spigot ends in such a manner as to allow field checking of setting depth of the pipe in the socket. Pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the bottom rows of pipe are not damaged by crushing. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's Name

Nominal Size
Class Pressure Rating
PVC 1120
NSF Logo
Identification Code

The lubricant shall be that as recommended and supplied by the pipe manufacturer.

3.1.2 Polyvinyl Chloride Pipe (PVC) Cast Iron Pipe Size. This pipe shall meet the requirements of AWWA C900-75, latest revision, "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water" and shall be furnished in cast iron pipe equivalent outside diameters with separate couplings including gaskets.

The pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D-1784. The standard code designation shall be PVC 1120. The PVC compounds shall be tested and certified as suitable for potable water products by the NSF approval marking.

Solvent cement couplings or joints shall not be used. PVC joints using elastomeric gaskets shall be tested as assembled joints and shall meet the laboratory performance requirements specified in ASTM D-3139.

Pipe shall be pressure Class 200, DR 14 or Class 150, DR 18 as shown on the drawings or the bid form.

Pipe and Couplings shall be marked as follows:

Nominal Size and OD Base
Material Code Designation (PVC 1120)
Dimension Ratio Number
AWWA Pressure Class
AWWA Designation Number (AWWA C900)
Manufacturers Name or Trade Mark and Production Record Code
Seal of the NSF Laboratory

Each standard and random length of pipe shall be proof tested at four times its rated class pressure for a minimum of 5 seconds. Bells or couplings shall be tested with the pipe.

The pipe shall not split, crack, or break when tested by the parallel plato method, and it shall not flake or disintegrate when tested by the acetone immersion method as specified by ASTM D-2241.

3.1.3 High Density Polyethylene Pipe (HDPE). The pipe shall be manufactured from new, high performance, high molecular weight, high density polyethylene resin conforming to ASTM D 1248, ASTM D 3350 with Cell Classification PE 345444C, and

having a Plastic Pipe Institute (PPI) rating of PE 3408. The pipe shall be series 1000 as manufactured by Phillips Driscopipe or approved equal.
The Contractor shall furnish the Engineer written warranties obtained from the manufacturer and the installer against defects in materials and workmanship in accordance with ASTM D 3261 and ASTM F 714. Samples of pipe physical and chemical data sheets shall be submitted to the Engineer for approval prior to the pipe being purchased.

All HDPE pipe and fittings shall comply with the ASTM F 714. All pipe and fittings shall have a minimum Standard Dimension Ratio (SDR) of 11 unless otherwise stated on the Drawings. The pipe shall be supplied in standard laying lengths not exceeding 50 ft.

The pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious effects, and shall be uniform in color, density, melt index, and other physical properties. The pipe shall be joined with thermal butt-fusion joints. All joints shall be made in strict compliance with ASTM D 2657 and the manufacturer's recommendations. Field-cutting of pipes, where required, shall be made with a machine specifically designed for cutting pipe. The cuts shall be carefully made, without damage to pipe, so as to leave a smooth end at right angles to the axis of pipe. Cutter ends shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.

The Contractor shall exercise care when transporting, handling, and placing the pipe and fittings, such that they will not be cut, kinked, twisted, or otherwise damaged. The pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the height of stacking will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical. Ropes, fabric or rubber-protected slings and straps shall be used when handling the pipe. Slings, straps, etc. shall not be positioned at butt-fused joints. Chains, cables, or hooks shall not be inserted into the pipe ends as a means of handling pipe.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's name and/or trademark
Nominal size
Standard Dimension Ratio (SDR)

3.1.4 Ductile Iron Pipe. Ductile Iron Pipe shall be designed in accordance with AWWA (ASA A21.50) and for the conditions as stated in these specifications and the pressure rating for the pipe shall be 350 PSI. Ductile iron pipe shall conform to AWWA C-151 (ASA A21.51). Pipe shall be cement lined in accordance with AWWA C104 (ASA A21.4) and all exposed pipe and fittings shall have a shop prime coat applied that is compatible with subsequent field enamel paint coats.

The specified thickness will be determined for the given internal and external loading requirements in accordance with ASA A21.50 and will be shown on the drawings or the bid form.

The net weight, class or nominal thickness and sampling period shall be marked on each pipe.

Pipe joints shall be mechanical joint, rubber ring slip joint, flanged, or locked mechanical joint equal to AWWA C-111.

3.1.5 Flanged Pipe. All ductile iron flanged pipe shall be designed in accordance with AWWA C110 and AWWA C115. The pipe shall have a pressure rating of 250 psi and it shall be coated on the inside with a cement lining as per AWWA C104.

3.1.6 Fittings. Ductile Iron mechanical joint fittings with appropriate adapters shall be used with PVC pipe and ductile iron pipe. Fittings shall comply with AWWA C-110 or C-111 and shall be manufactured for the size and pressure class of the line on which they are used. Compact fittings are acceptable and they shall conform to the latest AWWA specifications.

Mechanical joint fittings shall be used with ductile iron pipe for below ground burial and flange fittings shall be used for all interior piping where ductile iron pipe is used.

3.1.7 Pipe Handling. Pipe delivered to the site shall be stored, handled, distributed, placed, joined together, etc. in accordance with the manufacturer's recommendation unless directed otherwise by the Engineer.

3.1.8 Process Piping Location. The water main shall be installed in the locations as shown on the drawings and as directed by the Engineer. The Contractor and Engineer shall agree as to the exact location of the water line and there shall be no disputes unless it is clear that the proposed location significantly deviates from the drawings. At those locations where the drawings indicate that a fitting must be installed either by declaration on the drawings or by a defined bend as shown on the drawings, the Contractor shall do so and shall avoid over deflection of the pipe.

3.1.9 Excavation. The Contractor shall make trench excavations to only such width to provide ample room for proper construction. Sheeting and shoring shall be provided as required for proper safety and compliance with OSHA regulations. Rock excavation shall be taken to a depth of 6 inches below the bottom of the pipe. If poor foundation conditions exist due to unstable subsurface conditions, the trench shall be under excavated to the depth required and filled with stone to obtain proper bearing capacity.

Watchmen or barricades, lanterns, and other such signs and signals as is necessary to warn the public of the dangers in connection with open trenches, excavations and other

obstructions shall be provided by and properly maintained at the expense of the Contractor.
Only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the excavation.

3.1.10 Blasting and Rock Excavation. The Contractor shall make his own investigation as he deems necessary to ascertain the sub surface conditions to be encountered in the work.

All blasting operations shall be conducted in accordance with municipal ordinances, state and federal laws and the applicable blasting codes. Soil particle velocity shall not exceed the limit set by Kentucky law. All explosives shall be stored in conformity with the applicable ordinances, laws and safety regulations. No blasting shall be done within five feet of any water mains, sewer lines, natural or manufactured gas lines, liquid petroleum lines, or other utilities.

The Contractor shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping shall not be permitted as a method to breaking boulders. No blasting shall be permitted on Sundays or after dark.

Prior to commencing with the work, the Contractor shall, during a preconstruction conference with the Owner and Engineer, state clearly his approach to performing the excavations on the project. He shall be familiar with the laws and ordinances covering blasting and shall also give consideration to the use of hydraulically operated rock breaking devices in lieu of blasting where considered necessary. If blasting is not handled in an expert manner at all times the Engineer reserves the right to suspend blasting and require the work to proceed without it. Prior to blasting, the Contractor shall make his own detailed preblast survey of adjacent walks, curbs, retaining walls, house foundations, etc. to determine conditions prior to the work. Such a file of information, including photographs, may be certified in such a manner as the Contractor believes necessary. This information if required or performed shall be supplied to the Engineer prior to performing the work.

3.1.11 Storage of Excavated Material. All excavated material shall be stored in a manner that will not endanger the work and that will avoid obstructing roadways, sidewalks, and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

3.1.12 Shoring Sheeting and Bracing. The Contractor shall furnish place and maintain such sheeting and bracing as may be required to support the sides of the excavation or to protect other structures from possible damage. All sheeting and bracing shall be removed upon completion of the work unless permitted to be left in place by the Engineer. Any sheeting or bracing left in place shall be cut off at least two feet below the finished

ground surface elevation. The cost of furnishing, placing, maintaining, and removing sheeting and bracing shall be included in the unit price bid for water lines and all work shall conform the OSHA requirements.

3.1.13 Bedding and Backfill. All water mains shall be bedded with select earth backfill or six inches of #9 or approved equal stone under and on both sides of the pipe where it is installed along the unpaved areas. Where the water line is installed along the paved areas the water line shall be backfilled with #9 or approved equal stone. Trenches shall be backfilled immediately after the water main has been installed. No rock larger than two inches will be permitted within six inches of the pipe. In unpaved or unsurfaced areas the remainder of the fill may be mounded over the top of the trench. Where trenches are in paved or traveled areas, or yard areas, compaction shall be performed during backfill. The Contractor at no time shall open up more than 500 feet of trench.

Any damage to underground structures, pipes wires, drains, etc., shall not be backfilled until they have been satisfactorily repaired or replaced to the original serviceability at the Contractor's expense and as approved by the Engineer. Settlement of backfill may be done with water furnished by the Contractor under the direction of the Engineer where such will not endanger traffic of damage property. When excavated rock is used for backfilling, it shall have sufficient dirt or fine material to fill all voids and shall not be used within twelve inches of the pipe.

To be accepted as final cleanup all excess rock one inch and larger shall be removed from the disturbed site.

3.1.14 Thrust Blocks and Anchorage. Thrust blocks shall be installed at all tees, bends, crosses, dead ends, valves, hydrants, blowoff assemblies, and as directed by the Engineer. The size of the thrust block shall depend on the soil and type of fitting, and shall conform to the pipe manufacturer's recommendations. At any location where a vertical bend is required the Contractor shall install the anchorage as directed by the Engineer in conjunction with the pipe manufacturer.

Thrust blocks shall be constructed of Class B concrete conforming to KBH Specification 601 and placed between the fitting and the trench wall. At no time will sack-crete or pre bagged concrete mixtures be allowed. All thrust block and anchorage concrete shall be delivered to the job site by means of a ready mix concrete truck and placed immediately upon arrival.

The thrust blocks shall be sized as shown on the detail drawings or as directed by the Engineer.

3.1.15 Temporary Surfacing. All trenches in paved areas shall, following compacted backfill, receive a top layer of compacted dense grade stone as shown on the detailed drawings. Such temporary surfacing shall be maintained and shall be paved as soon as conditions permit.

3.1.16 Hydrostatic Testing. The water line and appurtenances, as rapidly as valves are installed, shall be hydrostatically tested in accordance with these specifications. Defective joints of pipe shall be replaced as directed by the Engineer. Cracked or defective pipe, fittings, valves, or hydrants shall be replaced by the Contractor and the test shall be repeated until the test results are satisfied. All meter settings and service tubing as shown on the drawings shall be included in the hydrostatic test.

The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section and the hydrostatic test shall be of at least a two hour duration. The test pressure shall not vary by more that five psi. for the duration of the test.

3.1.16.1 Pressurization. After the pipe has been installed all or any valved section shall be subjected to the hydrostatic test. Each valved section of the pipe shall be slowly filled with water and the specified test pressure, corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. As part of the testing equipment a meter shall be installed to measure all water added to the tested section.

3.1.16.2 Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.

3.1.16.3 Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five psi. of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

3.1.16.4 Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in pounds per square inch

This formula is based on an allowable leakage of 11.65 gpd./mi./in. of nominal diameter at a pressure of 150 psi.

All leaks shall be repaired whenever or wherever the is evidence of a leak. Water used by the Contractor shall be paid for by the Contractor at the rate of $2.00 per 1,000 gallons.

3.1.17 Sterilization. Upon completion and acceptance of the hydrostatic test of a section of the water main that section shall be thoroughly disinfected before being place in service by the use of chlorine or chlorine compounds in such amounts as to produce a concentration of not less than 50 ppm and a residual of not less than 25 ppm at the end of 24 hours and followed by thorough flushing. Putting small amounts of chlorine in each joint will not be acceptable.

3.1.18 Other Utilities. Other utilities encountered in the work shall be preserved and protected. Where relocation or repair is required to accommodate the work it shall be made in a manner acceptable to the utility having jurisdiction over the service connection. Accommodation of service connections shall not constitute any basis for extra payment.

Prior to construction, the Contractor shall arrange to meet with representatives of all utilities, and provide them with his anticipated work schedule. The Contractor shall have the utility companies make their best determination of utility locations in the areas in which he is working. Throughout the progress of the work such field markings of utilities shall be kept current.

3.1.19 Payment for Water. All water used from the Owner shall be metered by meters supplied by the Contractor. The Contractor shall pay for such water at the rate of $2.00 per 1,000 gallons. This shall include any unmetered water lost which shall be computed on the basis of a discharge velocity of seven feet per second, the diameter of the line, and the estimated duration of free uncontrolled discharge or the approved method.

3.1.20 Cleanup. The Contractor shall provide effective cleanup of the work as it progresses. At the time of final inspection no trenches shall show any undue evidence of the construction. All areas shall be left free of ruts due to construction and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded and shall be completely restored, and all yards and fields shall be reseeded. Straw and fertilizing shall accompany the seeding and the seed mixture shall match the existing ground cover. If necessary to hasten proper restoration of terraces, principally along ditch lines, the Contractor shall sod such areas at the Engineer's direction.

3.1.21 Protection of Adjacent Landscape. Reasonable care shall be taken during construction of the process lines to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

3.1.22 Underground Marking Tape. At all locations where PVC pipe is utilized a detectable underground marking tape shall be place in the trench approximately six inches below the finished grade. The tape used shall be mylar encased aluminum foil with the printing "CAUTION - Buried Water Line Below." Printing shall be readable through the clear mylar and surface printing is not acceptable. Tape size shall be two inch width as provided by Lifeguard, Inc. or approved equal. Color of the tape shall be blue.

3.2 Sewer Pipe Materials. All pipe materials shall conform to the manufacturer's standard lengths and diameters. Testing when required by the Owner shall be done in accordance with the appropriate ASTM specifications for the material selected. The gravity sewer main type shall be PVC or ductile iron pipe.

3.2.1 Polyvinyl Chloride Pipe (PVC) Gravity Sewer. PVC pipe shall comply with ASTM D-3034 for material and shall be SDR 21 or as shown on the drawings or indicated on the bid form.

All fittings shall meet the latest requirements of ASTM D-3034 and shall be bell and spigot type with rubber gaskets compatible with the pipe and conforming to ASTM D-3212.

Wall thickness shall be in accordance with ASTM D-2241. Pipe ends shall be beveled to accept the coupling with gasket. The bell section shall be designed to be as strong as the pipe wall.

Samples of pipe physical and chemical data sheets shall be submitted to the ENGINEER for approval prior to the pipe being purchased.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color and shall have a ring painted around the spigot ends in such a manner as to allow field checking of setting depth of the pipe in the socket. Pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the bottom rows of pipe are not damaged by crushing. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's Name
Nominal Size
Class Pressure Rating
PVC 1120
Identification Code

The CONTRACTOR shall use the lubricant that is recommended and supplied by the pipe manufacturer.

Where gravity sewer mains area constructed of materials which might cause the gravity sewer main to be confused with potable water mains, the gravity sewer main shall be appropriately identified.

3.2.2 Ductile Iron Pipe. Ductile Iron Pipe shall conform to ANSI Specification A 21.51 (AWWA C 151), relative to manufacture materials, dimensions, inspection, testing and marking. The thickness of ductile iron pipe shall be in accordance with ANSI Specification A 21.50 (AWWA C 150). Minimum standard thickness class shall be 51 for ductile iron pipe with mechanical joint fittings and 53 for ductile iron pipe with flanged joints, unless indicated otherwise on the plans.

All buried ductile iron pipe shall be cement mortar lined and bituminous coated. All exposed ductile iron pipe shall be cement mortar lined and epoxy painted. All process yard piping shall be slip-on joints with mechanical joint fittings and all interior piping and fittings shall be flanged joints except as noted by the ENGINEER. Joints for ductile iron pipe shall be either the mechanical or the push-on joint type with rubber gaskets (unless otherwise indicated on the plans) and shall conform to the ANSI Specification for "Rubber-Gasket Joints for Ductile Iron Pipe and Fittings", A 21.11 (AWWA C 111).

Fittings shall be ductile iron and shall conform to the American National Standard for Ductile Iron Fittings A 21.10 (AWWA C 110). No compact fitting are acceptable below the center of the clarifier.

3.2.3 Pipe Handling. Pipe delivered to the site shall be stored, handled, distributed, placed, joined together, etc. in accordance with the manufacturer's recommendation unless directed otherwise by the ENGINEER.

3.2.4 Gravity Sewer Main Location. The gravity sewer main shall be installed in the locations as shown on the drawings and as directed by the ENGINEER. The CONTRACTOR shall be responsible for construction staking, based upon horizontal and vertical control points furnished by the ENGINEER. Changes in either vertical or horizontal alignment, as may be required during construction due to unforeseen obstacles or to accommodate changes in right-of-way, shall be made by the CONTRACTOR at the direction of the ENGINEER. Such modifications in alignment shall be accommodated by the CONTRACTOR and the completed work shall be paid for under the unit prices bid for the work. The CONTRACTOR and ENGINEER shall agree as to the exact location of the gravity sewer main and there shall be no disputes unless it is clear that the proposed location significantly deviates from the drawings.

3.2.5 Excavation. The CONTRACTOR shall make trench excavations to only such width to provide ample room for proper construction. Sheeting and shoring shall be

provided as required for proper safety and compliance with OSHA regulations. Rock excavation shall be taken to a depth of 6 inches below the bottom of the pipe. If poor foundation conditions exist due to unstable subsurface conditions, the trench shall be under excavated to the depth required and filled with stone to obtain proper bearing capacity.
Watchmen or barricades, lanterns, and other such signs and signals as is necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions shall be provided by and properly maintained at the expense of the CONTRACTOR.

Only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the excavation.

3.2.6 Blasting and Rock Excavation. The CONTRACTOR shall make his own investigation as he deems necessary to ascertain the sub surface conditions to be encountered in the work.

All blasting operations shall be conducted in accordance with municipal ordinances, state and federal laws and the applicable blasting codes. Soil particle velocity shall not exceed the limit set by Kentucky law. All explosives shall be stored in conformity with the applicable ordinances, laws and safety regulations. No blasting shall be done within five feet of any water mains, sewer lines, natural or manufactured gas lines, liquid petroleum lines, or other utilities.

The CONTRACTOR shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping shall not be permitted as a method to breaking boulders. No blasting shall be permitted on Sundays or after dark.

Prior to commencing with the work, the CONTRACTOR shall, during a preconstruction conference with the Owner and ENGINEER, state clearly his approach to performing the excavations on the project. He shall be familiar with the laws and ordinances covering blasting and shall also give consideration to the use of hydraulically operated rock breaking devices in lieu of blasting where considered necessary. If blasting is not handled in an expert manner at all times the ENGINEER reserves the right to suspend blasting and require the work to proceed without it. Prior to blasting, the CONTRACTOR shall make his own detailed preblast survey of adjacent walks, curbs, retaining walls, house foundations, etc. to determine conditions prior to the work. Such a file of information, including photographs, may be certified in such a manner as the CONTRACTOR believes necessary. This information if required or performed shall be supplied to the ENGINEER prior to performing the work.

3.2.7 Storage of Excavated Material. All excavated material shall be stored in a manner that will not endanger the work and will avoid obstructing roadways, sidewalks, and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and

accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

3.2.8 Shoring Sheeting and Bracing. The CONTRACTOR shall furnish place and maintain any sheeting and bracing required to support the sides of the excavation or to protect other structures from possible damage. All sheeting and bracing shall be removed upon completion of the work unless permitted to be left in place by the ENGINEER. Any sheeting or bracing left in place shall be cut off at least two feet below the finished ground surface elevation. The cost of furnishing, placing, maintaining, and removing sheeting and bracing shall be included in the unit price bid for gravity sewer mains and all work shall conform the OSHA requirements.

3.2.9 Bedding and Backfill. All gravity sewer mains shall be bedded with six inches of #9 stone under and on both sides of the pipe and at least 12-inches on top of the pipe where it is installed along the unpaved areas. Following stone bedding of the sewer, the CONTRACTOR shall place the trench refill in 6-inch layers. At those locations in traveled areas such as streets, driveways, parking lots, defined parking areas and any other locations where traffic is evident, the trench shall be backfilled to grade with #9 stone.

A minimum of 30-inches of cover shall be maintained. Whenever 30-inches cover cannot be maintained, additional protection shall be provided. In streets and roads, etc., the refill shall be thoroughly compacted in the 6-inch layers. If compaction is not adequate, the ENGINEER may require complete trench refill with #57 stone with compacted D.G.A. above as the final course. The CONTRACTOR at no time shall open up more than 500 feet of trench.

Any damage to underground structures, pipes wires, drains, etc., shall not be backfilled until they have been satisfactorily repaired or replaced to the original serviceability at the CONTRACTOR'S expense and as approved by the ENGINEER.

Before final cleanup will be accepted, all excess rock one inch and larger shall be removed from the disturbed site.

3.2.10 Temporary Surfacing. All trenches in paved areas shall, following compacted backfill, receive a top layer of compacted D.G.A. as shown on the detailed drawings. Such temporary surfacing shall be maintained and shall be paved as soon as conditions permit. All public or private drives shall be promptly backfilled or bridged.

3.2.11 Cradles and Encasements. Cradles or encasements, as required to support the sewer pipe, shall be of crushed stone or concrete and shall be installed as specified below.

3.2.11.1 Crushed Stone Cradle. In all cases where the bedding is not specified, the sewer pipe is to be laid in a crushed stone cradle. The crushed stone shall be Kentucky Highway No. 78 or No. 9 Crushed Stone, as specified by the Kentucky Department of Highways Standard Specifications.

3.2.11.2 Concrete Cradle, Encasement, or Cap. Where a concrete cradle, encasement or cap is required, Section 601 of the Kentucky Department of Highways Standard Specifications shall be used. The pipe shall be laid and supported in accordance with the specifications for pipe on a concrete cradle, and the concrete deposited around the pipe at the required width and depth to a plane at least 6 inches over the top of the pipe, as indicated on the plans. Proper bracing of the pipe shall be provided to prevent floating by the concrete encasement.

3.2.11.3 Branches and Fittings. The CONTRACTOR shall provide branches and fittings as directed on the plans or by the ENGINEER. T-branches and Y-branches, placed in the sewer for property service connections, shall be located by the CONTRACTOR, at such point so as to result in the property service connection having the shortest length possible between the sewer and property line or easement line, unless otherwise indicated on the Plans or directed by the ENGINEER.

3.2.12 Sewer Joints at Manholes. The CONTRACTOR shall furnish shop drawings of each type of manhole connection to be incorporated into the work. These shall be developed by the sewer pipe manufacturer and shall provide watertight connections of each manhole. Type of joint shall be reviewed by the ENGINEER prior to commencement of the work.

3.2.13 Pipeline Testing. As individual sections of sewers are constructed, the CONTRACTOR shall, without undue delay, undertake cleaning and testing of the sewer sections. Initially, the CONTRACTOR will provide access to all manholes and adequate lightning equipment and assist the ENGINEER in "lamping" all sewers. The lighting equipment provided shall be ORECK XL Police Cordless Rechargeable Spotlite or equal. The sewers shall be essentially free of dirt and debris. Any obvious leaks or sags in the sewer line shall be corrected prior to testing.

All sections of the sewer installed under this contract shall be air tested.

3.2.13.1 Low Pressure Air Testing. The CONTRACTOR will at his expense provide the necessary equipment and labor for low pressure air testing of the sewer lines in accordance with the latest revision of ASTM C 828. Any sections of sewer failing to pass such tests shall be repaired and retested at the CONTRACTOR'S expense until proven satisfactory.

3.2.13.2 Leakage Tests. A leakage test may be requested by the ENGINEER at any time to determine whether or not there is excessive infiltration or exfiltration and to assure that the sewer section is substantially watertight. The ENGINEER may order the CONTRACTOR to make leakage test of as may sections as may be necessary to determine whether the work complies with the criteria for the rate of leakage. A section shall consist of a reach from one manhole to the next manhole provided the manholes are at least 300 feet apart and not more than 400 feet apart. The CONTRACTOR may

commence filling sections of the sewer prior to the actual time established for testing. During the test, the section of water being tested shall be filled to a sufficient depth so that the loss of water can be measured by the vertical drop of water level in the upstream manhole of the test section. During the minimum two hour test period, water shall not be added to the sewer and water shall not be permitted to drop more than three inches or as defined in subsequent sections.
The lengths of test sections shall be controlled by the CONTRACTOR so that no manhole in the test section is surcharged to a height exceeding the full barrel of the manhole.

3.2.13.3 Smoke Testing. The CONTRACTOR shall be fully equipped for conducting a "smoke test" on all sewer lines to be constructed if required by the ENGINEER.

The smoke test will assist the CONTRACTOR in proving his work as construction progresses and show up faulty materials and workmanship. Whenever possible this is to be done in advance of backfilling.

The smoke testing blower shall have a capacity of at least 1200 cfm. The smoke bombs shall produce a chemical reaction-generated, white to gray smoke, leaving no residue and being non-toxic and non-explosive. Each shall be capable of producing 25,000 cubic feet of smoke per three (3) minutes.

The first manhole to manhole section of sewer laid, for each size pipe and type of joint, shall be given a smoke test prior to the sewer being backfilled and when the sewer trench is dewatered to the bottom of the pipe being tested. When the materials being used and the CONTRACTOR'S installation methods have been proven satisfactory, subsequent smoke testing may be done after backfilling has been placed at the CONTRACTOR'S option.

If required, the smoke test shall be applied to all sewers and laterals laid. Such testing shall be done while the water level in the trenches is below the bottom of the pipe to be tested and in not more than two sections between manholes at a time. All defected work, as so proven by the smoke test, shall be immediately repaired and retested until proven satisfactory.

Inspection in pipe laying and smoke testing shall in no way relieve the CONTRACTOR of the responsibility for passing subsequent leakage test.

3.2.14 Leakage Defined. Leakage into the sewer including manholes, shall not exceed a rate of 250 gallons per 24 hours per inch diameter per mile of sewer. There shall be no gushing or spurting streams entering the sewer or manholes regardless of the rate of infiltration. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

3.2.15 Other Utilities. Other utilities encountered in the work shall be preserved and protected. Where relocation or repair is required, it shall be made in a manner acceptable to the utility having jurisdiction over the service connection. Accommodation of service connections shall not constitute any basis for extra payment.

Prior to construction, the CONTRACTOR shall arrange to meet with representatives of all utilities, and provide them with his anticipated work schedule. The CONTRACTOR shall have the utility companies make their best determination of utility locations in the areas in which he is working. Throughout the progress of the work such field markings of utilities shall be kept current.

3.2.16 Payment for Water. All water used from the Owner shall be metered by meters supplied by the CONTRACTOR. The CONTRACTOR shall pay for such water at the rate charged by the local water provider. This shall include any unmetered water lost. Lost water shall be computed on the basis of a discharge velocity of seven feet per second, the diameter of the line, and the estimated duration of free uncontrolled discharge or the approved method.

3.2.17 Cleanup. The CONTRACTOR shall provide effective cleanup of the work as it progresses. At the time of final inspection no trenches shall show any undue evidence of the construction. All areas shall be left free of ruts due to construction and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded and shall be completely restored. All yards and fields shall be re-seeded. Straw and fertilizer shall accompany the seeding and the seed mixture shall match the existing ground cover. If necessary, to hasten proper restoration of terraces, principally along ditch lines, the CONTRACTOR shall sod such areas at the ENGINEER'S direction. Final cleanup shall be performed within 60 days from day of installation, for all line segments.

3.2.17.1 Dredge or Fill Material. Prior to the discharge of any dredged or fill material into streams, the CONTRACTOR shall attain a Section 404 Permit from the U.S. Army Corps of ENGINEERS.

3.2.17.2 Connection at Septic Tank. The CONTRACTOR shall be responsible for making the sewer line connection into the new septic tank system.

3.2.17.3 Protection of Adjacent Landscape. Reasonable care shall be taken during construction of the process lines to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

3.3 Chemical Pipe Materials. All pipe materials shall conform to the manufacturer's standard lengths and diameters. Testing when required by the Owner shall be done in accordance with the appropriate ASTM specifications for the material selected. The chemical feed type shall be Schedule 80 PVC pipe.

3.3.1 Polyvinyl Chloride Pipe Schedule 80 PVC. PVC pipe shall conform to standards for the National Sanitation Foundation, ASTM D-1784-60T and CS-207-60.

The name of the manufacturer of the plastic pipe to be used must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, 12454-B (PVC 1120) published by ASTM.
Samples of pipe physical and chemical data sheets shall be submitted to the Engineer for approval prior to the pipe being purchased.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color. Pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the bottom rows of pipe are not damaged by crushing. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's Name
Nominal Size
Class Pressure Rating
Sch 80 PVC
NSF Logo
Identification Code

3.3.2 Fittings. Fittings shall be as manufactured by R & G Sloan Mfg., Division of Atlantic Research Corporation.

3.4 As-Built Drawings. As each line is installed, i.e., Line A, Line B, etc., the CONTRACTOR shall maintain a carefully marked-up set of plans to show exact "as-built" location of all manholes, showing entrance and exit invert elevations and top of manhole elevations, wyes, tees, etc. Measured distance between manholes shall also be shown.

As-built drawings shall also show the accurate location of other structures and utilities adjacent to or crossing the work. As-built drawings shall be periodically delivered to the ENGINEER.

3.4.1 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 4 - VALVES AND PIPING APPURTENANCES

4.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to furnish and install the valves and piping appurtenances as shown on the drawings, as specified herein and as directed by Engineer.

4.1 Gate Valves and Valve Boxes. Valves shall be resilient type and shall be designed for a minimum water working pressure of not less than 200 pounds per square inch. Valves shall have ends required for the piping in which they are installed. Gate valves shall have a clear water way equal to the nominal diameter, and shall be opened by turning to the left. The operating nut or wheel shall have an arrow cast in the middle indicating the direction of the opening. Each valve shall have the manufacturer's initials, pressure rating, and the year in which manufactured, cast onto the body. Valves shall be iron body, bronze mounted, non rising stem, parallel seated gate valves and shall conform to the standard specifications of the AWWA. Prior to shipment from the factory each valve shall be tested by hydraulic pressure of at least 300 pounds per square inch.

Valves two inches and larger shall be iron body, bronze mounted, non-rising stem, double disc, parallel seated gate valves and shall conform to standard specifications of the American Water Works Association. The Contractor shall furnish the Engineer catalogs showing description, type and dimensions of valves he proposes to use subject to approval by the Engineer.

4.2 Butterfly Valves. All butterfly valves shall be of the tight-closing, rubber-seat type with rubber seats that are securely fastened to the valve body. No metal to metal seating surfaces shall be permitted. Valves shall be bubble-tight at rated pressures with flow in either direction, and shall be satisfactory for applications involving throttling service and/or frequent operation and for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90° from the full open position to the tight shut position.

Valve bodies shall be constructed of cast iron ASTM A-126 Class B for flanged and valves or ASTM A-48 Class 40 for wafer type valves. Flange drilling shall be in accordance with ANSI B16.1 standard for cast iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be in strict accordance with AWWA Standard C504.74.3

Valve discs shall be constructed of alloy cast iron ASTM A-436 Type 1. Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel.

Valve seats shall be of a synthetic compound. Valves shall have seats that are simultaneously molded in, vulcanized and bonded to the body. Seat bond must withstand 75 lbs. pull under test procedure ASTM D-429, Method B.

Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5 of the compressive strength of the bearing or shaft material.

4.3 Air Relief Valves. A four-inch size air relief valve shall be installed on the filter backwash line in the pipe gallery. The valves shall be that as manufactured by APCO Model 200 or approved equal. It shall be constructed of cast iron with a stainless steel float and linkage, and a Buna-N seat.

4.4 Check Valve. The valve shall be installed as shown on the Drawings. The valve shall be a wafer-type and the body made of cast iron. The plug and seat shall be bronze and conform to ASTM Designation B-584. The guide bushings shall be brass and conform to ASTM Designation B-16. The valve spring and seat retainers shall be stainless steel and conform to ASTM Designation A-313. The valve plug shall be guided at both ends by a center shaft integral with the valve plug. Alignment of the center shaft shall be provided by guide bushings.

4.5 Pump Control Valve. Valves shall be designed for a minimum water working pressure of not less than 200 pounds per square inch. The pump control valves shall be installed as shown on the Drawings. The valves shall open and close while pump is running and shall prevent return flow if there shall be a power failure. The valve shall be that as manufactured by Bermad Model 740-Q or approved equal.

The valves shall consist of a wide, Y-pattern body, hydrodynamically designed with semi-straight flow and a double chambered diaphragm actuator. The valve body shall have a single removable seat with full flow opening, free of bottom stem guide, and a resilient sealing disc for drip tight closing. The valves diaphragm actuator shall contain two defined control chambers that can be removed as one distinct assembly. The actuator shall include the separating partition containing the valve stem bearing and the assisting spring which shall be placed over the valve sealing disc.

When the valve is about to close, the valve indicator shall activate the limit switch assembly to stop the pump.

4.6 Valve Boxes. Where required, valve boxes shall be set plumb and straight and with the operating nut directly in the center in thoroughly compacted earth with the top of the box level and projecting one fourth inch above high type streets, and an inch above other unpaved streets. The valve boxes, except in high type streets, shall have a four inch thick concrete slab three feet in diameter around and sloping away from the valve box.

Valve boxes shall be of cast iron of extension type with screw or slide adjustments and with flared base. The minimum thickness of metal shall be 3/16". The cover shall have the word "WATER" cast in the metal. Valve boxes shall be installed over each outside

gate valve unless otherwise shown on the Drawings. The boxes shall be of such lengths as will provide a cover of not less than 30 inches over the pipe.

4.7 Electric Operators. All electric actuators shall conform to the requirements of AWWA Standard C540-93. All actuators shall be as manufactured by AUMA Actuators, Inc. of Pittsburgh, PA. or approved equal.

Actuators shall contain motor, gearing, manual over-ride, limit switches, drive coupling, integral motor controls, position feedback transmitter (where required) and mechanical dial position indicator (where required).

The motor shall be specifically designed for actuator service. The motor shall be of the indication type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure shall be totally enclosed, non-ventilated.

Motors shall be capable of operating on 460 volt - 3 phase - 60 hertz power.

Actuator enclosure shall be NEMA 4 (watertight). All external fasteners on the electric actuator shall be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.

All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor.

Manual over-ride shall be by handwheel. Manual operation shall be via power gearing to minimize required rimpull and facilitate easy changeover from motor to manual operation when actuator is under load. Return from manual to electric mode of operation shall be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.

Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. A minimum of eight (8) heavy-duty contacts shall be provided for each actuator. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.

Mechanically operated torque switches shall be furnished at each end of travel. Torque switches shall trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.

All wiring shall be terminated at a plug and socket connector.

Quarterturn actuators shall be furnished with mechanical stops that restrict the valve/actuator travel.

Actuator must be capable of the following valve closing times/operating speeds: quaterturn valves - 60 seconds closing time, gate valves and sluice gates - 12 inches per minute operating speed.

Actuators shall be capable of operating in an ambient temperature range of -20 to 175 degrees F (without motor controls) and -20 to 160 degrees F (with motor controls).

All actuators in open/close service will be furnished with integral motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in mid-travel, wrong phase sequence or phase failure). An interface with the control system must be furnished with optical isolators to separate incoming voltage signals from the internal motor controls.

Actuators in modulating service shall be selected such that the required dynamic valve torque is no more than 60% of the electric's actuator's maximum rated breakaway torque. Power gearing in modulating actuators shall have zero backlash between the motor and actuator output.

All actuators in modulating service shall be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner. The positioner shall be capable of accepting a 4-20 mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed", or "last position" on loss of 4-20 mADC command signal.

4.8 Solenoid Valve. There shall be installed two 2-inch electric valves on the 2-inch lines that serve to operate the surface filter wash. The valves will be installed as shown on the Drawings and their operation will be interfaced with the filter control panel as described in the electrical section of these Drawings and Specifications. These valves will operate the filter surface wash for the filters.

4.9 Clamp & Couplings. All couplings shall be in accordance with AWWA Standard C-219 and shall be the Smith-Blair, Inc. Type Model number 411 or approved equal. The couplings shall consist of a cylindrical sleeve with conical inner surfaces at each end; resilient, wedge-shaped, specially-compounded rubber gaskets; ring-shaped followers and high-strength, low-alloy track-head, oval-neck, rolled-threaded bolts with heavy hex nuts.

4.10 Quick Disconnect Couplings. The quick disconnect couplings, as manufactured by OPW Engineering Systems Model number 633-A or approved equal, shall be installed as shown on the Drawings. The couplings shall consist of a stainless steel female adapter

with NPT threads. A stainless steel lockable dust cap, OPW Model number 634-B or approved equal, shall be provided for each adapter. A chain shall be provided with each dust cap for attachment to the side of building.

4.11 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 5 - MECHANICAL EQUIPMENT

5.1 HIGH SERVICE PUMPS (BASE BID).

5.1.1 Work Included. Under this item, the Contractor shall furnish and install the three (3) high service pumps as shown on the Drawings. The pumps shall be vertical turbine water lubricated. Each unit shall include a bowl assembly, strainer, column and open line shaft, discharge head, and a driver as shown on the Drawings and described herein.

5.1.2 Conditions of Service. The pumps shall be rated for the following flow rates and shall produce the noted total pump head including velocity head losses at the pump discharge.

FLOW RATE (GPM)	PUMP HEAD (TDH)
1000	315
1200	291
1400	260

Maximum pump speed shall not exceed 1770 RPM with the driver size limited to 125 HP. The pumps shall be that as manufactured by Flowserve Model 12ETMH, Four Stage, or approved equal. The pumps shall have an operating efficiency of 81.5%. The column size to meet AWWA Guidelines. The maximum column friction loss shall be based on 5% head loss and velocity of 5 ft/s.

5.1.3 Pump Construction.

5.1.3.1 Bowl Assembly. The pump bowl shall be of close grained cast iron having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, sand holes, and all other faults; accurately machined and fitted to close dimensions. The impeller shaft shall be of stainless steel of not less than 12% chrome content and shall be supported by bronze or neoprene bearings located on both sides of each impeller.

The impeller shall be of the enclosed type and shall be bronze, of heavy construction, accurately fitted and balanced. For shaft sizes up through 2-3/16" diameter, the impeller shall be locked securely to the impeller shaft with a tapered lock bushing. For shaft sizes above 2-3/16" they shall be secured with a thrust washer, key and snap ring. The bowls and impellers shall be designed with smooth passages to assure efficient operation. The impellers shall be adjustable by means of a top shaft adjusting nut.

5.1.3.2 Discharge Column Assembly. The total length of the discharge column shall extend from the bowl assembly to the bottom of the discharge head. The column pipe shall be not less than eight inches inside diameter. The joints are to be butted to insure perfect column alignment after assembly.

The line shafting shall be of ample size to operate the pump without distortion or vibration. The shaft shall be fitted with stainless steel replaceable sleeves. The column assembly shall have bronze guides fitted into the coupling and secured in place by the butted pipe ends. Each guide shall contain a water lubricated rubber bearing designed for vertical turbine pump service.

5.1.3.3 Discharge Head. A suitable base of high grade cast iron shall be provided for mounting the motor and with discharge elbow having above-ground flanged discharge outlet for ten inch standard pipe.

5.1.3.4 Pump Components. The components of the pump shall be constructed according to the following. The pump shaft shall be stainless steel in accordance with AISI A582 416; the shaft coupling, ASTM A108 12L14; connector bearing, bronze ASTM B505 Alloy 932; threaded discharge case, cast iron ASTM A48 Class 30; top bowl bearing, bronze ASTM B505 Alloy 932; top bowl, intermediate bowl, suction case, and threaded discharge case shall meet ASTM A48 Class 30; and impeller, bronze ASTM B584 Alloy 836.

5.1.4 Payment. Payment for the high service pumps shall be that which is subsidiary with the bid schedule.

5.2 BACKWASH PUMPS (BASE BID).

5.2.1 Work Included. Under this item, the Contractor shall furnish and install the two (2) backwash pumps as shown on the Drawings. The pumps shall be vertical turbine water lubricated. Each unit shall include a bowl assembly, strainer, column and open line shaft, discharge head, and a driver as shown on the Drawings and described herein.

5.2.2 Conditions of Service. The pumps shall be rated for the following flow rates and shall produce the noted total pump head including velocity head losses at the pump discharge.

FLOW RATE (GPM)	PUMP HEAD (TDH)
2000	38
2500	30
3000	33

Maximum pump speed shall not exceed 890 RPM with the driver size limited to 25 HP. The pumps shall be that as manufactured by Flowserve Model 18ENH, One Stage, or approved equal. The pumps shall have an operating efficiency of 77.7%. The column size to meet AWWA Guidelines. The maximum column friction loss shall be based on 5% head loss and velocity of 5 ft/s.

5.2.3 Pump Construction.

5.2.3.1 Bowl Assembly. The pump bowl shall be of close grained cast iron having a minimum tensile strength of 30,000 pounds per square inch, free from blow holes, sand holes, and all other faults; accurately machined and fitted to close dimensions. The impeller shaft shall be of stainless steel of not less than 12% chrome content and shall be supported by bronze or neoprene bearings located on both sides of each impeller.

The impeller shall be of the enclosed type and shall be bronze, of heavy construction, accurately fitted and balanced. For shaft sizes up through 2-3/16" diameter, the impeller shall be locked securely to the impeller shaft with a tapered lock bushing. For shaft sizes above 2-3/16" they shall be secured with a thrust washer, key and snap ring. The bowls and impellers shall be designed with smooth passages to assure efficient operation. The impellers shall be adjustable by means of a top shaft adjusting nut.

5.2.3.2 Discharge Column Assembly. The total length of the discharge column shall extend from the bowl assembly to the bottom of the discharge head. The column pipe shall be not less than eight inches inside diameter. The joints are to be butted to insure perfect column alignment after assembly.

The line shafting shall be of ample size to operate the pump without distortion or vibration. The shaft shall be fitted with stainless steel replaceable sleeves. The column assembly shall have bronze guides fitted into the coupling and secured in place by the butted pipe ends. Each guide shall contain a water lubricated rubber bearing designed for vertical turbine pump service.

5.2.3.3 Discharge Head. A suitable base of high grade cast iron shall be provided for mounting the motor and with discharge elbow having above-ground flanged discharge outlet for ten inch standard pipe.

5.2.3.4 Pump Components. The components of the pump shall be constructed according to the following. The pump shaft shall be stainless steel in accordance with AISI A582 416; the shaft coupling, ASTM A108 12L14; connector bearing, bronze ASTM B505 Alloy 932; threaded discharge case, cast iron ASTM A48 Class 30; top bowl bearing, bronze ASTM B505 Alloy 932; top bowl, intermediate bowl, suction case, and threaded discharge case shall meet ASTM A48 Class 30; and impeller, bronze ASTM B584 Alloy 836.

5.2.4 Payment. Payment for the backwash pumps shall be that which is subsidiary with the bid schedule.

5.3 SAMPLE PUMPS (BASE BID).

5.3.1 Water Sample Pumps. The water sample pumps shall be installed as shown on the Drawings. Each pump shall be closed coupled and have operating conditions at 3.2 GPM at 45-feet TDH. The motors shall be ¾ HP TEFC, 3600 RPM, 3 phase, 60 hertz, and 230/460 volt. The water sample pumps shall be furnished with wall mount brackets and all accessories necessary for mounting at wall locations as shown on the Drawings. The water sample pumps shall be Model 1.25X1X4 SMP as manufactured by Flowserve, or approved equal.

5.3.2 Payment. Payment for the water sample pumps shall be that which is subsidiary with the bid schedule.

5.4 WWTP ELECTROMAGNETIC FLOW METERS (ALTERNATE NO. 2).

5.4.1 Work Included. Under this item, the Contractor shall furnish and install two (2) 6-inch electromagnetic flow meters, converters/transmitters, and appurtenances as shown on the Drawings.

5.4.2 Electromagnetic Flow Meter. Flanged Magnetic Flow Meters shall be as manufactured by Flomotion Systems Inc., Model MS2500-P150-B6A2A with 304SS flow tube, or approved equal. Flow meters shall be installed on the 12-inch raw sewage lines prior to each oxidation ditch as shown on the drawings and as directed by the Engineer.

The meter shall be a velocity sensing electromagnetic type, microprocessor based signal converter, sealed housing, flanged tube meter for 300 psi working pressure, and CSA approved. The meter shall be manufactured to highest standard available for magmeters. The meter shall be a Flomotion MS2500 with a digital indicator reading in units of 100 gallons per minute and shall be accurate within 0.2% of true flow. The meter assembly shall operate within a range of 85.4 to 2,803 GPM and be constructed as follows:

Meter Tube shall be fabricated stainless steel pipe and use 150 lb AWWA Class “D” flat face steel flanges. The internal and external of the meter tube shall be blasted to near white metal and lined with 40 mils of NSF approved fusion bonded, epoxy coating, applied by the fluidized bed method. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow. Electrodes shall be 316 stainless steel.

Signal Converter/Transmitter shall be programmable 4-20mA and two selectable frequency or scaled pulse outputs. 90-264 VAC power output. The signal converter shall mount directly to the meter for ease of installation. The Converter/Transmitter shall mount directly to the meter for ease of installation. The Converter/Transmitter shall indicate direction of flow and provide a flow rate indication and a totalization of flow volume for both forward and reverse directions. Both forward and reverse totalizers shall

be electronically resettable. The microprocessor based signal converter shall have a self diagnostic test mode and a backlit display that continuously displays "Rate of Flow" and "Total Volume". The signal converter configuration parameters shall be lockout protected, but can be changed via the front panel keypad or with the use of a personal computer or electronic organizer with a 9-pin RS232 serial interface port. The Converter/Transmitter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities. The Converter/Transmitter shall be capable of remote mount of up to 300 feet from sensor, and shall be supplied in a corrosion resistant non-metallic NEMA 4X enclosure, with all calibration complete for desired requirements. Converter/Transmitter shall be supplied with a programmable low flow drop out and empty pipe zero return.

Converter/Transmitter shall be Flomotion Systems, Inc., Model ML110B0A1B0, or approved equal.

Grounding Rings shall be 316 stainless steel and shall be supplied with meter tube.

Volumetric Testing of all meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated as a unit at near minimum, intermediate, and maximum manufactures specified flow ranges of the meter. The amount of water used to conduct the test must be shown on a shipping tag attached to the meter. The test facility must be certified annually to an accuracy of 0.2% and be traceable to the National Institute of Standards and Technology.

The flow meters shall be provided with the following size for the specified application and location:

Flow Meter	**Size (inches)**
WWTP Flow Meter No. 1	6
WWTP Flow Meter No. 2	6

5.4.3 Payment. Payment for the electromagnetic flow meters and converter/transmitters shall be that which is subsidiary with the bid schedule.

5.5 PRISON ELECTROMAGNETIC FLOW METER (ALTERNATE NO. 4).

5.5.1 Work Included. Under this item, the Contractor shall furnish and install one (1) 12-inch electromagnetic flow meter, converters/transmitter, and appurtenances at the Federal Prison entrance as shown on the Drawings.

5.5.2 Electromagnetic Flow Meter. Flanged Magnetic Flow Meters shall be as manufactured by Flomotion Systems Inc., Model MS2500 with 304SS flow tube, or approved equal. Flow meters shall be installed on the 12-inch finished water line prior to

the entrance of the Federal Prison as shown on the drawings and as directed by the Engineer.

The meter shall be a velocity sensing electromagnetic type, microprocessor based signal converter, sealed housing, flanged tube meter for 300 psi working pressure, and CSA approved. The meter shall be manufactured to highest standard available for magmeters. The meter shall be a Flomotion MS2500 with a digital indicator reading in units of 100 gallons per minute and shall be accurate within 0.2% of true flow. The meter assembly shall operate within a range of 85.4 to 2,803 GPM and be constructed as follows:

Meter Tube shall be fabricated stainless steel pipe and use 150 lb AWWA Class "D" flat face steel flanges. The internal and external of the meter tube shall be blasted to near white metal and lined with 40 mils of NSF approved fusion bonded, epoxy coating, applied by the fluidized bed method. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow. Electrodes shall be 316 stainless steel.

Signal Converter/Transmitter shall be programmable 4-20mA and two selectable frequency or scaled pulse outputs. 90-264 VAC power output. The signal converter shall mount directly to the meter for ease of installation. The Converter/Transmitter shall mount directly to the meter for ease of installation. The Converter/Transmitter shall indicate direction of flow and provide a flow rate indication and a totalization of flow volume for both forward and reverse directions. Both forward and reverse totalizers shall be electronically resettable. The microprocessor based signal converter shall have a self diagnostic test mode and a backlit display that continuously displays "Rate of Flow" and "Total Volume". The signal converter configuration parameters shall be lockout protected, but can be changed via the front panel keypad or with the use of a personal computer or electronic organizer with a 9-pin RS232 serial interface port. The Converter/Transmitter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities. The Converter/Transmitter shall be capable of remote mount of up to 300 feet from sensor, and shall be supplied in a corrosion resistant non-metallic NEMA 4X enclosure, with all calibration complete for desired requirements. Converter/Transmitter shall be supplied with a programmable low flow drop out and empty pipe zero return.

Converter/Transmitter shall be Flomotion Systems, Inc., Model ML110B0A1B0, or approved equal.

Grounding Rings shall be 316 stainless steel and shall be supplied with meter tube.

Volumetric Testing of all meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated as a unit at near minimum, intermediate, and maximum manufactures specified flow ranges of the meter. The amount of water used to conduct the test must be shown on a shipping tag attached to the meter. The test facility must be certified annually to an accuracy of 0.2% and be traceable to the National Institute of Standards and Technology.

The flow meters shall be provided with the following size for the specified application and location:

Flow Meter	**Size (inches)**
Prison Flow Meter No. 1	12

5.5.3 Payment. Payment for the electromagnetic flow meter and converter/transmitter shall be that which is subsidiary with the bid schedule.

5.6 CHEMICAL TRANSFER PUMPS (ALTERNATE NO. 2).

5.6.1 Work Included. Under this item, the Contractor shall furnish and install two (2) chemical transfer pumps for caustic soda, pulsation dampeners, and appurtenances as shown on the Drawings.

5.6.2 Transfer Pumps. Transfer pumps shall be peristaltic type pumps with a heavy-duty modular design suitable for 24-hr/day operation.

1. Process Conditions

Pump Model	*Flomotion Sysytems, Inc. ALP45*
Quantity	*Two*
Tag Number	*Transfer Bulk*
Fluid Being Metered	*Caustic Soda*
Viscosity (cps)	*Specify*
Specific Gravity	*Specify*
Tubing Material	*Fiber Braided EPDM*
Max – Min Capacity	*20 GPM / 40 GPM*
Pump RPM Range	*40 – 1800 RPM*
Max Flow Rate (GPH)	*20 GPM*
Fittings	*Peristaltic Tubing Specific – 2"NPT*
Discharge Pressure (PSI)	*45-PSI Max.*
Power Input	*230/460vac, 3ø, 60hz*

2. Pump
   a. Horizontal, positive displacement, peristaltic hose pump.
   b. Capable of operating in either direction, reversible.
   c. Capable of running dry without damage.
   d. No valves, mechanical seals, or packing.
   e. Pump shall have rollers with sealed bearings that contact the hose.

f. Pump capable of rotating 180 degrees for two different mounting positions.
g. Pump must be capable of lubrication by food-grade non-petroleum grease or 90% glycerin & 10% glycol blend of hose lubricant.

3. Hose
   a. Hose shall be manufactured specifically for peristaltic pump service, fiber braided EPDM as Specified for extended hose life.
   b. Hose replacement shall be accomplished without pump removal.
   c. Hose clamps shall be stainless steel.

4. Pump Casing and Support Frame
   a. Pump housing shall be constructed of aluminum or cast iron.
   b. Pump rotor shall be constructed of aluminum.
   c. Pump rollers shall be constructed of aluminum.
   d. Support frame shall be constructed of steel.
   e. Pump casing, rotor, frame painted with industrial grade paint.
   f. Rotor is mounted on a keyed gearbox shaft.
   g. Front window sized accordingly to view rotation.

5. Connector
   a. As specified by Pump Specification.

6. Pump Drive
   a. Gearbox will be mounted directly to pump casing.
   b. Gearbox shaft is stepped for easily rotor alignment.
   c. Gearbox will be manufactured by SEW Eurodrive.
   d. Gearbox will be lubricated prior to shipment.
   e. Motor will be TEFC, 3 Phase, 230/460v, 4 pole, 60 Hz, Inverter Duty (100:1 turndown) unless otherwise specified in the Pump Specification.

7. Speed Controller
   a. Controller shall be remote wall mount and housed in a NEMA 4X enclosure.
   b. Controller shall have an integral 6-button keypad and display.
   c. Controller can be operated in manual or automatic mode via 4-20mA input. In automatic mode the speed range shall have the capability of being optimized to the input signal.
   c. Controller shall have the capability to accept a contact closure from an optional tubing rupture detector. The capability of starting a back-up pump shall also be provided.
   e. The controller shall have an integral run timer to monitor tubing life.
   f. The controller shall have the following additional input and output

functions:

1. 4-20mA or 0-10VDC speed reference - output
2. Fault - output
3. Loss of input signal - output
4. Run/Stop - output

g. Controller shall have password protection to prevent unauthorized programming changes.

h. Controller power input 115/230VAC Single Phase or 230 VAC Three Phase.

8. Manufacturer.

a. Transfer pumps shall be as manufactured by Flomotion Systems, Inc., Model ALP45, or approved equal.

9. Pulsation Dampener.

a. Epoxy coated steel housing.

b. EPDM bladder with 2-inch ANSI 150# 304SS flanges with PPY inserts.

c. Pressure gauge and charging valve assembly shall be provided.

d. Pulsation dampener shall be as manufactured by Flomotion Systems, Inc., Model ALHP40, or approved equal.

5.6.3 Payment. Payment for the chemical transfer pumps and dampeners shall be that which is subsidiary with the bid schedule.

SECTION 6 - BUILDINGS

6.0 Work Included. The Contractor shall provide all work for furnishing, installing and constructing the buildings as shown and specified. This shall include but not limited to the following:

- WTP No. 1 High Service/Backwash Pump Building (BASE BID)
- WWTP Chemical Storage Building (ALTERNATE NO. 2)

6.1 Unit Masonry.

6.1.1 Scope of Work. Furnish all labor, materials, and equipment required to construct and install unit masonry for structures as shown on the Drawings and specified herein.

6.1.2 Quality Assurance for Fire Resistance. Where fire-resistance ratings are indicated for unit masonry work, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by a recognized testing and inspecting organization or by another means, as acceptable to the authority having jurisdiction.

6.1.3 Submittals. The Contractor shall submit to the Engineer manufacturer's product data for each type of masonry unit, caulking compound, accessory, and other manufactured products, including certifications that each type complies with specified requirements.

The Contractor shall submit to the Engineer for verification purposes, samples of each exposed masonry unit. Include in each set of samples the full range of exposed textures to be expected in the completed work. For initial selection of exposed masonry units submit samples showing full range of textures available.

6.1.4 Concrete Block. Blocks shall be of nominal dimensions and shapes as shown on the Drawings. They shall have actual dimensions 3/8-inch less than nominal dimensions to allow for width of joints. Interior blocks shall be regular units, with smooth faces on both sides.

Special blocks shall be used at bond beams, corners and junctions, and about windows and doors.

Blocks shall be made of Portland Cement, Ohio River Sand or clean crushed limestone fine aggregate and crushed limestone.

Blocks shall meet the requirements of the Standard Specifications for Hollow-Load-Bearing Concrete Masonry Units, ASTM Designation C 90, Grade N, Type 1, normal-weight.
Except as specified under Article 9, "Rejection", of ASTM Designation C 90, the expense of inspection and testing shall be borne by the Owner.

6.1.5 Mortar Materials.

Portland Cement: Any standard brand conforming to ASTM Specification C 150, same as specified for concrete.

Masonry Cement: Any standard brand conforming to ASTM C 91.

Lime: Hydrated lime must be at least 92 percent hydrated, conforming to ASTM Standard C 207.

Sand: First quality clean natural Kentucky or Ohio River Sand. When dry 100 percent shall pass a No. 8 sieve and not more than 35 percent shall pass a No. 50 sieve, and conforming to ASTM Standard Specification C 144.

6.1.6 Metal Ties and Anchors. Masonry wall steel wire reinforcement shall consist of Cavity-Lok, Block-Lok, Rectangular Ties and "Z" Bars as manufactured by AA Wire Products Company, Dur-O-Wal, Inc. or equal.

Block-Lok shall have 2 galvanized (ASTM A641, Class 3) side rods and galvanized (ASTM A153, Class B-2), flush welded, cross ties spaced not greater than 16 inches on centers as follows:

	Heavy Duty	Standard	Spec. Standard	Extra Heavy Duty
Knurled Side Rods	3/16" Dia.	8 Ga. Galv.	3/16" Dia.	
Cross Ties	9 Ga.	9 Ga.	9 Ga. Galv.	3/16" Dia.

Rectangular Ties shall be not dipped galvanized (ASTM A153, Class B-2) after fabrication, 3/16" diameter by 4 inches wide, without moisture drip.

Dovetail Anchor Slots shall be 24-gauge galvanized (ASTM A153, Class B-2) steel with 1-inch wide by 1-inch deep by 5/8-inch throat equal to AA Wire Products Company AA100. Dovetail Anchors shall be 1-inch wide, 12-gauge galvanized (ASTM A153, Class B-2) steel and corrugated. Length shall be sufficient to extend from face of concrete, through joint, to within 5/8 inch of masonry face except for partition walls where length shall be 5 1/2 inches from face of concrete to end of anchor.

6.1.7 Caulking Compound and Accessories. Caulking compound shall be Sonolastic NP1 or NP2 as manufactured by Sonneborn-Contech Inc. or equivalent by W. R. Grace Co. Color shall be light gray throughout unless noted on Drawings.

For water immersion, prime with Sonneborn-Contech Primer No. 733 for concrete and masonry, and Primer No. 758 for glass and metals.

Where additional sealant backing is needed to control the depth of sealant in relation to joint width. Use Sonneborn Sonofoam Backer-Rod (closed cell polyethylene foam) equivalent W.R. Grace Co. products, or equal.

6.1.8 Window Sills and Copings. Type of windows, sills and copings shall be shown on Drawings.

Cut stone window sills and copings shall be standard quality Indiana Limestone of fine to medium texture, free from defects marring appearance. Color shall be gray selected to eliminate a spotty appearance and to obtain even distribution of texture and color. Exposed surfaces shall have a Standard Machine Smooth Finish.

Precast concrete window sills and copings shall be top quality units of fine to medium texture, free from defects marring appearance. Color shall be gray. Exposed surfaces shall have a smooth stonelike finish.

Sills and copings shall be cut and/or cast accurately to shape and dimensions with joints and bonding as shown on the Drawings. Exposed faces shall be straight and true with sharp lines and arises. Beds and joints shall be straight and at right angles to face. Make joints 1/4 inch wide unless otherwise shown on Drawings. All sills and copings shall have drip grooves.

Exterior sills, copings and similar units with exposed top surfaces shall be cut or cast with a wash. Provide raised fillets at back of window sills. Provide holes and sinkages for all anchors and dowels as required. Provide Lewis holes for all units requiring metal anchorage. Locate holes at least two inches from any soffit or exposed face. Anchors and bolts shall be steel or wrought iron, hot zinc-coated after fabrication.

6.1.9 Mortar. Mortar shall be in accordance with the Property Specifications, ASTM Designation C 270. Unless otherwise indicated on the Drawings, mortar shall be Type M, which shall be proportioned by volume, 1 part Portland Cement, 1 part masonry cement and not less than 4 1/2 parts nor more than 6 parts sand measured in a damp loose condition (80 pounds per cubic foot, dry basis), or 1 part Portland Cement, 1/4 part hydrated lime, and not less than 2 3/4 parts nor more than 3 3/4 parts sand measured in a damp loose condition. Sand shall be adjusted to obtain specified strength. All mortar shall be used within two hours after mixing.

The Contractor shall have on the job and use adequate and accurate equipment for obtaining required proportions by volume and cement, sand, and lime in the mortar.

Mortar shall not be used after initial set.

The mortar shall be thoroughly mixed, and only in such quantity as is needed for immediate use. Mortar shall be mixed with a maximum amount of water consistent with satisfactory workability for the mason. Overwetting of mixes shall not be permitted. Only machine mixing shall be used, except for small jobs when hand mixing is specifically authorized by the Engineer.

For machine mixing, while the mixer is in operation, the mortar materials shall be batched in the following order. Add approximately 3/4 of the required water, 1/2 the sand, all of the cement, then the remainder of the sand. Allow the batch to mix briefly and then add water in small quantities until satisfactory workability for the mason is attained. Caution is urged to avoid overwetting of the mix. The mortar shall then be mixed a minimum time of 5 minutes after all materials have been added. The mixer drum shall be completely empty before recharging next batch.

For hand mixing, the cement and sand shall be thoroughly mixed in the following manner, before water is added: Spread the sand in the box, spread the cement on top of the sand and mix well with hoe from both ends of the box. Add about 3/4 of the required water and mix until all materials are uniformly damp. Add water in small amounts and continue mixing until satisfactory workability for the mason is attained. Allow the batch to stand approximately 5 minutes and remix thoroughly with the hoe, without additional water.

The mortar shall contain as much water as it can possibly carry and still provide satisfactory workability for the mason at the time the masonry unit is laid in the wall. It shall be retempered on the board as necessary to maintain this consistency. Retempering of the mortar in the mortar box shall not be permitted. Overwetting mixes to reduce tempering time, or excessive retempering with continual additions of water, tend to weaken paste. The size of batches should be limited to avoid this requirement.

In cold weather, sand and water shall be heated sufficiently to maintain the temperature of mortar when used to above 50 degrees Fahrenheit.

Antifreeze compounds to lower the freezing point of mortar shall not be used. Accelerators or other admixtures shall not be permitted without acceptance of the Engineer.

6.1.10 Concrete Block Construction. Walls shall be laid up with blocks and with thickness as shown on the Drawings. Concrete block shall be laid in a running bond pattern. Grouted construction, reinforced construction, control joints, expansion joints, roof anchors, and other special construction shall be as shown on the Drawings.

Masonry reinforcement shall be as hereinafter specified.

Block shall be delivered hand stacked or in original packages. In unloading, they must be carefully handled in the same manner, hand stacked or "ricked" on boards. Throwing or dumping of block or any handling as to cause chipping or otherwise marring of corners or edges will not be permitted.

Handle and store materials off the ground in such manner as to prevent damage or intrusion of foreign matter. All masonry units shall be covered. Store concrete units under a cover that permits circulation of air without excessive moisture absorption. Store cement, lime, gypsum and air setting mortars in tight sheds with elevated floors.

All masonry units shall be laid plumb, level and true to line in full bed of mortar. Lay out all face coursing in advance vertically and horizontally for placing doors, windows, and structural steel to minimize cutting closures or jumping bond. All head joints and bed joints shall be completely full of mortar. Mortar for the bed joints shall be spread thick, and the furrow in the mortar shall be shallow, not deep. Mortar spread on the wall shall be limited to that which can be covered before the surface of the mortar has begun to dry. Ample mortar for the head joint shall be placed on the end of each unit to insure a full joint when the unit is shoved into place. Enough mortar shall be used to cause mortar to ooze out on both sides of the head joint and bed joint. Slushing is not permitted. Units shall be adjusted to the line immediately when first set into the wall, and they shall not be moved thereafter unless relaid in fresh mortar.

All joints shall be of uniform thickness, approximately 3/8 inch. All exterior joints shall be cut flush. As the mortar takes its initial set (when the mortar requires pressure to make a print with the thumb), they shall be tooled to provide a concave surface. A tool approximately twice the diameter of the joint shall be used. All masons must use jointing tools of the same size. Head joints shall be tooled first. Sufficient pressure shall be applied during the tooling of the joints to compact the mortar firmly against the units and provide a neat smooth weathertight joint. Exposed interior masonry work shall have neatly tooled concave joints made with same size tool used on exterior joints.

Where cutting concrete block is necessary, use motor-driven carborundum or diamond saw or other method to produce clean cut edges. Do all necessary cutting to accommodate installation of electric outlets, conduits, plumbing fixtures, pipes, brackets, and bathroom accessories. Block with chipped or irregular cut surfaces will not be accepted.

Protect concrete block facing against staining. When work is not in progress, all unfinished masonry shall be covered with a weighted down, nonstaining, waterproofed material or canvas to overhang the wall at least two feet. When work is resumed, top surface of work shall be cleaned of all loose mortar and, in drying weather, thoroughly wetted. Concrete units shall be cleaned but not wetted.

No masonry shall be laid when the temperature is below 32 degrees Fahrenheit on a rising thermometer or below 40 degrees Fahrenheit on a falling thermometer, unless adequate precaution against freezing is provided. No masonry shall be constructed on or with frozen materials. All masonry units stored in the open or stacked near the mortar boards shall be covered with canvas or waterproofed material to prevent excessive wetting when freezing is expected. In cold weather, masonry shall be protected against freezing for at least 48 hours after being laid with the temperature on both sides of the wall maintained above 40 degrees Fahrenheit.

Point and fill all holes and cracks in exposed joints with additional fresh mortar. If the mortar has hardened, defects shall be chiseled out, wetted and refilled solidly with fresh mortar and tooled as specified.

Clean exposed masonry surfaces thoroughly from top down, to remove stains and mortar deposited during construction. Cleaning with soap powder or other mild solutions shall not be attempted in less than 48 hours after the construction of the wall.

Concrete block masonry walls shall be cleaned in strict accordance with the recommendations of the National Concrete Masonry Association.

6.1.11 Reinforcement. Use reinforcement at control joints as shown on the Drawings.

Anchor block to adjacent columns and beams with dovetail anchors 24 inches O.C. horizontally and 16 inches O.C. vertically unless otherwise required or shown.

6.1.12 Installation of Caulking Compounds and Accessories. Caulking compound shall completely seal all joints around frames and sills of doors, windows and other openings in masonry and concrete walls, and all other joints or spaces noted on the Drawings to be caulked. Set door thresholds in full bed of caulking compound. All caulking compound, primer and joint filler shall be installed in strict accordance with the manufacturer's printed instructions, which shall be available at the job site. Refer to Division 3 for special joint requirements in connection with precast and prestressed structural concrete members.

All joint surfaces must be dry, thoroughly clean and primed as recommended by the caulking manufacturer. Apply primer with a brush or clean cloth in sufficient amount to obtain 100 percent coverage. Best results are obtained when primer is applied in a thin coat for most surfaces; however, porous surfaces require a somewhat heavier but not excessive coat. Allow primer to dry for the recommended period before applying sealant.

The depth of sealant shall be 1/2 the width of the joint, with a maximum depth of 1/2 inches and a minimum of 1/4 inches. Joint depths exceeding this design criteria should be filled to the proper depth using a joint filler or backup material such as a backer-rod,

which should be about 1/8 inch larger in diameter than the width of the joint to allow for compression. Where the joint is too small to permit a backer-rod, a polyethylene film strip must be used to prevent the sealant bonding to joint filler.

Caulking can be applied with a bulk or air powered caulking gun. See manufacturer's recommendations for minimum temperature at which caulking can be applied.

See manufacturer's instructions for application to masonry, metal, glass and wood.

Remove excess caulking and leave surface neat, smooth and clean. All caulked joints shall be watertight.

6.1.13 Installing Window Sills and Copings. Units shall be set by experienced masons to produce a first class job. Thoroughly clean units, then sponge with clean water just before setting; when setting in cold weather, clean by brushing instead of sponging.

Set each stone plumb, level and true to line in a full bed of mortar and tap to even bearing. Sawing through mortar joints to correct bearing or adjust joint will not be permitted.

Soft wood wedges soaked in water, may be used where necessary to prevent crushing of mortar; wedges must be removed when dry and before pointing. Keep face of units free from mortar.

Brush joints clean, carefully remove any wedges so that pointing will be continuous; after thorough wetting, point all joints (except those specified to be left open or caulked) flush with pointing mortar. Leave building expansion joints open except where shown on the Drawings to be filled. No pointing shall be done when temperature is below 35 degrees Fahrenheit.

After completion of setting, all units shall be thoroughly cleaned by scrubbing with brushes and soap power or other suitable cleaning compound or by the application of steam. Cleaning compounds shall not contain acid or other ingredients that will injure units. Cleaning shall begin at top and continue down face of building. Upon completion, leave units clean and free from mortar, stain and traces of cleaning compound and with all joints pointed.

Protect offsets and sills with covering until completion of masonry work. Use galvanized nails to prevent rust stains. Protect other work as necessary to prevent damage. Replace damaged or defective units.

Prepare and submit fabrication and setting drawings to the Engineer; do not fabricate units until Drawings have been accepted. Drawings shall show jointing, bonding, connection with other work, typical and special anchoring dimensions and setting number

of each unit. Each piece, when delivered, shall have corresponding setting number marked on back or unexposed edge.

6.1.14 Built-In Work. Consult other trades in advance and make provisions for installation of their work in order to avoid cutting and patching. Built-in work specified under other sections of the Specifications is to be installed as the work progresses.

Set sills and copings and steel lintels in beds of mortar unless otherwise shown on Drawings. Fill jambs and heads of metal door frames solid with mortar. Caulk around all sides of metal window, curtain wall, and door frames.

6.2 Reinforced Unit Masonry.

6.2.1 Related Documents. Drawings and General Provisions of Contract, including the General Conditions, Supplementary General Conditions, Special Conditions, and Division 1 Specification Sections, apply to this section.

Requirements of Section "Unit Masonry" apply to work of this section.

6.2.2 Description of Work. Extent of each type of reinforced unit masonry work is indicated on Drawings and in Schedules.

6.2.3 Submittals. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of reinforcement bars. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.

6.2.4 Materials. General: Refer to Section "Unit Masonry" for masonry materials and accessories not included in this Section.

Reinforcement Bars: Provide deformed bars of following grades complying with ASTM A 615, except as otherwise indicated.

Provide Grade 60. Deformed Steel.

Shop-fabricate reinforcement bars which are shown to be bent or hooked.

6.2.5 Placing Reinforcement. General: Clean reinforcement of loose rust, mill scale, earth, ice or other materials which will reduce bond to mortar or grout. Do not use reinforcement bars with kinks or bends not shown on Drawings or Final Shop Drawings, or bars with reduced cross-section due to excessive rusting or other causes.

Position reinforcement accurately at the spacing indicated. Support and secure vertical bars against displacement. Horizontal reinforcement may be placed as the masonry work

progresses. Where vertical bars are shown in close proximity, provide a clear distance between bars of not less than the nominal bar diameter or 1" (whichever is greater).

Splice reinforcement bars where shown; do not splice at other points unless acceptable to the Engineer. Provide lapped slices, unless otherwise indicated. In splicing vertical bars or attaching to dowels, lap ends, place in contact and wire tie.

Provide not less than minimum lap indicated, or if not indicated, as required by governing code.

Embed prefabricated horizontal joint reinforcement as the work progresses, with a minimum cover of 5/8" or exterior face of walls and 1/2" at other locations. Lap units not less than 6" at ends. Use prefabricated "L" and "T" units to provide continuity at corners and intersections. Cut and bend units as recommended by manufacturer for continuity at returns, offsets, column fire-proofing, pipe enclosures and other special conditions.

Anchoring: Anchor reinforced masonry work to supporting structure as indicated.

Anchor reinforced masonry walls to non-reinforced masonry where they intersect.

6.2.6 Installation, General. Refer to Section "Unit Masonry" for general installation requirements of unit masonry.

6.2.7 Installation of Reinforced Concrete Unit Masonry. Pattern Bond: Lay CMU wall units in 1/2-running bond with vertical joints in each course centered on units in courses above and below, unless otherwise indicated. Bond and interlock each course at corners and intersections. Use special-shaped units where shown, and as required for corners, jambs, sash, control joints, lintels, bond beams and other special conditions.

Maintain vertical continuity of core or cell cavities, which are to be reinforced and grouted, to provide minimum clear dimension indicated and to provide minimum clearance and grout coverage for vertical reinforcement bars. Keep cavities free of mortar. Solidly bed webs in mortar where adjacent to reinforced cores or cells.

Where horizontal reinforced beams (bond beams) are shown, use special units or modify regular units to allow for placement of continuous horizontal reinforcement bars. Place small mesh expanded metal lath or wire screening in mortar joints under bond beam courses over cores or cells of non-reinforced vertical cells, or provide units with solid bottoms.

Use Grout Mix as indicated on Structural Drawings.

Use "Coarse Grout" per ASTM C 476 for filling 4" spaces or larger in both horizontal directions.

Grouting Technique: Use low-lift grouting techniques subject to requirements which follow.

Provide minimum clear dimension of 1" and clear area of 8 sq. in. in vertical cores to be grouted.

Place vertical reinforcement prior to laying of CMU. Extend above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 64 bar diameters nor 4 ft.

Lay CMU to maximum pour height. Do not excess 4' height or if bond beam occurs below 4' height stop pour at course below bond beam.

Pour grout using chute or container with spout. Rod or vibrate grout during placing. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate grout pours 1-1/2" below top course of pour.

Bond Beams: Stop grout in vertical cells 1-1/2" below bond beam course. Place horizontal reinforcing in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beam.

6.3 Brickwork

6.3.1 Scope. This Section includes brickwork and other related items necessary to complete the project.

6.3.2 Samples. Lay up, where directed at site, sample panel, four (4) feet by four (4) feet, using full range of brick proposed for facing for approval.

6.3.3 Materials.

a.	Facing Brick:	Shall be approved by the Owner and/or as directed by the Engineer.
b.	Common Brick:	ASTM C 62-62
c.	Portland Cement:	ASTM C 150-66 Type 1
d.	Masonry Cement:	ASTM C 91-66
e.	Sand:	ASTM C 144-66T, Natural
f.	Water:	Free from matter that could impair suitability for use in mortar.
g.	Hydrated Lime:	ASTM C 207-49 Type S
h.	Wall Reinforcing:	Dur-O-Wal, trussed Type.
i.	Cleaning Agent:	"Sure-Klean", suited to kind and color of brick.

6.3.4 Mortar.

a. For work below grade, use mortar composed of one part portland cement, ¼ part hydrated lime and three parts sand, by volume. Optional use, one part portland cement, one part masonry cement, and six parts sand by volume. Measure sand damp and loose.
b. For work above grade, use mortar composed of one part portland cement, one part hydrated lime and six parts sand, by volume. Optional use, one part masonry cement, and three parts sand by volume.
c. Mix materials mechanically for not less than five minutes after all ingredients are in mixer.

6.3.5 Laying Brick.

a. Lay brick plumb, level, true to line in running bond or as indicated. Align on exposed face.
b. Finish joints flush that will not be exposed in finish work. Finish joints, that will remain exposed with 24 inch sled runner. Tool vertical joints first. Lay three courses to approximately eight inches vertically, using joints of uniform size.
c. Lay brick in full bed of mortar with head and edge joints completely filled.
d. Lay out courses to minimize cutting and avoid jumping bond.
e. Build in indicated flashing as work progresses.
f. Provide weep holes, approximately four feet on centers, in horizontal courses approximately eight inches above finish grade. Keep weep holes free from mortar.
g. Air space between brick and inside wall kept free of excess mortar by means of a wood strip.

6.3.6 Reinforcing. Reinforce brick with Dur-O-Wal from back up wall or use dovetail anchor if adjacent to concrete, at sixteen (16) inches vertically and twenty-four (24) inches horizontal.

6.3.7 Chases and Embedded Items. Build in flashing, sleeves, clips chases and accessories as work progresses.

6.3.8 Protection.

a. Do not lay brick work when temperature is below 40° F. Do not use frozen or ice covered materials.
b. Cover top of walls at end of day's work.
c. Provide for heating and protecting brickwork from freezing.

6.3.9 Cleaning.

a. Keep face of brick free from excess mortar while laying bricks. Brush brickwork with dry fiber brush as soon as is practicable after laying. Remove adhered matter.
b. Clean brickwork with fiber brushes and clear water or cleaning agent. Use cleaning agent according to manufacturer's recommendations.

6.3.10 Control Joints. Contractor shall provide control joints at locations as recommended by the brick manufacturer.

6.4 Shingle Roof System. The asphalt shingle roof shall be Oakridge® PRO 30 AR fiber glass-based asphalt shingles as manufactured by Owens Corning or approved equal. The Contractor shall install the asphalt shingles in accordance to the manufacturer's published specifications. The asphalt shingles shall be in compliance with the minimum requirements of the following performance tests: ASTM D 3018 Type I – Standard Specification for Class A Shingles Surfaced with Mineral Granules, ASTM D 3161 – Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method), ASTM D 3462 – Standard Specification for Asphalt Shingles made from Glass Felt and Surfaced with Mineral Granules, ASTM D 4586 – Standard Specification for Asphalt Roof Cement, Asbestos-Free, and ASTM E 108 Class A – Standard Test Methods for Fire Tests of Roof Coverings. Shingles shall carry Underwriter's Laboratories Labels: UL® 790, Class A Fire Resistance; UL® 997, Wind Resistance; and ASTM D 3462. Color samples shall be submitted for Owner's selection.

6.4.1 Roof Shingle Warranty. The roofing shingles shall have a thirty (30) year Limited Warranty.

6.5 Fabricated Wood Trusses.

6.5.1 Work Included. Contractor shall provide labor, material, equipment and services necessary to furnish and install fabricated wood trusses and sheathing as indicated on Drawings and specified.

6.5.2 Quality Assurance. Fabricator's Qualifications: Minimum of three years experience in successful fabrication of trusses comparable to type indicated for this project. Acceptable manufacturer - Bluegrass Truss Company or approved equal.

6.5.3 References. Truss Design Standard: Design specification for metal plate connected wood trusses published by Truss Plate Institute (TPI).

Wood Structural Design Standard: National design specification for wood construction published by NFPA.

Grading of Lumber: Provide lumber graded by a recognized agency, with rules and service complying with requirements of American Lumber Standards Committee (ALSC) and PS 20. Use only lumber pieces which bear inspection service's grade mark.

Truss Fabrication Standard: Quality control manual published by Truss Plate Institute.

6.5.4 Submittals. Product Data: Submit fabricator's specifications and installation instructions for work, covering lumber, metal plates, hardware, fabrication process, treatment (if any), handling and erection.

Submit certification, signed by an officer of fabricating firm, indicating that trusses to be supplied comply with indicated design requirements.

Shop Drawings: Submit shop drawings showing species, sizes and stress grades of lumber to be used; pitch, span, camber configuration, bracing and bridging as recommended by TPI, and spacing for each type of truss required; type, size, material, finish, design value and location of metal connector plates and bearing and anchorage details.

To the extend engineering design considerations are indicated as fabricator's responsibility, submit design analysis and test reports indicating loading, section modulus, assumed allowable stress, stress diagrams, calculations and similar information needed for analysis and to ensure that trusses comply with requirements.

Provide shop drawings which have been signed and stamped by a structural engineer licensed to practice in the State of Kentucky.

Shop drawings shall be submitted to Engineer for review prior to fabrication.

6.5.5 Delivery, Storage, Handling. Handle and store trusses with care and in accordance with manufacturer's instructions and TPI recommendations to avoid damage from bending, overturning or other cause for which truss is not designed to resist or endure.

Time delivery and erection of trusses to avoid extended on site storage and to avoid delaying work of other trades whose work must follow erection of trusses.

6.5.6 Design Requirements. Trusses shall be designed to meet the live and dead loads specified plus dead weight of truss. Refer to structural drawing notes for loadings.

6.5.7 Dimension Lumber. Provide sizes as required by ALSC PS 20 for dressed dimension lumber, S4S, unless otherwise indicated.

Provide seasoned lumber with 19 percent maximum moisture content at time of dressing.

Lumber Species: Any softwood, at fabricator's option, as required to comply with other requirements.

Grade: Any grade of lumber fulfilling requirements indicated for species, stress ratings and moisture content.

Stress Rating: Provide lumber which has been graded or tested and certified at indicated moisture content, to be in compliance with stress ratings higher than that caused by maximum design loading.

6.5.8 Metal Connector Plates, Fasteners and Anchorages. Connector Plate Material: Metal complying with following requirements, unless otherwise indicated; not less than 0.036 inch thick, coated thickness.

Galvanized sheet steel: ASTM A446, Grade A, Coating G60.

6.5.9 Fasteners and Anchorage. Provide size, type, material and finish indicated, complying applicable federal specifications for nails, screws, bolts, nuts, washers and anchoring devices.

6.5.10 Fabrication. Cut truss members to accurate lengths, angles and sizes to produce close fitting joints with proper wood to wood bearing in assembled units.

Fabricate metal connector plates to proper size, configuration, thickness and anchorage details required for types of joint designs indicated.

Assemble truss members in design configuration indicated using jigs or other means to ensure uniformity and accuracy of assembly with close fitting joints. Position members to produce design camber indicated.

Connect truss members by means of metal connector plates accurately located and securely fastened to wood members by means indicated or approved.

6.5.11 Erection. Erect and brace trusses to comply with recommendations of manufacturer and the Truss Plate Institute.

Erect trusses with plane of truss webs vertical (plumb) and parallel to each other, located accurately 24 inches center to center unless noted otherwise on Drawings.

Hoist units in place by means of proper lifting equipment suited to sizes and types of trusses required, applied at proper lift points as recommended by fabricator, exercising care not to damage truss member joints by out-of-plane bending or other causes.

Provide temporary bracing as required to maintain trusses plumb, parallel and in proper location, until permanent bracing is installed as recommended by TPI.

Anchor trusses securely at all bearing points to comply with methods and details indicated by truss fabricator.

Install permanent bracing and related components to enable trusses to maintain design spacing, withstand live and dead loads including lateral loads, and to comply with other indicated requirements.

Do not cut or remove truss members.

6.6 Roof Plywood Sheathing. Plywoods shall be products of U.S. Plywood Corporation, Georgia-Pacific, or approved equal. Each panel shall be identified with appropriate trademark of the American Plywood Association, and shall meet the requirements of the latest edition of U.S. Product Standard PS1 or one of APA Performance Standard. Panel thickness, grade, and group number or span rating shall be at least to that shown on the Drawings. Application shall be in accordance with recommendations of American Plywood Association.

Panel roof sheathing shall be APA Structural I Rated Sheathing Exposure 1. Sheathing permanently exposed to weather shall be classified "Exterior". Wood blocking shall be provided at panel side edges. Maximum nailing pattern shall be 6" O.C. along boundary edges and 12" O.C. along intermediate framing members, unless indicated otherwise. Connections shall be 8d galvanized nails minimum.

6.7 Windows. All windows shall be Traco TR-600 Series Horizontal Slider Windows as manufactured by Traco Manufacturing, Warrendale, Pennsylvania or approved equal, sizes are noted on drawings. All materials and labor shall be included for the complete installation of the windows as shown on the drawings. The windows shall have thermal block built into frame to prohibit heat transmission, 3/4" dual sealed, double strength insulation glass, continuous spacer, double seal consisting of polyisobutylene and silicone, triple interlock, double weather-stripping, a lock and they shall have a clear anodized finish. All windows shall be delivered to the construction site packaged and protected from the weather and stacked vertically until ready for use. Installation shall be in accordance with the manufacturer's recommendations. All windows shall be set with aluminum trim to match the windows and caulked to prevent weather penetration. Windows frames shall have mounting fins for installation into masonry walls.

6.8 Steel Doors and Frames.

6.8.1 REFERENCES

- ASTM A591 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hop-Dip Process

- ASTM A568 - Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

- ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- ASTM A1011 - Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
- ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
- ANSI/SDI A250.6 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- ANSI/SDI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 1998.
- ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames (Formerly SDI-105).
- DHI A115.1G - Installation Guide for Doors and Hardware.
- SDI 111 - Recommended Standard Details for Steel Doors & Frames.
- ANSI/NFPA 252 - Fire Tests of Door Assemblies.
- ANSI/UL 10B - Fire Tests of Door Assemblies.
- ANSI/UL 10C - Positive Pressure Fire Tests of Door Assemblies.
- ANSI/UL 1784 - Air Leakage Tests of Door Assemblies
- UL - Building Materials Directory; Underwriters Laboratories Inc.
- WH - Certification Listings; Warnock Hersey International Inc.
- NFPA 80 - Fire Doors and Fire Windows.

6.8.2 SUBMITTALS

1. Submit manufacturer's data sheets on each product to be used, including:
    - Preparation instructions and recommendations.
    - Storage and handling requirements and recommendations.
    - Installation methods.

2. Certificates:
    - Provide manufacturer's certification that products comply with referenced standards as applicable.

3. Shop Drawings:
    - Show all openings in the door schedule and/or the Drawings.
    - Provide details of door design, door construction details and methods of assembling sections, hardware locations, anchorage and fastening methods, door frame types and details, anchor types and spacing, and finish requirements.

4. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and finishes.

5. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and finishes.

6.8.3 QUALITY ASSURANCE

Doors and frames shall conform to the requirements of ANSI A250.8-1998 (SDI-100) and other specifications herein named.

Fire Rated Doors and Frames: Ratings as indicated on Door Schedule, when tested in accordance with NFPA 252, UL 10B or UL 10C.

- Labeled by UL, WH, or other agency acceptable to the authorities having jurisdiction.

6.8.4 DELIVERY, STORAGE, AND HANDLING

Products shall be marked with Engineer's opening number on all doors, frames, misc. parts and cartons.

Upon delivery, inspect all materials for damage; notify shipper and supplier if damage is found.

Protect products from moisture, construction traffic, and damage.

- Store vertically under cover.
- Place units on 4 inch (102 mm) high wood sills or in a manner that will prevent rust or damage.
- Do not use non-vented plastic or canvas shelters.
- Should wrappers become wet, remove immediately.

- Provide 1/4 inch (6 mm) space between doors to promote air circulation.

6.8.5 COORDINATION

- Coordinate with door opening construction and door frame and door hardware installation.

6.8.6 MANUFACTURERS

- Acceptable Manufacturer :
- Amweld Building Products, Inc.
- Steelcraft
- Kewanee Corp.
- Ceco Door Products
- Or Approved Equal

6.8.7 MATERIALS

Doors, frames, frame anchors, and hardware reinforcements for each of the levels and models specified shall be provided to meet the requirements of the performance levels specified. The material used in manufacturing these products and components shall comply with ANSI/SDI A250.8. Hardware reinforcing on doors and frames shall comply with ANSI/SDI A250.6. The physical performance levels shall be in accordance with ANSI/SDI A250.4.

All steels used to manufacture doors, frames, anchors, and accessories shall meet at least one or more of the following requirements:

- Cold rolled steel shall conform to ASTM A1008 and A568.
- Hot rolled, pickled and oiled steel shall comply with ASTM A1011 and A568.
- Hot dipped zinc coated steel shall be of the alloyed type and comply with ASTM A924 and A653.
- Steel Sheet, Electrolytic Zinc-Coated shall conform to ASTM A591.

6.8.8 FRAMES

Provide Levels and Models in accordance with ANSI/SDI A250.8 as indicated in the door schedule.

Interior frames: Level 3, Extra heavy-duty, Model 1, Full flush design, 0.0598 inch (1.3 mm) minimum steel frame thickness.

Exterior frames: Provide in accordance with ANSI/SDI A250.8 in the frame configuration and depth as indicated on the Drawings. Minimum thickness as follows:

- Exterior frames: Level 3, Extra heavy-duty, Model 1, Full flush design, 0.0635 inch (1.3 mm) minimum steel frame thickness.

Provide units of galvanized steel where indicated on the door schedule.

Provide face welded type frames unless otherwise indicated.

Provide frames, other than slip-on drywall type with a minimum of three anchors per jamb suitable for the adjoining wall construction. Provide anchors of not less than 0.042 inch (1.0 mm) in thickness or 0.167 inch (4.2 mm) diameter wire. Frames over 7 feet 6 inches (2286 mm) shall be provided with an additional anchor per jamb.

Base anchors shall be provided, other than slip-on drywall type, with minimum thickness of 0.042 inch (1.0mm). For existing masonry wall conditions that do not allow for the use of a floor anchor, an additional jamb anchor shall be provided.

Prepare all frames for all mortise template hardware and reinforced only for surface mounted hardware. Drilling and/or tapping shall be completed by others.

Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8.

6.8.9 STEEL DOORS

Provide 1-3/4-inch thick doors of materials and ANSI/SDI A250.8 grades and models specified below, or as indicated on the Drawings or schedules.

Interior doors: Provide interior doors in accordance with ANSI/SDI A250.8 and in the configuration and sizes as indicated on the door schedule:

- Level 2, Heavy duty, Model 1, Full flush design, minimum 0.0478-inch-thick cold rolled steel sheet faces.

Exterior doors: Provide exterior doors in accordance with ANSI/SDI A250.8 and in the configuration and size as indicated on the door schedule:

- Level 3, Extra heavy duty, Model 1, Full flush design, minimum 0.0635-inch-thick cold rolled steel sheet faces.

Face steel sheet shall meet at least one or more of the following requirements:

- Level 2, 0.042 inch (1.0 mm) minimum thickness

End closure: The top and bottom of the doors shall be closed with channels or closures. The channels or closures shall have a minimum material thickness of 0.042 inch (1.0 mm).

Inverted closure channels: Set flange edges flush with door top/bottom.

Core: Provide in accordance with ANSI/SDI A250.8.

Door edge design: Provide in accordance with ANSI/SDI A250.8.

Minimum hardware reinforcing gages shall comply with Table 4 of ANSI/SDI A250.8.

Provide louvers and vision lites where indicated on the Drawings in accordance with ANSI/SDI A250.8.

Provide steel astragals where indicated on the Drawings or where required by the

manufacturer or NFPA 80.

6.8.10 FABRICATION

Fabricate doors and frames in accordance with ANSI/SDI A250.8.

Prime finish: Doors and frames shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion. All surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI/SDI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

Factory applied finish: Meet the performance requirements and acceptance criteria as stated in ANSI/SDI A250.3. Color shall be:

- As selected from the manufacturers standard colors.

Design clearances: Fabricate doors and frames to maintain the following clearances:

- The clearance between the door and frame shall be 1/8 inch (3.2 mm) in the case of both single swing and pairs of doors.
- The clearance between the meeting edges of pairs of doors shall be 3/16 inch (4.8 mm) plus or minus 1/16 inch (1.6 mm). For fire rated applications, the clearances between the meeting edges of pairs of doors shall be 1/8 inch (3.2 mm) plus or minus 1/16 inch (1.6 mm).
- The clearance measured from the bottom of the door to the bottom of the frame (undercut) shall be a maximum of 3/4 inch (19.1 mm) unless otherwise specified. Fire door undercuts shall comply with ANSI/NFPA 80, "Fire Doors and Fire Windows."
- The clearance between the face of the door and the stop shall be 1/16 inch (1.6 mm) to 3/32 inch (2.4 mm).
- All clearances shall be, unless otherwise specified in this document, subject to a tolerance of plus or minus 1/32 inch (0.8 mm).
- The clearance at the bottom shall be 3/4 inch (19.1 mm).
- The clearance between the face of the door and doorstop shall be 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm).
- All clearances shall be, unless otherwise specified, subject to a tolerance of plus or minus 1/32 inch (0.8 mm).

6.8.11 EXAMINATION

Verify that project conditions are suitable before beginning installation of frames. Do not begin installation until conditions have been properly prepared.

- Verify that completed openings to receive knock-down wrap-around frames are of correct size and thickness.
- Verify that completed concrete or masonry openings to receive butt type frames are of correct size.
- Verify that drywall construction walls are the correct thickness.

6.8.12 INSTALLATION

Install frames plumb, level, rigid, and in true alignment in accordance with ANSI A250.11 and DHI A115.1G.

Install fire rated doors and frames in accordance with NFPA 80.

All frames other than slip-on types shall be fastened to the adjacent structure so as to retain their position and stability. Drywall slip-on frames shall be installed in prepared wall openings in accordance with manufacturer's instructions.

Install frames as masonry is laid-up. Fill welded wrap-around frames in masonry construction solid with grout. Brace or fasten frame in such a way to prevent pressure of the grout from deforming frame.

Install frames in stucco construction as work progresses. Fill welded wrap-around frames solid with grout where indicated. Brace or fasten frame in such a way to prevent pressure of the grout from deforming frame.

Grout shall be mixed to provide a 4 inch (102 mm) maximum slump consistency, hand troweled into place. Grout mixed to a thin "pumpable" consistency shall not be used.

If additives are used in masonry or plaster work during cold weather, field coat the inside of steel frames with a bituminous compound to prevent corrosion.

Doors shall be installed and fastened to maintain alignment with frames to achieve maximum operational effectiveness and appearance. Doors shall be adjusted to maintain perimeter clearances specified. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.

6.8.13 ADJUST AND CLEAN

- Adjust doors for proper operation, free from binding or other defects.
- Clean and restore soiled surfaces. Remove scraps and debris and leave site in a clean condition.

6.8.14 PROTECTION

- Protect installed products until completion of project.

Touch-up, repair or replace damaged products before Substantial Completion

6.9 Rubber Vinyl Base. Vinyl base shall be rubber, manufactured in accordance with Federal Specification SS-W-40a, Type II, 1/8-inch thick by 4-inches high with round top, coved base, and ribbed back. A toeless flat base shall be provided where the rubber base is used in conjunction with carpeting. All internal and external corners shall be premolded (either factory or on-site forming may be utilized). The vinyl base shall that the Contractor proposes to install shall be available in at least 10 standard colorations.

The Contractor shall submit (1 ½-inch minimum length) of each available coloration to the Owner for color selection.

6.10 Overhead Door. The overhead doors shall be Stormtite Series 625 as manufactured by Overhead Door Corporation. The overhead doors shall be the size as shown on the Drawings. The front slat shall be fabricated of 24-gauge galvanized steel. The back slat shall be 24-gauge galvanized steel. Slat cavity shall be filled with CFC-free, foamed-in-placed, polyurethane insulation. The bottom bar shall be two prime-painted steel angles, minimum thickness 1/8-inch, bolted back to back to reinforce the curtain in the guides, and shall have a bottom weather seal. Guides shall be three structural steel angles with a minimum thickness of 3/16-inch. Guides shall be weather stripped with a vinyl weather seal at each jamb, on the exterior curtain side. Guides will be equipped with windlock bars as required to meet the minimum design windload of 20 psf. Brackets shall be hot rolled steel galvanized plates to support the counterbalance, curtain and hood. The counterbalance shall be adjustable helical torsion springs designed for standard 20,000 cycles. The counter-balance is housed in a steel tube or pipe barrel, supporting the curtain with a deflection limited to 0.03-inch per foot span. The counterbalance shall be adjustable by means of an adjusting tension wheel. The hood shall be minimum 24-gauge galvanized steel. Intermediate supports shall be furnished to support the hood where required on wider openings. The hood will be supplied with an internal hood baffle weather seal. The overhead door shall be equipped with an electric motor, cylinder locks and interlock switches. Slats and hood shall be galvanized per ASTM A653 and shall receive a rust inhibitive, roll-coating process, including bonderizing, 0.02 mils thick baked-on prime paint, and 0.6 mils thick baked on polyester top coat. Overhead door shall be motor operated. Motor operator shall be ½ Hp, 240 volt, single phase, 60 Hz, RSX® Operator as manufactured by Overhead Door Corporation, or approved equal.

6.11 Payment. Payment for Buildings shall be that which is subsidiary with the Bid Schedule.

SECTION 7 - COATINGS AND PAINTING

7.0 Work Included. The Contractor shall furnish and apply coatings and paint to those items and surfaces as described herein and shown on the Drawings. Specific surfaces to be coated for this project include but are not limited to the following:

1. WTP No. 1 High Service/Backwash Pump Building (BASE BID)
2. WWTP Chemical Storage Building (ALTERNATE NO. 2)
3. All Concrete Surfaces
4. All Exposed Piping
5. All Exposed Conduit
6. All Walls and Ceilings
7. All Metals and Machinery

This list is intended to note the major items that will require coatings and does not include incidental items such as miscellaneous metals, concrete, etc.

7.1 Definitions.

A. The term "paint" as used herein includes enamels, paints, sealers, fillers, emulsions, and other coatings.

B. MDMTPC = Minimum Dry Mil Thickness Per Coat

C. MDFT = Minimum Dry Film Thickness

D. SSPC = The Society for Protective Coatings

7.2 Submittals. The Contractor shall submit the manufacturer's name and brand of coating materials proposed to be used for field painting of this project within 60 days of Notice to Proceed date.

Before any materials are delivered to the job site, the Contractor shall submit to the Engineer a complete list of all materials proposed to be furnished including quantities, types and descriptions of paint for each part of the project. Material list shall make reference to the specified paint systems and the painting schedule for each paint product proposed to be used, indicating type of surface to be painted, building or location and system as specified. In cases where paint materials other than those described in the Specifications are proposed, a materials list will not be considered as acceptance of such substitute materials; further data will be required as specified herein. Two copies of the full range of colors available in each of the proposed products shall be submitted with the materials list.

The Contractor shall submit the following data to the Engineer for review prior to placing the material order. For purposes of comparison, indicate specified materials for which substitute materials are proposed.

1. Example of past performance of paints under similar conditions (case histories).

2. Types of paint.

3. Percentage of solids by volume.

4. Recommended usage.

5. Current recommended method of application published by manufacturer.

Where standard stock chart colors are not satisfactory, the Contractor shall furnish color samples. All tinting and matching shall be to the satisfaction of the Engineer.

7.3 Quality Assurance. All painting shall be done by qualified, skilled, experienced painters. In the acceptance or rejection of completed painting, no allowance will be made for lack of skill on the part of the painters.

Labels on paint containers shall include the following:

1. Manufacturer's name.

2. Generic type of paint.

3. Manufacturer's stock number.

4. Color.

5. Instructions for thinning, where applicable.

The Contractor shall be responsible for the compatibility of all paints used in the work. A compatible paint will be considered a paint which precludes adverse effects related to bonding, drying delamination, scaling, lifting, and bleeding. In cases where shop-applied primers and coatings on materials and equipment furnished by suppliers are products different from those described in the Specifications, the Contractor shall verify compatibility with the specified field-applied coating system. If requested by the Engineer, verification shall be made by performing "lift" tests on small areas before complete painting or by other methods acceptable to the Engineer. Where thinning is necessary, only the products of the manufacturer furnishing the paint, and products for thinning purposes only, will be allowed.

Minimum dry mil thicknesses per coat (MDMTPC) and/or spreading rates in square feet per gallon shall be governed by the manufacturer's current data sheets or literature containing recommendations or instructions regarding these values. These recommended dry mil thickness and/or spreading rate values will be considered requirements to be met same as if set out herein in these Specifications and Contract Documents and must be included with material list submittals before the Engineer grants approval to use any paint materials. Do not exceed manufacturer's recommended coverage rates. The number of coats to be applied are specified herein and shall govern. Where the total dry film thickness is specified, this thickness shall govern over the MDMTPC.

The Contractor shall provide assurance that a qualified representative of the paint manufacturer makes periodic visits to the project site during painting to verify proper application procedures, quality and progress of work, and if necessary, to instruct painting personnel in any special preparation and/or application procedures.

7.4 Product Delivery, Handling and Storage. All materials shall be delivered to the job site in the original sealed and labeled containers of the paint manufacturer and shall be subject to inspection by the Engineer. All labels shall be legible and intact at time of use. Paint manufacturer's written instructions for proper surface preparation, mixing, thinning, application and drying shall be furnished with the paint, available at all times at the job site, and strictly followed.

7.5 Environmental Requirements. The Contractor shall comply with the manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied. Do not apply finish in areas where dust is being generated. Paint shall not be applied if the ambient temperature or temperature of surface to be painted is below 50°F or below the temperature recommended by the paint manufacturer; the relative humidity is above 85%; or the relative humidity is such that the paint will not dry properly as determined by the Engineer.

The Contractor shall protect with drop cloths, masking or other acceptable means all surfaces which could be damaged in function or appearance by paint, including surfaces not being painted concurrently and surfaces not to be pained. Hardware, accessories, fixtures and similar items shall be removed and replaced after completion of painting. Spray painting will not be permitted when it will cause damage to adjacent or otherwise located surfaces. All paint spatters on glass shall be wiped off immediately.

7.6 Products. Except as otherwise specified, materials shall be the products of the following manufacturers or equal:

Tnemec Company, Inc.
Sherwin-Williams Company

Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise acceptable to the Engineer.

All field applied primers and undercoats shall be provided to ensure compatibility of total coating systems and of the same manufacturer as the finish coats for each system as specified hereafter. Provide barrier coats over incompatible primers or remove and reprime as required. No thinner or solvents other than those approved by the Coating Manufacturer shall be used.

All materials shall herein be assigned a designation number for ease of reference. The minimum material requirements shall be as listed.

Designation	Generic Composition	No. of Coats	Dry Mill Thickness Per Coat	Manufacturer's Name
Primer P-3	Polyamide Cured Epoxy	1 1	3.0 - 5.0 3.0 - 5.0	Tnemec N69-1211 Sherwin-Williams Copoxy or Macropoxy 646
Primer P-4	High Build Epoxy Primer	* *	* *	Tnemec Series 130 Sherwin-Williams Cement-Plex 875
Primer P-5	Synthetic Resin	*	*	Tnemec 151 Sherwin-Williams Loxon Conditioner.
Primer P-6	PVA Sealer	1 1	1.5 - 2.5 1.0 - 2.0	Tnemec 51-792 Sherwin-Williams Multi-Purpose Latex Primer
Primer P-7	Primer	1 1	1.0 - 2.0 1.0 - 2.0	Tnemec 151 Sherwin-Williams Multi-Purpose Latex Primer
Finish F-1 (Non-Submerged)	Polyamide Epoxy	1	3.0 - 5.0	Tnemec N69 HB Epoxoline II Sherwin-Williams Macropoxy 646
Finish F-1 (Submerged)	Polyamine Epoxy	3 3	4.0 - 6.0 4.0 - 6.0	Tnemec N69 HB Epoxoline Sherwin-Williams Dura-Plate 235
Finish F-2	Aliphatic Polyurethane	1 1	3.0 – 5.0 3.0 – 5.0	Tnemec Series 1074 - Endura Shield II Sherwin-Williams Acrolon 218HS or Hi-Solids Polyurethane
Finish F-3	High Build Epoxy	1 2	10.0 - 12.0 4.0 – 6.0	Tnemec N69 HB Epoxoline II Sherwin-Williams Macropoxy 646
Finish F-4	Waterborne Acylic	1 1	- -	Tnemec Series 156 Sherwin-Williams Loxon XP
Finish F-5	Semi-Gloss	2 2	1.5 - 2.5 2.5 - 4.0	Tnemec -1029 Sherwin-Williams Sher-Cryl Semi-Gloss
Finish F-6 (buried concrete and buried pipe ONLY)	Coal Tar Epoxy	2 1	8.0 - 10.0 16.0 - 20.0	Tnemec 46H-413 Tneme Tar Sherwin-Williams Hi-Mil Sher-Tar
Finish F-7	Clear High Content Acrylic Finish	2 2	0.5 0.5	ACRI-SEAL 800 by Toc KURE-N-SEAL by Sonneborn CURECRETE by Tnemec

*Masonry porosity shall be completely filled to seal all surface voids (possibly a minimum of two coats).

Type of Surface	Prime Coats	Coats	Minimum Number of Coats	Minimum Total Finished Dry Mil Thickness (Note 1)
Exposed Pipe without Bituminous Coating	P-3 (Note 2)	F-1	3	9.0
Manhole Frames and Covers	P-3 (Note 2)	F-1	3	9.0
Non-submerged Interior Metals and Machinery	P-3 (Note 2)	F-1	3	9.0
Submerged Metals and Machinery (Note 3)	P-3 (Note 2)	F-1	3	12.0
Non-submerged Exterior Metals and Machinery	P-3 (Note 2)	F-1 First Coat (Note 5) F-2 Finish Coat	3	9.0
Concrete Walls and Ceilings	-	F-3	2	8.0
Concrete Submerged Walls (Note 3)	-	F-1	3	12.0
Concrete Floors	F-7	F-7	2	1.0
Interior Masonry	P-4	F-3	3	8.0
Exterior Masonry	P-5	F-4	2	8.0 - 10.0 (Note 4)
Interior Walls (Drywall)	P-6	F-3	3	5.5
Wood	P-7	F-5	3	4.0

Notes:

1. The total finished dry mil thickness shall be in accordance with the manufacturer's coating system's requirements.

2. Use P-3 for shop primer and field touch-up primer.

3. The term submerged applies to water and wastewater. Special consideration shall be given to applications where acids or other highly corrosive materials will be present.

4. Total dry film thickness of 8.0 - 10.0 mils excludes the primer.

5. Color of F-1 to be the same as F-2.

7.7 Colors. The Contractor shall comply with OSHA requirements concerning color coding and safety markers. Color coding shall be as follows, unless otherwise specified or directed by the Engineer:

Application	Color	
	Tnemec	**Sherwin Williams**
Dangerous Machine Parts and Energized Equipment	OSHA Safety Orange	OSHA Safety Orange
Traffic Operations and Housekeeping Markings	OSHA White	OSHA White
Fire Protection Equipment and Flammable Material	OSHA Safety Red	OSHA Safety Red
Radiation Hazards	OSHA Purple	OSHA Purple
Water Lines		
Raw	2033 Palm Green	4070 Generator Green
Settled or Clarified	2038 Pool Green	4068 Alloy Aqua
Finished or Potable	2042 Victorian Blue	4086 Safety Blue
Non-Potable	2041 Venice Blue w/2008 Safety Red Bands	086 Safety Blue w/Safety Red Bands
Wastewater Lines		
Backwash Waste	2012 Tan Bark	4003 Pallet Tan
Sludge Blowdown	2005 Suede Brown	4009 Walnut Brown
Chemical Lines		
Alum or Ferric Chloride	Safety Orange	Safety Orange
Ammonia	White	White
Carbon Slurry	2009 Black	4032 Black
Chloride (Gas & Solution)	Safety Yellow	Safety Yellow
Fluoride	2040 Powder Blue w/Safety Red Bands	4061 Hydro Blue w/Safety Red Bands
Lime Slurry	2034 April Green	4069 Emerald Ice
Potassium Permanganate	Violet	4080 Plumb
Sulfur Dioxide	2031 Pale Lime w/Safety Yellow Bands	4069 Emerald Ice w/Safety Yellow Bands
Compressed Air	Safety Green	Safety Green

Surfaces to be coated which are not listed in the color coding schedule shall have colors selected by the Engineer. Coating, except two part epoxies, shall be delivered to the job site premixed. Job tinting will not be acceptable, except as approved by the Engineer. All mixing shall be done in mixing pails placed in suitably sized non-ferrous or oxide resistant metal pans.

7.7 Execution. The Contractor shall examine surfaces scheduled to receive paint and/or coating finishes for conditions that will adversely affect application, permanence or quality of work and which cannot be put into an acceptable condition through surface preparation. Do not proceed with surface preparation or coating application until conditions are suitable. If surfaces are not thoroughly dry or if they cannot be put in proper condition to receive paint by customary cleaning methods, the painting applicators shall notify the Contractor in writing requesting necessary corrections. Review the specified or approved painting and coating systems and bring questions or doubts as to the proper performance in writing to the Engineer at least 15 calendar days prior to commencing work. Otherwise, the Contractor shall assume the responsibility for providing the desired results.

The commencement of painting work in any area or space will be construed as acceptance of the surface as being satisfactory and corrected at no additional cost to the Owner.

7.8.1 Preparation of Surfaces. All surfaces shall be thoroughly cleaned and free of dust, dirt, rust, scaling, loose paint or oily materials. No painting shall be done until surface is inspected by the Engineer. For non-ferrous metals and concrete, surface preparation shall be as follows, but not less than that required by the paint manufacturer. References to SSPC refer to The Society for Protective Coatings specifications. Surfaces shall be primed and/or treated, as specified, as soon after completion of surface preparation as practicable, but in any event before any visible or detrimental corrosion or contamination occurs. A prepared surface, which becomes corroded or contaminated, shall be re-prepared before treating and/or priming at no additional cost to the Owner. Concrete to be coated shall have their surfaces prepared by a light abrasive blast cleaning or water blast in accordance with SSPC-SP 13 to remove loose coatings and provide a textured surface to enhance adherence of the new coating. No abrasive blast cleaning shall be done on the job in areas containing pumps, motors or other equipment that could be damaged by infiltration of abrasive particles.

All new non-galvanized structural steel for non-submerged service shall have their surfaces prepared according to SSPC-SP 6, Commercial Blast Cleaning.

All unprimed metal surfaces and miscellaneous fabricated metals (exclusive of structural steel and galvanized metals) to be painted shall be thoroughly cleaned according to SSPC-SP2 Hand Tool Cleaning or SSPC-SP3-63 Power Tool Cleaning, unless specifically required elsewhere in these Specifications.

All new non-galvanized structural steel and fabricated metals for submerged service or high temperature service shall have their surfaces prepared according to SSPC-SP 10Near-White Metal Blast Cleaning.

Prepare concrete surfaces in accordance with manufacturer's instructions, SSPC-SP 13, and ICRI 310.2

Wood surfaces shall be thoroughly cleaned of all extraneous matter and all cracks, nail holes, and other defects properly filled and smoothed. Wood trim shall be sanded to fine finish and wiped clean of dust.

7.8.2 Shop Priming. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used.

7.8.3 Thinning. Thinning shall be done strictly in accordance with the paint manufacturer's instructions and only upon notification to the Engineer. When thinning is acceptable, additional coats of paint shall be applied as needed to build up to the specified dry paint film thickness.

7.8.4 Application. On metal surfaces apply each coat of paint at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Deficiencies of film thickness shall be corrected by the application of additional coat(s).

On masonry, the application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded.

On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative finish either by decreasing the coverage rate or by applying additional coats of paint.

Evenly brush out each finish coat and permit to dry per manufacturer's recommendation before applying any subsequent coats.

All paints and catalogs shall be maintained at minimum manufacturer's application temperature before applying.

Successive coats of paint shall be tinted so as to make each coat easily distinguishable from each other with the final undercoat tinted to the approximate shade of the finished coat.

Finish surfaces shall not show brush marks or other irregularities. Undercoats shall be thoroughly and uniformly sanded with No. 00 sandpaper or equal to remove defects and provide a smooth even surface.

Painting shall be continuous and shall be accomplished in an orderly manner so as to facilitate inspection. Materials subject to weathering shall be prime coated as quickly as possible. Surfaces of exposed members that will be inaccessible after erection shall be cleaned and painted before erection.

All surfaces to be painted as well as the atmosphere in which painting is to be done shall be maintained at the conditions recommended by manufacturer by heating and

ventilating, if necessary, until each coat of paint has hardened. Any defective paint shall be scraped off and repainted in accordance with the Engineer's directions.

Apply one coat of metal primer, of the type specified above, and one coat of flat black metal enamel, to the surfaces of all ductwork behind grilles, for a distance of 18 inches.

Perform all required back-priming work before items are installed.

Hardware accessories, machine surfaces, plates, lighting fixtures, and similar items in place, prior to cleaning and painting, and not intended to be painted, shall be removed during painting operations or provided with surface-applied protection.

The Contractor shall not only protect his work at all times, but shall also protect all adjacent work and materials by the use of sufficient dropcloths during the progress of his work. Upon completion of the work, he shall clean up all paint spots, oil, and stains from floors, glass, hardware, and similar finished items.

Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

Finish exterior and interior doors on tops, bottoms and side edges the same as door faces, unless otherwise indicated.

7.9 Payment. Payment for painting shall be that which is subsidiary with the Bid Schedule.

SECTION 8 - MISCELLANEOUS

8.0 Work Included. Under this section the Contractor shall provide all labor, tools, equipment and materials to perform the work which involves the installation of roof hatches, aluminum access hatches, aluminum railings, aluminum ladders, and aluminum stairs.

8.1 Roof Hatches - Clearwell Pump House Building (BASE BID). The roof hatches, for the Clearwell Pump House Building, shall be Aluminum Type "D" Double Leaf Hatch as manufactured by Bilco or approved equal. Furnish and install where indicated on plans metal roof hatch Type D, size 4'-0" x 4'-0". The roof hatch shall be double leaf. The roof hatch shall be pre-assembled from the manufacturer. The hatches shall be spring operated box type design and able to support a live load of 40 lb/ft^2. The corner joints shall be fully welded and all hardware shall be corrosion resistant. Installation of the hatches shall be in accordance with manufacturer's recommendations. It shall be the responsibility of the Contractor to ensure the compatibility of the hatches and the 26 gauge metal roof system.

8.2 Roof Hatches - Clearwell (BASE BID). The roof hatches, for the Clearwell, shall be Aluminum Type "E-50" Single Leaf Hatch as manufactured by Bilco or approved equal. Furnish and install where indicated on plans metal roof hatch Type E, size 3'-0" x 3'-0". The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer. The hatches shall be spring operated box type design and able to support a live load of 40 lb/ft^2. The corner joints shall be fully welded and all hardware shall be corrosion resistant. Installation of the hatches shall be in accordance with manufacturer's recommendations.

8.3 Roof Hatches – Raw Water Booster Pump Station (ALTERNATE NO. 3). The roof hatches, for the Raw Water Booster Pump Station, shall be Aluminum Type "F-50" Single Leaf Hatch as manufactured by Bilco or approved equal. Furnish and install where indicated on plans metal roof hatch Type F, size 4'-0" x 4'-0". The roof hatch shall be single leaf. The roof hatch shall be pre-assembled from the manufacturer. The hatches shall be spring operated box type design and able to support a live load of 40 lb/ft^2. The corner joints shall be fully welded and all hardware shall be corrosion resistant. Installation of the hatches shall be in accordance with manufacturer's recommendations. It shall be the responsibility of the Contractor to ensure the compatibility of the hatches and the standing seam metal roof system.

8.4 Access Hatches – WWTP Flow Meter Valve Vaults (ALTERNATE NO. 2) and Master Meter (ALTERNATE NO. 4). There shall be furnished as shown on the drawings aluminum access hatches. Hatches shall be sized to allow removal of all valves and meters. The hatch shall be of non-skid design and be designed to handle a H-20 Uniform live load with a maximum allowable deflection of 1/150 of the span. A recessed, vandal proof

locking device shall be provided as part of the hatch. A positive hold open bar shall also be provided to secure the hatch in the open position.

All hinges and hinge bolts shall be stainless steel. All hinge bolt nuts shall be tack welded to prevent removal of bolts. All fasteners used on the hatches shall be non-corrosive. All areas of hatch frames that will be in contact with concrete shall be coated with bitumastic paint. Bolts as required shall be threaded into the hatch frame from the concrete side and secured with stainless steel nuts. All bolts shall be installed to prevent interference when closing the hatch. Stainless steel bolts for mounting each rail support plate shall be furnished so that each set of guide rails can mount directly to the access hatch. Two (2) keys shall be provided, on a key ring complete with the manufacturer's identification.

Unless otherwise noted on the drawings, the access hatch assemblies shall be manufactured by Halliday Products, Series H1C or approved equal.

8.5 Aluminum Railings. Handrail shall be 1-1/2-inch Schedule 40 aluminum pipe. All rails, posts, and fitting assembly spacers shall be formed from 6063-T6 extruded aluminum pipe ASTM-B-429. All other parts shall be 6063 extruded aluminum of 214-F aluminum castings. Unexposed parts shall be number 300 series stainless or chrome plated. Blind rivets shall be number 305 stainless steel.

Railing components shall be 204-RI clear anodized finish. All components shall be wrapped separately during shipping to protect the finish. Handrail system posts and bars shall be the length on center and height as shown on drawings or as directed by the Engineer. In areas where safety chains are required in the handrail system, use 1000 lb. test steel galvanized chain or approved equal.

Handrails shall be standard two line system as manufactured by TFCO Aluminum or approved equal. Posts shall be secured by manufacturer’s standard base mounting flanges with three or four plated bolts, side mounted with brackets, or as shown on drawings. All connections shall be made with standard fittings.

8.6 Aluminum Ladders. Aluminum ladder shall be "TUFLADDER" as manufactured by Thompson Fabricating, LLC (Birmingham, AL.) or approved equal. The rung shall be designed to provide a non-slip, "power grip" surface with a 1" wide striated top surface and a semi-circular bottom. The straight sides and semi-circular bottom shall have striations at approximately 5/16" centers for enhanced gripping. The rung shall be an aluminum extrusion, alloy 6063-T6, of sufficient section modulus and moment of inertia to withstand the design loads. The side rails shall be 1 1/2" schedule 40 aluminum pipe, alloy 6105-T5, 6063-T6 or 6061-T6. The pipe shall conform to ASTM B-429 or B-221. The ladder shall meet the requirements of OSHA and ANSI A14.3. Ladder rungs shall be designed to withstand a concentrated load of 250 pounds plus 30% impact. Maximum rung deflection shall not exceed L/360. The design load shall be applied to a 4" wide area. Ladder side rails shall be designed to withstand a minimum live load of two (2), 250 pound loads plus 30% impact concentrated between any two consecutive

attachments. Pipe for side rails shall have the same finish as the handrail if the ladder is located at an opening in the handrail. Rungs, cage and brackets are to be "mill" finish.

8.6.1 Aluminum Ladder Cage. General cage design and size shall be in accordance with ANSI A14-3. The cage shall be shipped knocked down for field assembly. The prefabricated horizontal bands shall be aluminum bars, alloy 6061-T6, 3"x1/4" for the top and bottom bands and 2"x1/4" for the intermediate bands. The pre-cut, pre-drilled vertical bars shall be aluminum alloy 6061-T6, 1 1/2"x3/16". All hardware necessary for the assembly of the cage and erection of the ladder shall be furnished by the ladder manufacturer. All hardware shall be stainless steel type 303. Cages are required on ladders only where shown on the plans.

8.7 Aluminum Stairs. The stairs shall be constructed of aluminum as shown on drawings. All treads shall be pressure locked, 1 1/4-inch checked nosing, and 2 1/4-inch tread depth construction. Handrails shall be delivered to the site complete and ready for installation with all necessary hardware. The Contractor shall be responsible of verifying all field measurements prior to fabrication of the stair systems.

8.8 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 9 - WATER MAINS

9.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to furnish and install the water mains as shown on the drawings and as directed by the Engineer.

9.1 Water Pipe Materials. All pipe materials shall conform to the manufacturer's standard lengths and diameters. Testing when required by the Owner shall be done in accordance with the appropriate ASTM specifications for the material selected. The water main type shall be PVC water pipe or ductile iron.

9.1.1 Polyvinyl Chloride Pipe PVC SDR 17 or SDR 21. PVC pipe shall comply with ASTM D-1784 for material and shall be Class 250 (SDR 17) or Class 200 (SDR 21) as shown on the drawings or indicated on the bid form. All PVC pipe shall conform to the latest revisions of the following specifications:

ASTM D2241 (PVC Plastic Pipe SDR-PR and Class T)
National Sanitation Foundations Testing Laboratories (NSF)

The name of the manufacturer of the plastic pipe to be used must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, 12454-B (PVC 1120) published by ASTM. Rubber gaskets shall conform to ASTM D3139.

Wall thickness shall be in accordance with ASTM D-2241. Pipe ends shall be beveled to accept the coupling with gasket. The bell section shall be designed to be as strong as the pipe wall.

Samples of pipe physical and chemical data sheets shall be submitted to the Engineer for approval prior to the pipe being purchased.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color and shall have a ring painted around the spigot ends in such a manner as to allow field checking of setting depth of the pipe in the socket. Pipe must be delivered to the job site by means that will adequately support it and not subject it to undue stresses. In particular, the load shall be so supported such that the bottom rows of pipe are not damaged by crushing. The pipe shall be unloaded carefully and stored as close to the final point of placement as is practical.

Pipe markings shall include the following marked continuously down the length:

Manufacturer's Name

Nominal Size
Class Pressure Rating
PVC 1120
NSF Logo
Identification Code

The lubricant shall be that as recommended and supplied by the pipe manufacturer.

9.1.2 Polyvinyl Chloride Pipe (PVC) Cast Iron Pipe Size. This pipe shall meet the requirements of AWWA C900-75, latest revision, "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water" and shall be furnished in cast iron pipe equivalent outside diameters with separate couplings including gaskets.

The pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D-1784. The standard code designation shall be PVC 1120. The PVC compounds shall be tested and certified as suitable for potable water products by the NSF approval marking.

Solvent cement couplings or joints shall not be used. PVC joints using elastomeric gaskets shall be tested as assembled joints and shall meet the laboratory performance requirements specified in ASTM D-3139.

Pipe shall be pressure Class 200, DR 14 or Class 150, DR 18 as shown on the drawings or the bid form.

Pipe and Couplings shall be marked as follows:

Nominal Size and OD Base
Material Code Designation (PVC 1120)
Dimension Ratio Number
AWWA Pressure Class
AWWA Designation Number (AWWA C900)
Manufacturers Name or Trade Mark and Production Record Code
Seal of the NSF Laboratory

Each standard and random length of pipe shall be proof tested at four times its rated class pressure for a minimum of 5 seconds. Bells or couplings shall be tested with the pipe.

The pipe shall not split, crack, or break when tested by the parallel plato method, and it shall not flake or disintegrate when tested by the acetone immersion method as specified by ASTM D-2241.

9.1.3 Ductile Iron Pipe. Ductile Iron Pipe shall be designed in accordance with AWWA (ASA A21.50) and for the conditions as stated in these specifications and the pressure rating for the pipe shall be 350 PSI. Ductile iron pipe shall conform to AWWA

C-151 (ASA A21.51). Pipe shall be cement lined in accordance with AWWA C104 (ASA A21.4) and all exposed pipe and fittings shall have a shop prime coat applied that is compatible with subsequent field enamel paint coats.

The specified thickness will be determined for the given internal and external loading requirements in accordance with ASA A21.50 and will be shown on the drawings or the bid form.

The net weight, class or nominal thickness and sampling period shall be marked on each pipe.

Pipe joints shall be mechanical joint, rubber ring slip joint, flanged, or locked mechanical joint equal to AWWA C-111.

9.1.4 Fittings. Ductile Iron mechanical joint fittings with appropriate adapters shall be used with PVC pipe and ductile iron pipe. Fittings shall comply with AWWA C-110 or C-111 and shall be manufactured for the size and pressure class of the line on which they are used. Compact fittings are acceptable and they shall conform to the latest AWWA specifications.

Mechanical joint fittings shall be used with ductile iron pipe for below ground burial and flange fittings shall be used for all interior piping where ductile iron pipe is used.

9.1.5 Mechanical Joint Restraints. Restraint devices for mechanical joint fittings shall be used with all ductile iron fittings and PVC pipe. Restraints shall conform to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A2153 and shall be manufactured for size and pressure class of the line on which they are used. Restraint devices for nominal pipe sizes 3-inch through 36-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. All Mechanical joint restraints shall be the MEGALUG® Restraint Series 2000 as manufactured by EBAA Iron, Inc., or approved equal.

9.2 Pipe Handling. Pipe delivered to the site shall be stored, handled, distributed, placed, joined together, etc. in accordance with the manufacturer's recommendation unless directed otherwise by the Engineer.

9.3 Water Main Location. The water main shall be installed in the locations as shown on the drawings and as directed by the Engineer. The Contractor and Engineer shall agree as to the exact location of the water line and there shall be no disputes unless it is clear that the proposed location significantly deviates from the drawings. At those locations where the drawings indicate that a fitting must be installed either by declaration on the drawings or by a defined bend as shown on the drawings, the Contractor shall do so and shall avoid over deflection of the pipe.

9.4 Excavation. Excavation of the pipe trench shall be via the use of bucket and hoe type equipment. The use of trencher type equipment shall not be allowed. The minimum width of the pipe trench shall not be less than 24 inches for the 12-inch pipe.

The Contractor shall make trench excavations to only such width to provide ample room for proper construction. Sheeting and shoring shall be provided as required for proper safety and compliance with OSHA regulations. Rock excavation shall be taken to a depth of 6 inches below the bottom of the pipe. If poor foundation conditions exist due to unstable subsurface conditions, the trench shall be under excavated to the depth required and filled with stone to obtain proper bearing capacity.

Watchmen or barricades, lanterns, and other such signs and signals as is necessary to warn the public of the dangers in connection with open trenches, excavations and other obstructions shall be provided by and properly maintained at the expense of the Contractor.

Only one half of street crossings and road crossings shall be excavated before placing temporary bridges over the excavation.

9.5 Blasting and Rock Excavation. The Contractor shall make his own investigation as he deems necessary to ascertain the sub surface conditions to be encountered in the work.

All blasting operations shall be conducted in accordance with municipal ordinances, state and federal laws and the applicable blasting codes. Soil particle velocity shall not exceed the limit set by Kentucky law. All explosives shall be stored in conformity with the applicable ordinances, laws and safety regulations. No blasting shall be done within five feet of any water mains, sewer lines, natural or manufactured gas lines, liquid petroleum lines, or other utilities.

The Contractor shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping shall not be permitted as a method to breaking boulders. No blasting shall be permitted on Sundays or after dark.

Prior to commencing with the work, the Contractor shall, during a preconstruction conference with the Owner and Engineer, state clearly his approach to performing the excavations on the project. He shall be familiar with the laws and ordinances covering blasting and shall also give consideration to the use of hydraulically operated rock breaking devices in lieu of blasting where considered necessary. If blasting is not handled in an expert manner at all times the Engineer reserves the right to suspend blasting and require the work to proceed without it. Prior to blasting, the Contractor shall make his own detailed preblast survey of adjacent walks, curbs, retaining walls, house foundations, etc. to determine conditions prior to the work. Such a file of information, including photographs, may be certified in such a manner as the Contractor believes necessary. This information if required or performed shall be supplied to the Engineer prior to performing the work.

9.6 Storage of Excavated Material. All excavated material shall be stored in a manner that will not endanger the work and that will avoid obstructing roadways, sidewalks, and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

9.7 Shoring Sheeting and Bracing. The Contractor shall furnish place and maintain such sheeting and bracing as may be required to support the sides of the excavation or to protect other structures from possible damage. All sheeting and bracing shall be removed upon completion of the work unless permitted to be left in place by the Engineer. Any sheeting or bracing left in place shall be cut off at least two feet below the finished ground surface elevation. The cost of furnishing, placing, maintaining, and removing sheeting and bracing shall be included in the unit price bid for water lines and all work shall conform the OSHA requirements.

9.8 Bedding and Backfill. All water mains shall be bedded with select earth backfill or six inches of #9 or approved equal stone under and on both sides of the pipe where it is installed along the unpaved areas. Where the water line is installed along the paved areas the water line shall be backfilled with #9 or approved equal stone. Trenches shall be backfilled immediately after the water main has been installed. No rock larger than two inches will be permitted within six inches of the pipe. In unpaved or unsurfaced areas the remainder of the fill may be mounded over the top of the trench. Where trenches are in paved or traveled areas, or yard areas, compaction shall be performed during backfill. The Contractor at no time shall open up more than 500 feet of trench.

Any damage to underground structures, pipes wires, drains, etc., shall not be backfilled until they have been satisfactorily repaired or replaced to the original serviceability at the Contractor's expense and as approved by the Engineer. Settlement of backfill may be done with water furnished by the Contractor under the direction of the Engineer where such will not endanger traffic of damage property. When excavated rock is used for backfilling, it shall have sufficient dirt or fine material to fill all voids and shall not be used within twelve inches of the pipe.

To be accepted as final cleanup all excess rock one inch and larger shall be removed from the disturbed site.

9.9 Thrust Blocks and Anchorage. Thrust blocks shall be installed at all tees, bends, crosses, dead ends, valves, hydrants, blowoff assemblies, and as directed by the Engineer. The size of the thrust block shall depend on the soil and type of fitting, and shall conform to the pipe manufacturer's recommendations. At any location where a vertical bend is required the Contractor shall install the anchorage as directed by the Engineer in conjunction with the pipe manufacturer.

Thrust blocks shall be constructed of Class B concrete conforming to KBH Specification 601 and placed between the fitting and the trench wall. At no time will sack-crete or pre bagged concrete mixtures be allowed. All thrust block and anchorage concrete shall be delivered to the job site by means of a ready mix concrete truck and placed immediately upon arrival.

The thrust blocks shall be sized as shown on the detail drawings or as directed by the Engineer.

9.10 Temporary Surfacing. All trenches in paved areas shall, following compacted backfill, receive a top layer of compacted dense grade stone as shown on the detailed drawings. Such temporary surfacing shall be maintained and shall be paved as soon as conditions permit.

9.11 Hydrostatic Testing. The water line and appurtenances, as rapidly as valves are installed, shall be hydrostatically tested in accordance with these specifications. Defective joints of pipe shall be replaced as directed by the Engineer. Cracked or defective pipe, fittings, valves, or hydrants shall be replaced by the Contractor and the test shall be repeated until the test results are satisfied. All meter settings and service tubing as shown on the drawings shall be included in the hydrostatic test.

The test pressure shall not be less than 9.25 times the working pressure at the highest point along the test section and the hydrostatic test shall be of at least a two hour duration. The test pressure shall not vary by more that five psi. for the duration of the test.

9.11.1 Pressurization. After the pipe has been installed all or any valved section shall be subjected to the hydrostatic test. Each valved section of the pipe shall be slowly filled with water and the specified test pressure, corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. As part of the testing equipment a meter shall be installed to measure all water added to the tested section.

9.11.2 Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the Owner.

9.11.3 Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five psi. of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

9.11.4 Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in pounds per square inch

This formula is based on an allowable leakage of 11.65 gpd./mi./in. of nominal diameter at a pressure of 150 psi.

All leaks shall be repaired whenever or wherever the is evidence of a leak. Water used by the Contractor shall be paid for by the Contractor at the rate of $2.00 per 1,000 gallons.

9.12 Sterilization. Upon completion and acceptance of the hydrostatic test of a section of the water main that section shall be thoroughly disinfected before being place in service by the use of chlorine or chlorine compounds in such amounts as to produce a concentration of not less than 50 ppm and a residual of not less than 25 ppm at the end of 24 hours and followed by thorough flushing. Putting small amounts of chlorine in each joint will not be acceptable.

9.13 Other Utilities. Other utilities encountered in the work shall be preserved and protected. Where relocation or repair is required to accommodate the work it shall be made in a manner acceptable to the utility having jurisdiction over the service connection. Accommodation of service connections shall not constitute any basis for extra payment.

Prior to construction, the Contractor shall arrange to meet with representatives of all utilities, and provide them with his anticipated work schedule. The Contractor shall have the utility companies make their best determination of utility locations in the areas in which he is working. Throughout the progress of the work such field markings of utilities shall be kept current.

9.14 Payment for Water. All water used from the Owner shall be metered by meters supplied by the Contractor. The Contractor shall pay for such water at the rate of $2.00 per 1,000 gallons. This shall include any unmetered water lost which shall be computed on the basis of a discharge velocity of seven feet per second, the diameter of the line, and the estimated duration of free uncontrolled discharge or the approved method.

9.15 Cleanup. The Contractor shall provide effective cleanup of the work as it progresses. At the time of final inspection no trenches shall show any undue evidence of the construction. All areas shall be left free of ruts due to construction and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded and shall be completely restored, and all yards and fields shall be reseeded. Straw and fertilizing shall accompany the seeding and the seed mixture shall match the existing ground cover. If necessary to hasten proper restoration of terraces, principally along ditch lines, the Contractor shall sod such areas at the Engineer's direction.

9.16 Protection of Adjacent Landscape. Reasonable care shall be taken during construction of the process lines to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

9.17 Underground Marking Tape. At all locations where PVC pipe is utilized a detectable underground marking tape shall be place in the trench approximately six inches below the finished grade. The tape used shall be mylar encased aluminum foil with the printing "CAUTION - Buried Water Line Below." Printing shall be readable through the clear mylar and surface printing is not acceptable. Tape size shall be two inch width as provided by Lifeguard, Inc. or approved equal. Color of the tape shall be blue.

9.18 Underground Detection Wire. At all locations where yard piping is utilized, one strand of Number 12 copper wire shall be placed in the trench approximately six inches below the finished grade.

9.19 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 10 - CONNECTION

10.0 Work Included. Under this item the Contractor shall provide all labor, tools, equipment, and materials to connect and disconnect water mains as shown on the drawings and as directed by the Engineer.

10.1 Materials. The connections and disconnects shall be performed by the use of ductile iron mechanical joint fittings, approved tapping valves and sleeves, and water main pipe as shown on the drawings described elsewhere in these technical specifications. Concrete for thrust restraint shall be Class B concrete and sack-crete shall not be allowed.

10.2 Installation. The connections shall be made with a tapping sleeve and valve and done so in accordance with the Owners schedule of operation. Once the main line has been tapped the new section of water main shall be valved off from the rest of the system by closing the tapping valve. The tapping valve shall remain closed until the Engineer has been satisfied that the new water main has been installed correctly, met the requirements of the hydrostatic test, been sanitized in accordance with the regulatory requirements, and any water main to be abandoned has been disconnected from the water system. The disconnection of a water main that is to be abandoned shall be accomplished by installing a blind flange at the point of abandonment and secured by means of a concrete thrust block. In the event where the thrust block shall be installed in the area of the abandoned water main a minimum three foot section of the abandoned water main shall be removed and the void replaced with concrete.

10.3 Payment. The unit price bid shall constitute full compensation for furnishing and installing the connections including any abandonment or disconnections of the water mains. This shall include all fittings but water mains and gate valves shall be paid as per the bid schedule for those respective items.

SECTION 11 – WATER BOOSTER PUMP STATION (ALTERNATE NO. 1)

11.0 Work Included. The contractor shall furnish and install one factory built, factory delivered, above ground water booster pump station, with all the necessary internal piping, pumps, motors, valves, and controls and other necessary appurtenances installed on a fabricated aluminum base and enclosed in a modular structure as shown on the plans and as specified herein. The booster station shall be complete when delivered and will not require internal contractor construction except to install the power service through the service conduit provided for that purpose.

The above ground water booster pump station shall be manufactured by Engineered Fluid, Inc., Centralia, Illinois, represented by Mr. Jason Bivins, P.E. of Delaney and Associates, Erlanger, Kentucky, telephone (859) 342-4944, or approved equal.

11.1 Quality Assurance.The equipment and materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the contract drawings and operated per manufacturer's recommendations. In the application of the pumps and pump suction and discharge piping, the manufacturer shall demonstrate adherence to the requirements of the Hydraulic Institute for the pumps of this variety.

It is intended that the manufacturer of the selected equipment shall be a business regularly engaged in the manufacture, assembly, construction, start-up and maintenance of water distribution equipment of the type required for this project. The manufacturer shall have at least ten years of successful experience in providing stations of the type, design, function and quality as required for this project. As such, the pump station manufacturer shall be required to affix to the station an UNDERWRITERS LABORATORIES (UL) LABEL attesting to the compliance of the station equipment under the PACKAGED PUMPING SYSTEMS (QCZJ) UL Listing Category and/or INTERTEK TESTING SERVICES (ETL) LABEL attesting to the compliance of the station equipment under PACKAGED PUMPING SYSTEMS. The ETL label shall state the station conforms to UL STD 778 and is certified to CAN/CSA STD C22.2 NO. 108. This label shall be inclusive of the entire station with enclosure so as to demonstrate compliance with the National Electrical Code (NEC) requirements for working clearances and wiring procedures. Equipment manufactured without this third party certification label or equipment manufactured by an outside source or "brokered equipment" defined as systems not assembled on the premises of the named manufacturer by that company's employees shall not be allowed.

11.2 Kentucky Building Code By Kentucky Commonwealth Law, all Modular Buildings Manufactured in or imported into the state must have Model Plan Approval by the Kentucky Office of Housing, Buildings & Construction (State Fire Marshal) as administered by the Kentucky Industrialized Building System (K.I.B.S.) Program. An authorized Manufacturer will have an assigned KIBS Factory Number, and each unit will bear a serialized label certifying it is "In Compliance with the Standards Adopted by the Authority of the 2002 Kentucky Residential Code or the 2002 Kentucky Building Code." The pump station Manufacturer will be required to provide in the submittal the assigned KIBS Factory Number, and the Serial Number for each label

which will be attached to the Modular Station. Submittals lacking this information will not be reviewed.

11.3 Submittals. Equipment submittals shall be bound and in a minimum of six copies. The submittals shall contain a minimum of two full size drawings, size 24-inch x 36-inch; one each covering the booster pump station and the electrical control schematic. The booster pump station drawing shall be specific to this project, in at least three different views, be to scale and illustrate the National Electrical Code (NEC) clearances per Section 110-26 of the Code. The submittal booklets will be complete with data sheets covering all individual components that make up the booster pump station and the UL file number under which the manufacturer is listed, service department personnel statement as detailed in the specifications and be complete with the manufacturer's formal warranty policy. The submittal booklets shall be complete with a full size photocopy of the manufacturer's combination UL/manufacturer logo Packaged Pumping Systems label.

11.4 Building Enclosure. The station building enclosure shall be a factory assembled, modular structure of one (1) compartment all attached to the station base structure and requiring no additional assembly at the job site. The building design criteria shall be: (1.) To withstand snow load based on ASCE 7-05 Ground Snow Loads for the state and county of installation (2.) To withstand wind loads based on ASCE 7-05 for wind speeds; (3.) Be designed for site specific seismic requirements based on local conditions as dictated by the Available Ground Motion Parameters according to ASCE 7 and IBC 2006 and 2009 established by zip code and a live floor load of 125 PSF.

The modular building enclosing the station is shown at its minimum size so that National Standards mandated clearances are maintained above, below and around equipment for proper and safe servicing, removal and reinstallation of this equipment. The drawing for this equipment illustrates centerline and clearance/maintenance dimensions about major equipment items. Building sizes and construction dimensions less than those shown will not be allowed.

11.5 Building Construction. The materials specified are specifically chosen to be resistant to moisture degradation and infestation and be maintainable.

Insulation values for the walls and roof structure shall be a minimum R-21 in the walls and the roof. Insulation within the roof and wall panels shall be foam-in-place polyurethane material applied between the interior and exterior sheathing forming a closed cell bounded by the steel framing. The insulation shall have a minimum density of 2.2 lbs/cu. ft. nominal and shall be applied to the thickness required to provide a minimum R value of 21. The insulation shall have a ASTM E-84 flame spread index of 20 and smoke developed of 450.

Building framing materials shall comply with the A.I.S.I. Specification for the Design of Cold-formed Steel Structural Members and to Standards ASTM C-955, ASTM C-1007, ASTM C-645, ASTM C-754 and ICBO 4782P. and 4784P. A framing design incorporating the members covered by the listed specifications and standards shall develop a structure meeting or exceeding the building design criteria listed above. Structural insulated panels or SIPS will not be allowed.

The building structure shall be fabricated using steel C-studs as wall framing members and C-joists as roof trusses. The size, placement and spacing of studs and joists shall be in accordance with the design criteria and material standards. The wall C-studs shall be a minimum 2" x 3 5/8"

size of 16 gauge material minimum. The roof C-joists shall be a minimum 2" x 8" size of 16 gauge material minimum.

The exterior wall sheathing shall be ½" thick, exterior, CDX grade plywood.

The exterior roof sheathing shall be 5/8" thick, exterior, CDX grade plywood.

The interior wall sheathing shall be ¾" thick, exterior, CDX grade plywood.

The interior roof/ceiling sheathing shall be ¾" thick, exterior, CDX grade plywood.

OSB or particle board sheathing will not be allowed.

All interior wall & ceiling surfaces shall be covered with .090" thick FRP (fiberglass reinforced plastic) sheeting of pebble grain, gloss, white finish. The individual wall faces shall be covered with one continuous sheet. The FRP sheets shall be glued to the plywood sheathing requiring no fasteners. Corner moldings of like FRP material shall be installed & finished in a workmanlike manner.

Openings in the sidewalls and/or roof shall be as shown and be fully framed out and supported using single or multiple framing members sufficient to support and fasten those devices or equipment items requiring a framed opening, these being access hatches, HVAC equipment, pipe passages, conduit passages, door and window openings and other special purpose openings as might be shown and required.

The attaching of devices or equipment to the building at a framed opening shall be done fully according to the device manufacturers mounting instructions.

11.5.1 Heavy Duty Steel Doors. Doors are manufactured of 18-gauge galvanized steel. All doors shall be full flush construction and 1-3/4 inches thick. Doors shall be reinforced, stiffened, insulated, and sound deadened with a solid polystyrene foam board permanently bonded to the inside of each face skin. The lock and hinge edge of each door shall be welded with a center hairline seam the full height of the door. The lock edge shall be reinforced full height by a 14-gauge continuous one-piece channel x extruded templating. The hinge edge shall be reinforced full height by a 14-gauge continuous one-piece channel, formed and tapped for hinges. Top and bottom of the door shall be closed with 16-gauge channels. Doors shall have beveled 1/8-inch (3) in 2-inch (51) lock edge and square hinge edge. Doors shall be thoroughly cleaned and receive an iron phosphate treatment prior to receiving one coat of prime paint. Door closures and rim panics are reinforced with 14-gauge channels.

Doors shall be fully-mounted in frames produced for pre-hanging of commercial 1-3/4" doors. Frames are formed to 16-gauge commercial quality cold rolled steel conforming to ASTM A366 or A620 and A568. Frames are produced in two welded units, to be mechanically joined during installation. The base side is prepared for all required hardware. Both units, base and trim, are furnished with welded mitered faces. Frame anchoring includes compression anchors and stud screws. Door hinges shall be continuous gear hinges, fabricated of extruded 6063-T6 aluminum alloy/temper with pinless assembly. The doors shall have a lockset, exterior handle, interior panic type exit device, and top mounted-door closer with hold-open device.

Doors and frames shall be finished with a two-component, aliphatic/acrylic polyurethane coating, white in color, with a high gloss finish. The coating shall be resistant to a wide range of solvents and chemicals under splash and spill conditions. The coating system is V.O.C. compliant.

11.5.2 Mounting and Fastening The building shall be fabricated up from and securely attached to a framework fabricated of 2" x 6" steel tubing welded at each corner to form a base frame serving as a stable base for handling and transporting the building prior to attaching the building to the station base skid. To hold the building framing to the 2" x 6" base frame, 5/8" anchor studs will be welded to the base frame. In assembling the building framing to the base frame a 3 1/4" x 4" x 1/4" thick anchor plate under a flat washer, lock washer and 5/8" bolt shall be used to fasten the building framing to the framing base as shown. The base frame shall be grit blasted to a SP-6 finish and coated with the specified coating material.

The building enclosure shall be firmly and securely attached to the steel base structure by lag bolting from inside the station, through evenly spaced 9/32" holes pre-drilled into a 2" by 1-½" by 1/8" thick angle piece that has been continuously welded to the steel floor. The lag bolts shall screw into the 2" x 6" tubular base frame upon which the building has been built.

The lag bolts shall be plated steel, size 3/8" diameter x 2" long. The number and location of the lag bolts shall be as determined by structural analysis so as to maintain the live load and wind load ratings as specified and to resist shearing and tearing in the process of transporting and placing the finished station.

11.5.3 Exterior Treatment. The exterior finish will be field-applied brick, provided and installed by the installing contractor. The station manufacturer shall apply a layer of "housewrap" to the exterior of the building. The "housewrap" shall reduce air infiltration and moisture penetration and damage. The product shall be TYVEK or equal. The "housewrap" shall be stapled to the exterior sheathing. Unless an additional exterior material is placed over the "housewrap", nailer strips shall be nailed over the housewrap to keep the material from tearing away during shipment.

11.5.3.1 Field Applied Brickwork

A. Samples At the discretion of the Engineer, the contractor may be instructed to construct, at the project site, a sample panel, four (4) feet by four (4) feet, using the full range of facing brickwork materials proposed for approval.

B. Materials

a. Facing Brick:	ASTM C216-11, with the style and color to be approved by the Owner and Engineer
b. Portland Cement:	ASTM C 150-66 Type 1
c. Masonry Cement:	ASTM C 91-66
d. Sand:	ASTM C 144-66T, Natural
e. Water:	Free of matter that could impair suitability for use in mortar.
f. Hydrated Lime:	ASTM C 207-49 Type S
g. Wall Reinforcing:	Dur-O-Wal, trussed Type.
h. Cleaning Agent:	"Sure-Klean", suited to kind and color of brick.

C. Mortar Preparation

a. For work below grade, use mortar composed of one part portland cement, ¼ part hydrated lime and three parts sand, by volume. Optional use, one part portland cement, one part masonry cement, and six parts sand by volume. Sand shall be measured damp and loose.

b. For work above grade, use mortar composed of one part portland cement, one part hydrated lime and six parts sand, by volume. Optional use, one part masonry cement, and three parts sand by volume.

c. Mix materials mechanically for not less than five minutes after all ingredients are in mixer.

D. Brick Installation

a. Lay brick plumb, level, true to line in running bond or as indicated. Align on exposed face.

b. Finish joints flush that will not be exposed in finish work. Finish joints, that will remain exposed with 24 inch sled runner. Tool vertical joints first. Lay three courses to approximately eight inches vertically, using joints of uniform size.

c. Lay brick in full bed of mortar with head and edge joints completely filled.

d. Lay out courses to minimize cutting and avoid jumping bond.

e. Build in indicated flashing as work progresses.

f. Provide weep holes, approximately four feet on centers, in horizontal courses approximately eight inches above finish grade. Keep weep holes free from mortar.

g. Air space between brick and inside wall kept free of excess mortar by means of a wood strip.

E. Reinforcing Reinforce brick with Dur-O-Wal from back up wall at sixteen (16) inches vertically and twenty-four (24) inches horizontal.

F. Control Joints Contractor shall provide control joints at locations as recommended by the brick manufacturer.

G. Chases and Embedded Items Contractor shall build in flashing, sleeves, clips chases and accessories as work progresses.

H. Protection

a. Do not lay brick work when temperature is below 40° F unless approved by the Engineer. Do not use frozen or ice covered materials.

b. Cover top of walls at end of day's work.

c. If required, provide adequate heating and protection to prevent brickwork from freezing.

I. Cleaning

a. Keep face of brick free from excess mortar while laying bricks. Brush brickwork with dry fiber brush as soon as is practicable after laying, removing any adhered matter.
b. Clean brickwork with fiber brushes and clear water or cleaning agent. Use cleaning agent according to manufacturer's recommendations.

11.5.4 Steel Rafter/Shingle Roof System. The steel rafter/shingled roof system will be installed at the factory. The roof shall be a steel hip rafter system on 16" centers, deck with 5/8 CDX plywood, covered with 30 lb. felt underlayment and 24 ga., 30 year, shadow, shingled roof with aluminum fascia and soffit. The roof system shall have a 4:12 minimum pitch.

11.5.5 Building Substructure. The station base/substructure shall be completely fabricated aluminum structure, structurally sound for the purpose intended. The aluminum checked floor plate serving as flooring material shall meet or exceed the requirements for aluminum ASTM B-209, alloy 6061-T6. The structural shapes forming the substructure shall meet or exceed the requirements of aluminum ASTM B-308 of the following alloys:

Channel - Alloy 6061-T6
Pump base flange - Alloy 6061-T 651
Structural Tube and Angle - Alloy 6661-T6

The welding procedure used to fabricate the base/substructure shall be submerged arc, wire feed welding process performed by certified welders employed by the station manufacturer. As part of the equipment submittal, the station manufacturer shall provide copies of the welding certificates of the employees who are to perform the base/substructure welds.

The manufacturer shall include as part of the substructure, aluminum brick ledges in all areas where foundation cutouts are shown on the plans. The members shall be sized to support the exterior brick façade which will be installed in the field.

11.5.6 Piping Penetrations. Where suction and discharge piping, or any other pressure piping, passes through the station floor plate and base sub-structure, that area of the floor shall be provided with a grout sleeve made up of steel pipe of 9" height and of sufficient annular diameter to pass a full size pipe flange for the pipe size shown.

The steel sleeve shall be welded into the floor plate with a 1" projection above the floor in the station. Following installation of the inlet and outlet pipes, the installing contractor shall be responsible for furnishing and installing grout to close the opening around the installed pipe.

11.5.7 Floor Drain. The station shall have floor drains as shown on the drawing. The floor drains shall be a 4" grated opening with 4" I.D threaded hub for connection of a drain line up under the station floor.

11.6 Safety Floor Matting. The walkway areas (that space from the entrance ladder to the control panel and the entire NEC clearance area) shall be covered with a rubber drainage runner. The runner shall be medium duty, 1/2 inch minimum thickness of open slot design allowing fluids to drain under standing or walking surfaces. The runner shall have a tread design to promote sure footing. The underside of the runner shall have a raise knob design to permit aeration and drainage, and to reduce runner fatigue. The runner shall not be glued to the floor.

11.7 Delivery – Lifting Device. An adjustable spreader type lifting device, built to lift the building structure without impinging the lifting chains/cables on the building sidewalls, shall be provided by the pumping station manufacturer for use by the installing contractor for the purpose of unloading station from trailer.

11.8 Operating Conditions. The pump station shall be capable of delivering the fluid medium at the following capacities and heads when operating at 0 feet minimum suction pressure.

PUMP #1, #2 & #3

Design GPM 1400 @ 124 feet TDH;
NPSHr: 11.2 feet;
Suction Pressure: 78 PSI;
Discharge Pressure: 128 PSI
Pump Efficiency at design Point: 85.5%
Pump Power: Non-overloading for 60 rated h.p.;
Motor Speed: 1800 rpm nominal.

The pump driver shall be a standard, A.C. induction motor, open drip-proof construction, of the horizontal extended shaft, normal thrust type and shall be 60 h.p., 1,800 rpm nominal and suitable for 3 phase, 60 cycle, 480 volt electrical service.

The pump motor shall be sized so that the nameplate horsepower rating, without consideration of the service factor, shall not be exceeded at any point along the pump performance profile. The pump motor shall be complete with a 1.15 service factor when operated with constant speed starters (sine wave power). The service factor shall be 1.00 when operated with variable frequency drives (inverter power).

11.9 Booster Pumps – Closed Coupled End Suction, Centrifugal Type. The pumps employed within the pump station shall be of the closed coupled end suction, centrifugal type. The pumps shall be of close grain cast iron construction complete with bronze trim. The pumps shall conform to the detailed specifications as set forth below:

11.9.1 Casing. Volute type, bolted to adapter, with recessed lock fit to insure alignment. No stud or bolt holes are tapped through casing to liquid ways. Tapping openings provided for priming, venting, draining and suction and discharge gauge connections. Piping connection to be as shown per pump data sheets.

11.9.2 Impeller. Enclosed, single suction type, cast in one piece. All impellers are to be statically balanced to insure smooth operation, also hydraulically balanced except in some small sizes where end thrust is but a minor factor.

11.9.3 Wearing Rings. Renewable type; maintain proper running clearance with impeller hubs to minimize leakage between suction and discharge.

11.9.4 Shaft Sleeves. To be shouldered on shaft near impeller and covers full length of shaft from impeller hub to motor end bracket. Seals by compression between shaft sleeve and impeller hub, also between sleeve and shoulder on shaft, protecting shaft from contact with liquid.

11.9.5 Stuffing Box. The stuffing box shall be cast integral with the pump casing. The stuffing box shall contain a single face type mechanical seal. The seal shall have a carbon rotating head against a Ni-Resist stationary face and be complete with a Buna-N boot with stainless steel spring and spring retainer.

11.9.6 Adapter. Maintains rigid assembly between motor and casing. Machined lock between adapter and motor end bracket keeps adapter & casing in permanent alignment with motor and extended motor shaft.

11.9.7 Motor. Assembled as integral part of the complete units. Shaft carries impeller and sleeve. Motor bearings are ball bearing type, designed to carry all radial and thrust loads, and are installed in sealed housings which retain lubricant and exclude dirt and moisture. Motors shall be open drip proof. Motors shall be suitable for use with VFD's.

The Booster Pumps shall be closed coupled end suction, centrifugal type as manufactured by CORNELL Model 5RB, or approved equal.

11.10 Pump/Motor Vibration Isolation Pads. The pump/motor assembly shall be mounted to a fabricated steel base built specifically for the pump/motor to be mounted. Each mounting or attachment point shall be complete with a vibration isolation pad. The pad will be in two (2) parts, a 1/4" base layer followed by a 5/8" upper layer and be a nominal 2" x 2" square size for pump/motor combinations weighing up to 1500 pounds.

11.11 Elastomer Pipe Connector. The inlet side of each booster pump shall include an elastomer connector to help isolate vibration and noise in the piping system. The elastomer connector shall be of single sphere design, constructed of neoprene and nylon with bias-ply tire reinforcing cord to provide a 225 psi working pressure rating to a minimum of 120EF. The elastomer connector shall pass through the plate steel flanges designed to grip the connector so the connector seals without gaskets when the flange bolts are drawn up.

A control joint limiting pipe connector movement shall be supplied with each pipe connector.

11.12 Piping. Piping shall be steel and conform to material specification ASTM A-53(CW) for nominal pipe size four (4) inch and smaller and ASTM A-53(ERW) Grade B for nominal pipe size five (5) inches and larger. Steel butt-welding fittings shall conform to material specification ASTM A-234 Grade WPB and to the dimensions and tolerances of ANSI Standards B16.9 and B16.28 respectively.

Forged steel flanges shall conform to material specification ASTM A-105 Class 60 and/or ASTM A-181 for carbon steel forgings and to the dimensions and tolerances of ANSI Standards B16.5 as amended in 1992 for Class 150 and Class 300 flanges.

The piping sizes shall be as shown on the drawing.
Size 10 inch and below - Schedule 40
Size 12 inch thru 20 inch - Standard weight (.375" wall)
Size 24 inch and above - Standard weight (.500" wall)

All pipe welds shall be performed by certified welders employed by the pump station

manufacturer. As part of the equipment submittal, the pump station manufacturer shall provide copies of the welding certificates of the employees who are to perform the pipe welds.

All piping surfaces shall be prepared by gritblasting, or other abrasive blasting, prior to any welds taking place. Piping of 5" diameter and smaller may be cut by saw. Piping of 6" diameter and larger shall be bevel cut, and Oxyfuel or Plasma-arc cutting techniques shall be used to assure and facilitate bevel pipe cuts. No saw cuts or other form of abrasive cut-offs are allowed on 6" and larger diameter pipe.

In all cases, short circuit transfer, spray transfer or pulse-arc transfer modes of the gas metal arc welding process shall be applied semi-automatically. When utilizing the short circuit mode, shielding gas consisting of 50% carbon dioxide and 50% argon gas shall be used. When utilizing the spray or pulse-arc transfer modes, a shielding gas consisting of 5% carbon dioxide and 95% argon shall be used. In all cases, welding wire with a minimum tensile strength of 70,000 psi shall be employed. All flange welds and butt welds of equal size pipe shall be a single continuous nonstop weld around the complete circumference of the pipe. Whenever possible, vertical up weld passes will be applied to all pipe welds. No vertical down weld passes will be allowed. Completed welding assemblies shall create no internal obstruction, restriction or create any unintended sources of water deflection.

Piping of six (6) inch diameter and larger shall require a minimum of two (2) weld passes to complete each weld. The first pass, or root pass, shall be applied at the bottom of the bevel cut using the short circuit transfer welding mode, and the second pass, or cap pass, shall be applied over the root pass using the spray or pulse arc transfer welding modes to insure that at a minimum the total weld thickness shall be equal to thinnest of the two pieces being welded together.

11.13 Pipe Supports. Pipe supports by minimum sizing for:

- 8" and smaller piping shall be 2" x 3" x 3/16" wall rectangular tubing;
- 10" and larger piping shall be 3" x 4" x 1/4" wall rectangular tubing;
- 6" and larger piping shall be provided with "kick" bracing projecting fully from the underside of the pipe to the floor at an angle of no less than 15E from vertical out at a right angle to the run of the pipe being supported. These "kick" braces shall be in addition to the vertical pipe supports called out above.

Pipe supports are to be fully welded at both end points to the pipe and steel floor where required.

Simple pipe stands made of pipe welded only at the floor and upholding a bracket with or without a threaded jack bolt or a U-bolt are not acceptable, as no lateral or transverse support is provided**.**

11.14 Fusion Bonded Epoxy Coating-Steel Piping. Steel piping shall have applied to it a Fusion Bonded Epoxy Coating on the interior pipe surface that conforms to AWWA C-213-91 for steel water pipelines. The powder coating product shall be National Sanitation Foundation (NSF) Standard 61 certified material. The final product shall be capable of meeting Salt Spray Resistance ASTM B117 (1000 hour) with no blistering, undercutting or rust bleed; Humidity Resistance ASTM D2247 (1000 hour) with no blistering, undercutting or rust bleed; and Impact Resistance of ASTM G14-72 (160 in. lbs.). The Fusion Bonded Epoxy Coating shall provide a minimum total dry mil thickness of 12-16 mils. The epoxy powder coating shall be Pipe Clad® 1500 Red latest revision from Valspar, Inc.

Prior to shipment of the station, the station manufacturer shall provide in writing to the Engineer certification that the fusion bonded epoxy coating has been applied to all internal surfaces of the steel piping using the proper method. Said certification shall show under the station manufacturer's letterhead:

- Date of application;
- Material manufacturer and product designation including a product data sheet for the coating;
- Applier of the fusion bonded coating, name, address and phone number;
- Notarized signature of an officer of the station manufacturing company stating the fusion bonded epoxy coating was applied to AWWA Standard C213-91 or the latest revision.

11.15 Service Connection on Internal Piping. All plumbed devices within the station eventually requiring service, such as meters, control valves, pumps and like equipment, shall be easily removed from the piping by the presence of appropriately placed and sufficient quantity of adaptors and couplings as shown on the drawings; no less than the quantity of couplings and adaptors shown shall be allowed.

11.16 Restrained Joints. The main inlet and outlet piping to the station shall each be provided with two (2) or four (4) restraining points as welded on "eyes" or similar device welded to the framing to facilitate the attachment of joint restraint tie rods or other device to be used in retarding any pipe movement at the connections.

11.17 Compression Couplings. The booster station piping shall include a compression type, flexible coupling to prevent binding and facilitate removal of associated equipment where shown on the plans for this item. In lieu of a compression coupling, a Uni-Flange or a flanged coupling adapter (FCA) may be used. All compression couplings, Uni-Flanges, flanged coupling adapters (FCA), and flexible connectors/expansion joints shall include a minimum of two (2) control joint rods with appropriate restraining points.

11.18 Combination Pressure Gauges. Combination pressure gauges shall have a built-in pressure snubber and 4-1/2 inch minimum diameter faces and be turret style, black phenolic case with clear glass face. The movement shall be rotary, of 400 Series stainless steel with teflon coated pinion gear and segment. The gauge shall be bottom connected & accept a 1/4" NPT female thread. Combination pressure gauge range and scale graduations shall be in psi and feet of water as follows:

Suction Pressure - 0 to 200 psi, 20 psi figure intervals, with graduating marks every 2 psi (0-460 feet).

Discharge Pressure - 0 to 300 psi, 25 psi figure intervals, with graduating marks every 5 psi (0-690 feet).

All gauges will be panel mounted off the pipeline and be flexible connected to their respective sensing point. The gauge trim tubing shall be complete with both isolating and vent valves and the tubing shall be so arranged as to easily vent air and facilitate gauge removal. Gauges mounted directly to the pipeline or at the sensing point will not be accepted.

Gauges shall be manufactured by WIKA Model 212.34, or approved equal.

11.19 Sample Tap. A single, right angle outlet, smooth nose, brass sample tap shall be affixed to the manual vent ball valve for the low suction lockout and suction pressure gauge assembly.

11.20 Hose Bibb with Vacuum Breaker. There shall be provided a standard hose bibb with valve and vacuum breaker on the suction piping. The hose bibb connection shall be through a pressure regulator if the header pressure would exceed 60 psi.

11.21 Butterfly Valves. Valve body shall be wafer style and meet ANSI Class 125/150 flange standards. Metal reinforced dovetail seat shall ensure drop tight, bi-directional shutoff. The stem shall be one piece. The disc and stem shall be connected by a stainless steel torque plug which shall provide positive engagement. The valve shall have upper and lower RTFE inboard stem bearings, isolated from the line media, and a heavy-duty upper stem bushing.

The valve body shall be cast iron; aluminum bronze disc; stainless steel stem; EPDM seat; acetal upper stem bushing; BUNA-N V-cup stem seal.

Valve sized six (6) inches and smaller shall be equipped with lever operator and 10 degree increment throttling plate. Valve sized eight (8) inches and larger shall be equipped with a weather-proof, heavy-duty, gear operator complete with a position indicator.

The butterfly valves shall be manufactured by Keystone, Model 221-786, or approved equal.

11.22 Non-Slam Check Valve. Each pump discharge pipe run shall include a wafer-type, non-slam check valve. The body of the check valve shall be cast iron. The plug and seat shall be bronze and conform to ASTM Designation B-584. The seat shall contain a Buna-N seal to provide zero leakage. The seal design shall provide zero leakage at both low and high pressure without over-loading or damaging the Buna-N seal. The guide bushings shall be bronze copper alloy and conform to ASTM Designation B-584. The valve spring and seat retainers shall be stainless steel and conform to ASTM Designation A-313. The valve plug shall be guided at both ends by a center shaft integral with the valve plug. Alignment of the center shaft shall be provided by guide bushings.

Non-slam check valves shall be Val-Matic Series 1400-BN, or approved equal.

11.23 Relief Valve. The relief valve shall be pilot controlled, hydraulically operated, diaphragm type automatic control valve. The main valve shall be furnished with a resilient, replaceable seat. The control pilot shall be a direct-acting, adjustable, spring loaded, normally closed pilot designed to close the main valve whenever the sensed pressure is below the pilot spring setting. The relief valve shall function to limit the discharge header pressure to the value set into the control pilot. The valve shall be sized as shown on the plan and be globe pattern, flanged to meet ANSI Class 125 and have a maximum pressure rating of 250 psi.

The Relief Valve shall be manufactured by Cla-Val, Model 50G-01BKC, or approved equal.

11.24 Gate Valve. The meter inlet isolating valve where shown and as sized on the plan sheet covering this item shall be a gate valve meeting or exceeding AWWA Standard C-500. The gate

valve will be cast iron body, bronze mounted, resilient seat, NRS (non-rising stem). The valve will be flanged pattern with flange and drilling complying to ANSI B16.1, Class 125. The valve will be complete with handwheel operator and shall be constructed so as to open left (counter-clockwise). Maximum working pressure shall be 200 psi.

The gate valve shall be manufactured by M & H Valve, model 4067-02, or approved equal.

11.25 Magnetic Flow Meter. The magnetic flowmeter shall be microprocessor-based, and flanged. It shall indicate, totalize, and transmit flow in full pipes. The magnetic flowmeter shall utilize DC bi-polar pulsed coil excitation, automatically re-zeroing after every cycle. The accuracy shall be at least 0.5% of flow rate over a 33:1 turndown at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the NIST.

The flow sensor liner shall be Tefzel as approved by both the EPA and the FDA. The housing shall be steel. The integrally-mounted flow sensor and transmitter shall be FM approved and CSA approved. The electronics shall be remote mounted in a Nema 4X enclosure as shown on the plans.

The meter shall incorporate HI-Z circuitry. The preamplifier input impedance shall not be less than 10^{12} ohms. External ultrasonic electrode cleaners shall not be acceptable. Isolated outputs shall be 4-20 mA dc. Low flow cutoff shall be adjustable from 0-9% FS and there shall be two flow alarms settable from 0-99% of span.

The 2-line, 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display. The flowmeter shall incorporate the MAG-COMMAND feature allowing menu selection and changes to be made from outside the housing via Hall-effect sensors. It shall not be necessary to remove covers, panels or fasteners to accomplish calibration or program changes. The meter software shall incorporate a password feature preventing inadvertent program changes. All printed circuit boards shall be contained in a plug-in module and be interchangeable for any size without requiring test equipment. Totalized flow and programmed configuration shall be maintained in memory for the meters lifetime.

The flow meter shall be manufactured by Sparling Instruments, Inc., model FM656 TIGERMAGEP, or approved equal.

The design is based on the Sparling Model 656 Magnetic Flow Meter, requiring 3 upstream and zero downstream straight pipe diameter lengths for maintaining stated accuracy limits. Specification or of any other manufacturers flow meter will not keep this design within the accuracy limits of that flow meter.

11.26 Meter Test Port. The meter installation shall be complete with a meter test port as shown on the plans for this item. The test port shall be installed a minimum of two (2) diameters downstream of the meter. The test port shall consist of a NPT coupling in the pipe downstream of the meter capable of accommodating a threaded by hose connection adapter. The connection shall be plugged.

11.27. Pressure Testing. When the station plumbing is completed, the pressure piping within the station (including valves, pumps, control valves, and fittings), connections as make up the entire system shall be hydrostatically tested at a pressure of 150 psi or a pressure equal to the lowest test

pressure rating of the equipment within the tested system, whichever is lesser pressure. The test pressure shall be applied for a minimum of 20 minutes, during which time all joints, connections and seams shall be checked for leaking. Any deficiencies found shall be repaired and the system shall be retested.

The results of this testing shall be transmitted in writing to the Engineer prior to shipment of the station and shall note test pressure, time at full pressure and be signed by the Quality Control Manager or test technician.

11.28 Electrical Apparatus – Design, Assembly & Test. The electrical apparatus and control panel design, assembly, and installation, and the integration of component parts will be the responsibility of the manufacturer of record for this booster pumping equipment. That manufacturer shall maintain at his regular place of business a complete electrical design, assembly and test facility to assure continuity of electrical design with equipment application. Control panels designed, assembled or tested at other than the regular production facilities or by other than the regular production employees of the manufacturer of record for this booster pumping equipment **will not** be approved.

11.29 Conformance to Basic Electrical Standards. The manufacturer of electrical control panels and their mounting and installation shall be done in strict accordance with the requirements of UL Standard 508 and the National Electrical Code (NEC) latest revision so as to afford a measure of security as to the ability of the eventual owner to safely operate the equipment. No exceptions to the requirements of these codes and standards will be allowed; failure to meet these requirements will be cause to remove the equipment and correct the violation.

11.30 U.L. Listing. All service entrance, power distribution, control and starting equipment panels shall be constructed and installed in strict accordance with Underwriter's Laboratories (UL) Standard 508 "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility. All panels shall bear a serialized UL label indicating acceptance under Standard 508 and under Enclosed Industrial Control Panel or Service Equipment Panel. In addition, a photocopy of the UL labels for this specific project shall be transmitted to both the project engineer and the contractor for installation within their permanent project files, prior to shipment of the equipment covered under these specifications.

11.31 E.T.L. Listing. All control panels shall be E.T.L. Listed by Interek Testing Services (ITS) under Category 4 - Industrial Control Equipment. Each completed panel shall bear an E.T.L. listing label. The listing label shall include the station manufacturer's name, address and telephone number. The station manufacturer shall have quarterly inspections performed by ITS at the manufacturer's facilities to ensure that the products being listed comply with the report and procedural guide for that product.

11.32 Equipment Grounding. Each electrical equipment item in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, pump motor frames, control panel, transformer, convenience receptacles, dedicated receptacle for heater, air conditioner, dehumidifier, lights, light switch, exhaust fans and pressure switches.

All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a copper ground buss specific for grounding purposes and so labeled. The ground buss shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.

11.33 Panel Mounting Hardware. Metal framing channel shall be used exclusively for mounting of all electrical panels and electrical components except for those specifically designated otherwise.

11.34 Electrical Service. The contractor shall provide a 480 volt, 3 phase, 60 cycle, 4 wire electrical service for this station.

11.35.1 Electrical Apparatus – Distribution Panel. The distribution panel shall be a single section, bolt-on panelboard, bottom feed, surface mount, SE rated, NEMA 1 enclosure for three phase, three wire, 480 VAC Delta power and with aluminum bus. Circuit breakers are rated for 10 KAIC. The main circuit breaker shall be rated for 400 amp service. The distribution panel shall be complete with the following branch circuit breakers:

One (1) 3-pole, 400 amp main breakers;
Three (3) 3-pole, 125 amp domestic pump motor breakers;
One (1) 3-pole, 30 amp surge protection breaker;
One (1) 3-pole, 15 amp phase monitor breaker;
One (1) 2-pole, 30 amp primary transformer breaker;
One (1) 3-pole, 30 amp HVAC breaker;

11.35.2 Electrical Apparatus – Control Panel. All circuit breakers, motor starters, time delay relays and control relays shall be incorporated into one (1) NEMA 4/12 control panel.

There shall be provided, thermal-magnetic trip circuit breakers as follows:

One (1) Main Breaker, 60 amps;
Auxiliary Circuit Breakers, as necessary:

1. Controls
2. Lights
3. Heater
4. Air Conditioner
5. Dehumidifier
6. Exhaust Fan
7. Convenience Outlets
8. Telemetry
9. Spare

11.35.3 Electrical Apparatus – Adjustable Frequency Drives. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

The VFD package as specified herein shall be UL listed as a complete assembly and enclosed in an integrated UL type 1 enclosure, assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30%

nominal, and -35% nominal voltage as a minimum.

All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.

The keypad shall include Hand-Off Auto selections and manual speed control. The drive shall incorporate bumpless transfer of speed reference when switching between Hand and Auto modes. There shall be fault reset and Help buttons on the keypad. The Help button shall include on-line assistance for programming and troubleshooting.

There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

The VFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide on command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.

The VFD shall have cooling fans that are designed for easy replacement. Operating temperature will be monitored and used to cycle the fans on and off as required. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate of decelerate to setpoint without safety tripping or component damage (flying start).

The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.

The overloading rating of the drive shall be 110% of its normal duty current rating for one (1) minute every ten (10) minutes, 130% overload for two (2) seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

The VFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC buss) reactors, or 5% AC line reactors. VFDs with only one DC reactor shall add AC line reactors.

The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.

The VFD shall be capable of sensing a loss of load (broken belt/broken coupling) and signal the loss of load condition. Relay outputs shall include programmable time displays that will allow for drive acceleration from zero speed without signaling a false underload condition.

If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user.

The VFD shall have programmable Sleep and Wake up functions to allow the drive to be started and stopped from the level of process feedback signal.

All VFD to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
2. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.
3. Two (2) programmable analog inputs shall accept current or voltage signals.
4. Two (2) programmable analog outputs (0-20mA or 4-20mA).
5. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.
6. Three (3) programmable digital Form-C relay outputs.
7. Seven (7) programmable preset speeds.
8. Two (2) independently adjustable accel and decel ramps with 1 - 1800 seconds adjustable time ramps.
9. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.
10. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.
11. The VFD shall include password protection against parameter changes.

The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values shall be capable of being displayed at all times.

The VFD shall have an RS-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Each individual drive shall have the protocol in the base VFD. All protocols shall be certified by the governing authority. Serial communications capabilities shall include, but not be limited to; run-stop control, speed set adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output valves. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status

indicates and settings shall be transmitted over the serial communications buss - keypad Hand or Auto selected, bypass selected, the ability to change the PID setpoint. A minimum of 15 field parameters shall be capable of being monitored. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any VFD function.

All VFDs shall include EMI/RFI filters. The onboard filters shall allow the VFD assemble to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level.

All VFDs through 50 HP shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad.

THE VARIABLE FREQUENCY DRIVE UNITS SHALL BE ABB MODEL ACH550, or approved equal.

11.35.4 Electrical Apparatus – Running Time Meter. A running time meter shall be supplied for each pump to show the number of hours of operation. The meter shall be enclosed in a dust and moisture proof molded plastic case, suitable for flush mounting on the main control panel. The meter dial shall register in hours and tenths of hours up to 99999.9 hours before repeating. The meter shall be suitable for operation from a 115 volt, 60 cycle supply.

11.35.5 Electrical Apparatus – Phase Monitor. A phase monitor shall be supplied to protect three-phase equipment against phase loss, undervoltage and phase reversal conditions. When a fault is sensed, the monitor output relay opens within two seconds or less to turn the equipment off and/or cause an audio or visual alarm. Both Delta and Wye systems may be monitored. The monitor shall have an automatic reset and shall also include an adjustable voltage delay. The monitor shall have an indicator LED (glows when all conditions are normal and shall monitor phase sequence: ABC operate (will not operate CBA). The phase monitor shall be UL approved and CSA certified.

11.35.6 Electrical Apparatus – Surge Arrester. A secondary surge arrester shall be provided. Housing shall be Noryl and be ultrasonically sealed. Valve blocks shall be metal oxide with an insulating ceramic collar. Gap design shall be annular. The lead wire shall be permanently crimped to the upper electrode forming part of the gap structure. Arresters shall be UL and CSA listed Lightning Protective Devices.

11.35.7 Electrical Apparatus – Power Transformer. Balanced 115/230 single phase power for the auxiliary circuits within the scope of the booster station shall be obtained by use of a 10 KVA dry, step down transformer. The transformer shall be wall mounting type, in a NEMA 3R non-ventilated weatherproof enclosure. Transformer shall operate with noise levels equal to or less than ANSI and NEMA standards. Transformer insulation shall be Class 180c. The unit shall be "UL" approved for indoor/outdoor application.

11.35.8 Electrical Apparatus – Suction Pressure Control. Suction control of the pumping operation shall be provided by a bellows type, adjustable differential pressure switch. The switch shall be complete with a single pole, double throw contact block with 5 amp non-inductive rated contacts at 230 volts AC. The set points of the on/off cycle shall be independently adjustable

through the full range of the switch rating.

1. Low Suction Cut-out, 4-150 psi.
1A. Adjustable Differential, 2-25 psi.

A pressure gauge shall be sub-panel mounted adjacent to the low suction pressure switch. The gauge and switch shall be so plumbed with the suction header sensing line that a common blow-off valve can relieve pressure in both simultaneously for purposes of checking and calibrating the low suction lock-out.

11.35.9 Electrical Apparatus – Telemetry Control – Interface. It will be the responsibility of the booster station manufacturer to provide the following as an adjunct to the supplied telemetry equipment.

1. 1" telemetry entrance conduit complete to telemetry panel.
2. Size 12" x 12" NEMA 1 telemetry interface panel.
3. Separate 120 volt single phase power circuit in conduit to the telemetry interface panel.
4. Telemetry control circuits made up and in conduit from main control panel to telemetry interface panel terminal strip.
5. Metal framing channel to mount telemetry equipment.

11.35.10 Electrical Apparatus – Devices. Multi-position switches including Hand-Off-Automatic switches shall be oil tight, 3-position maintained and be located on the main control panel door.

Indicating lights shall be oil tight, with a full voltage pilot light.

Nameplates shall be furnished on all panel front mounted switches and lights.

Switches, lights and pushbuttons shall be Schneider Electric, Series XB, 22 mm, Die Cast Chrome plated devices. Pilot lights shall be with protected LED's for 120 Vac operation as XB4BVG,pushbuttons shall be non-illuminated, momentary contact, extended lens as ZB4BL and the switches shall be 2 position maintained, 2 position right-to-left, 3 position maintained, 3 position momentary-to-center, 3 position momentary from left to center, and 3 position momentary from right to center with standard black lever as ZB4BD.

Switches

1. Pump #1, 3-position;
2. Pump #2, 3-position;
3. Pump #3, 3-position;
4. Telemetry Test, 2-position.

Lights

1. Red – Low Suction Pressure;
2. Green – Pump #1 in Operation;
3. Green – Pump #2 in Operation;
4. Green – Pump #3 in Operation;

The solid state time delay relay shall have an adjustable time range of 10 seconds to 10 minutes. The relays shall be constructed to use a DIN rail mount socket so that the relays can be replaced without disturbing the wiring. The relay shall be complete with LED indicators for output and power.

Time Delay Relays

1. Low Suction Timer

The control panel door shall be complete on the interior with a stick-on transparency containing an "as-built" reproduction of the electrical control panel schematic. The wiring diagram shall be a corrected "as-built" copy & contain individual wire numbers, circuit breaker numbers, switch designation & control function explanations.

11.35.11 Electrical Apparatus – Conduit & Wiring. All service entrance conduits power and signal, shall be rigid steel conduit, individually sized to accept the inbound service conductors and telemetry/telephone/radio cables.

These service entrance conduits shall be installed from the main power or control panel through the capsule steel sidewall or the building floor and terminate exterior to the equipment enclosure as a thread hub. The service entrance exterior conduit connection points shall be capped or plugged for shipment.

All wiring within the equipment enclosure and outside of the panel enclosures shall be run in conduit except where watertight flexible conduit is properly used to connect pump drivers, fan motors, solenoid valves, limit switches, etc., where flexible connections are best utilized.

Devices and appliances where furnished by the original manufacturer and being equipped with a UL approved rubber cord and plug, may be plugged into a receptacle.

Equipment enclosure conduits shall be rigid, heavy wall, Schedule 40 PVC with solvent weld moisture-proof connections, in minimum size 3/4" or larger, sized to handle the type, number and size of equipment conductors to be carried.

The conduiting shall be in compliance with Article 347 of the National Electrical Code and NEMA TC-2, Federal WC-1094A and UL-651 Underwriters Laboratory Specifications.

Where flexible conduit connections are necessary, the conduit used shall be Liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed conduit sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 351 of the National Electrical Code.

Motor circuit conductors shall be sized for load. All branch circuit conductors supplying a single motor of one (1) horsepower or more shall have an ampacity of not less than 125 percent of the motor full load current rating, dual rated type THHN/THWN, as set forth in Article 310 and 430-B of the National Electrical Code, Schedule 310-13 for flame retardant, heat resistant thermoplastic, copper conductors in a nylon or equivalent outer covering.

Control and accessory wiring shall be sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code, Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NTMA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

11.35.11.1 Equipment Enclosure Conduit. Rigid, heavy wall, Schedule 40 PVC with solvent weld moisture-proof connections, in minimum size 3/4" or larger, sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 347 of the National Electrical Code and NEMA TC-2, Federal WC-1094A and UL-651 Underwriters Laboratory Specifications.

11.35.11.2 Flexible Connections. Where flexible conduit connections are necessary, the conduit used shall be liquid-tight, flexible, totally nonmetallic, corrosion resistant, nonconductive, U.L. listed conduit sized to handle the type, number and size of equipment conductors to be carried - in compliance with Article 351 of the National Electrical Code.

11.35.11.3 Motor Circuit Conductors. Sized for load. All branch circuit conductors supplying a single motor of one (1) horsepower or more shall have an ampacity of not less than 125 percent of the motor full load current rating, dual rated type THHN/THWN, as set forth in Article 310 and 430-B of the National Electrical Code, Schedule 310-13 for flame retardant, heat resistant thermoplastic, copper conductors in a nylon or equivalent outer covering.

11.35.11.4 Control & Accessory Wiring. Sized for load, type MTW/AWM (Machine tool wire/appliance wiring material) as set forth in Article 310 and 670 of the National Electrical Code, Schedule 310-13 and NFPA Standard 79 for flame retardant, moisture, heat and oil resistant thermoplastic, copper conductors in compliance with NTMA and as listed by Underwriters Laboratories (AWM), except where accessories are furnished with a manufacturer supplied UL approved rubber cord and plug.

11.35.12 Electrical Apparatus – Receptacles. Two (2) duplex, ground fault circuit interrupter type receptacles shall be furnished about the periphery of the equipment enclosure, with one (1) receptacle adjacent to the main control panel.

11.36.1 Convenience Group – Lighting. Exterior Lighting: An exterior light shall be provided as located on the drawing. The light shall be 50 watt high pressure sodium. Housing shall be one piece, injection molded, bronze polycarbonate. A button type photo control shall be provided.

Interior Lighting: There shall be one or more two-tube, 32 watt per tube, electronic start, enclosed and gasketed, forty-eight (48) inch minimum length fluorescent light fixtures installed within the equipment enclosure, as shown on the plan for this item. The light switch shall be of the night glow type and be located conveniently adjacent to the door.

Open fluorescent or incandescent fixtures **will not** be accepted.

11.36.2 Convenience Group – Heating/Cooling/Exhaust Fan. The unit shall be one-piece, wall-mounted, factory-assembled, pre-charged, prewired, tested and ready-to-operate. The unit shall

have a limited warranty of 5-years on parts and 1-year on compressor. Capacity and EER certified in accordance with ANSI/ARI Standard390-2003.

1. One (1) each exterior wall mounted, hard-wired as shown;
2. Enclosed weatherproof casing constructed of 20 gauge galvanized steel, finished with baked-on polyester enamel paint;
3. One (1) washable filter;
4. Remote adjustable thermostat;
5. Refrigerant: 410A (HFC);
6. Minimum EER Rating: 9.00

Cooling Capacity	BTUH	Breaker size	CFM @ 0.2" ESP, (Max/Min)	Heater	Bard Manufacturing Part Number
3.5 Ton	41,000	30	1635/1400	15 KW	W42A1-C15BW

11.36.3 Convenience Group – Dehumidifier.

1. One (1) each, installed as shown.
2. Capacity 30 pints per 24 hours.
3. Compressor rated 115 volts, 60 Hz, 3.4 operating amps.
4. 106 CFM fan, 2 fan speed.
5. Humidity range 35 to 80% RH, ambient temperature range of 41 to 95 F, Type R410A refrigerant.
6. Washable filter.
7. Condensate piped direct to drain.
8. UL listed rubber cord.
9. EPA compliant.

11.37 Factory Start-Up Service.

1. Start-up service technician shall be a regular employee of booster station manufacturer.
2. As part of the submittal covering this equipment, list the factory service manager, his employee number, his telephone number with extension and his number of years with the company. List also each start-up service technician, his employee number and years of service with the company.
3. Verify that one (1) or more of the service technicians listed above will perform the required start-up service on the equipment covered in the submittal.
4. One (1) full day at job site for start-up and training.
5. Start-up service to include two (2) bound O&M manuals.
6. Start-up service report attested to by start-up technician and representative of owner or engineer.
7. Service report distributed to:
   A. Manufacturer's File
   B. Engineer's File
   C. Contractor's File

D. Owner's File

11.38 Manufacturer's Warranty. The warranty is the sole responsibility of the station manufacturer and that manufacturer's warranty shall be provided in written form for inclusion with both the submittal covering the specified equipment and the O&M manuals provided with that equipment.

Said manufacturer's warranty shall at a minimum cover:

1. A period of one (1) year commencing upon successful start-up, after authorized manufacturer's start-up, not to exceed eighteen (18) months from the date of shipment.

2. The one (1) year period shall be inviolate regardless of any component manufacturer's warranty for equipment and components within the station.

3. The manufacturer's warranty shall cover all equipment, components and systems provided in or with the station by the manufacturer of the station, exclusive of those components supplied by and/or installed by others independent of the manufacturer of record for this station.

4. The warranty shall provide for the station manufacturer to bear the full cost of labor and materials for replacement and/or repair of faulty or defective components so there shall be no cost incurred by the Owner for this work during the warranty period.

5. The manufacturer's warranty policy is amended only by the items considered consumables, i.e., light bulbs, pump seals, pump packing, lubricants and other maintenance items consumed by usage.

6. No assumption of contingent liabilities for any component failure during manufacturer's warranty is made.

It is the intent of this manufacturer's warranty to gain for the owner a single source responsible party for all components specified herein. "Second party" or "pass through" warranties will not be accepted.

If the submitted written manufacturer's warranty does not meet the minimum requirements set forth above, that submittal will forthrightly be rejected.

11.39 Payment. The unit price bid shall constitute full compensation for the complete and functioning booster pump station.

SECTION 12 – CHAIN LINK FENCING

12.0 Worked Included. The Contractor shall furnish all labor, equipment and materials required to furnish and install chain link fence and gates complete including all erection accessories, fittings and fastenings, as specified herein, and any other incidental items of the types and sizes and at the locations shown on the Drawings.

12.1 Description. Chain link fence shall be installed after completion of clearing and grubbing. The fencing shall be of standard overall height of nine (9) feet and constructed of chain link fabric with three rows of barbed wire on top of steel brackets. Chain link fabric shall be one foot less than the complete overall height of the fence. Pedestrian gates shall have four foot openings. Vehicular gates shall be of the double swing type as shown and with the opening indicated on the Drawings.

12.2 Materials. The fence shall be constructed of one type material as indicated on the Drawings and as specified under this Section. Posts, braces and accessories shall conform to the standards of the Chain Link Fence Manufacturer's Institute (CLFMI) Specifications for industrial steel fences. Fence material, setting and accessories shall be as follows:

12.2.1 Fabric. Galvanized after woven, chain link copper bearing steel No. 9 gauge wire with 2-inch mesh with twisted and barbed finish at top and bottom and of a normal fabric width of eight feet.

12.2.2 Posts, Top Rail, and Braces. Shall be galvanized steel pipe, steel tube, H, I or U rolled sections, standard with the manufacturer.

12.2.3 Extended Arms. Shall be of the angle type and of pressed steel so as to receive three strands of barbed wire.

12.2.4 Barbed Wire. Shall be two-strand twisted No. 12-1/2 gauge double galvanized copper bearing steel wire with four point barbs of No. 14 gauge double galvanized copper bearing steel wire spaced approximately five inches apart.

12.2.5 Fence Installation and Post Setting. Shall conform to the CLFMI standards for chain link fence installation. The purpose of this fence is to keep people and animals out and therefore no crawl space beneath the fence will be allowed.

12.2.6 Gates. Frames shall be filled with fabric of the same specification as used in the chain link fence. Gates shall be equipped with offset hinges and latch for padlock arrangement, including 2-inch padlock, plus plunger rod and catch. Three keys shall be furnished with each padlock.

12.3 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 13 – EROSION CONTROL

13.0 Scope of Work. It is intent of this specification to define the acceptable methods and materials for preparing storm water Best Management Plan and Notice of Intent, installing all applicable erosion control measures in accordance with Best Management Practice Plan and as specified and maintain erosion control measures as needed.

13.1 Installation Plan.

13.1.1 Minimize Disturbance and Buffer Strips Only areas necessary for construction shall be disturbed, cleared or graded. Vehicles and construction equipment shall be excluded from these areas so to preserve all natural vegetation. All areas that are disturbed during construction, including slopes, shall be protected during clearing and construction in accordance with the approved erosion and sediment control plan until they are permanently stabilized.

If top soil is needed for the re-establishment of vegetation, it shall be piled until the necessary amount needed to finish grading of all exposed areas. Areas that are to be filled shall be cleared, grubbed to remove trees, vegetation, roots and other objectionable material, and stripped of topsoil.

Areas to receive topsoil shall be scarified to a minimum depth of three inches prior to the placement of topsoil. All fills shall be compacted as required by building standards to reduce erosion, slippage, settlement, subsidence and other related problems. Fill intended to support buildings, structures, conduits, etc., shall be compacted in accordance with local requirements or codes.

13.1.2 Land Grading for Minimizing Erosion. Only areas necessary for construction shall be disturbed, cleared or graded. Vehicles and construction equipment shall be excluded from these areas so to preserve all natural vegetation. All areas that are disturbed during construction, including slopes, shall be protected during clearing and construction in accordance with the approved erosion and sediment control plan until they are permanently stabilized. All sediment control measures shall be constructed and maintained in accordance with the approved erosion and sediment control plan and according to the standards and specifications for the appropriate erosion control practices.

If top soil is needed for the re-establishment of vegetation, it shall be piled until the necessary amount needed to finish grading of all exposed areas. Areas to receive topsoil shall be scarified to a minimum depth of three inches prior to the placement of topsoil.

The outer face of the fill slope should always be allowed to stay loose, not rolled, compacted, or bladed smooth. A bulldozer may run up and down the fill slope so the dozer treads create groves perpendicular to the slope. Use slope breaks, such as diversions, benches, or contour furrows as appropriate, to reduce the length of cut-and-fill slopes to limit sheet and rill erosion and prevent gullying. The finish cut-and-fill slopes,

which are to be vegetated with grass and legumes, should not be steeper than two horizontal to one vertical.

Roughen the surface of all slopes during the construction operation to retain water, increase infiltration, and facilitate vegetation establishment.

Seeps or springs encountered during construction shall be handled in accordance with approved methods.

Stabilize all graded areas with vegetation, crushed stone, rip-rap, or other ground cover as soon as grading is completed or if work is interrupted for 21 working days or more.

Use mulch to stabilize areas temporarily where final grading must be delayed. Stockpiles, borrow areas and spoil areas shall be shown on the plans and shall be stabilized to prevent erosion and sedimentation.

13.1.3 Erosion Control Blankets and Matting.

A. Site Preparation. Proper Site Preparation is essential to ensure complete contact of the protection matting with the soil. Grade and shape area of installation. Remove all rocks, clods, vegetation or other obstructions so that the installed blankets, or mats will have direct contact with the soil. Prepare seedbed by loosening two to three inches of topsoil above final grade. Incorporate amendments, such as lime and fertilizer, into soil according to soil test and the seeding plan.

B. Seeding. Seed area before blanket installation for erosion control and re-vegetation or seed after mat installation for turf reinforcement. When seeding prior to blanket installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

C. Anchoring. U-shaped wire staples, metal geotextile stake pins or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples should be a minimum of 11 gauge. Metal stake pins should be 3/16 inch diameter steel with a 1 ½ inch steel washer at the head of the pin. Wire staples and metal stake should be driven flush to the soil surface. Two inches of wood staking should remain above the soil surface. All anchors should be six to eight inches long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.

D. Installation on Slopes. Begin at the top of the slope and anchor its blanket in a six inches deep by six inches wide trench. Backfill trench and tamp earth firmly. Unroll blanket down slope in the direction of the water flow. Lay blankets loosely and maintain direct contact with the soil. Do not stretch. The edges of adjacent parallel rolls must be overlapped two to three inches and be stapled every three feet. When blankets must be spliced, place blankets end over end (shingle style) with six inches overlap. Staple through overlapped area, approximately twelve inches apart.

Blankets shall be stapled sufficiently to anchor blanket and maintain contact with the soil. Staples shall be placed down the center and staggered with the staples placed along the edges Steep slopes, 1:1 to 2:1, require 2 staples per square yard. Moderate slopes, 2:1 to 3:1, require 1 ½ staples per square yard (1 staple three feet on center). Gentle slopes require 1 staple per square yard.

E. Installation in Channels. Dig initial anchor trench twelve inches deep and six inches wide across the channel at the lower end of the project area. Excavate intermitten check slots, six inches deep and six inches wide across the channel at twenty five to thirty five foot intervals along the channel. Cut longitudinal channel anchor slots four inches deep and four inches wide along each side of the installation to bury edges of matting, whenever possible extend matting two to three inches above the crest of channel side slopes.

Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at one foot intervals. Note: matting will initially be upside down in anchor trench.

In same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of three inches. Secure these initial ends of the mats with anchors at one foot intervals, backfill and compact soil. Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining three inch overlap.

Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot the fold back against itself. Anchor through both layers of mat at one foot intervals the backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench. Alternate method for non-critical installations: place two rows of anchors on six inch centers at twenty five to thirty foot intervals in lieu of excavated check slots.

Shingle-lap spliced ends by a minimum of one foot with upstream mat on top to prevent uplifting by water or begin new rolls in a check slot. Anchor overlapped area by placing two rows of anchors, one foot apart on one foot intervals.

Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.

Anchor, fill and compact upstream end of map in a twelve inch by six inch terminal trench. Secure mat to ground surface using U-shaped wire staples geotextile pins or wooden stakes. Seed and fill turf reinforcement matting with soil, if specified. After seeding, spread and lightly rake ½ inch to ¾ inch of fine topsoil into the mat apertures to completely fill mat thickness. Use backside of rake or other flat implement.

Spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment. Do not drive tracked or heavy equipment over mat. Avoid any

traffic over matting if loose or wet soil conditions exist. Use shovels, rakes or brooms for fine grading and touch up. Smooth out soil filling just exposing top netting of matrix.

F. Inspection and Maintenance. All blanket and mats should be inspected periodically following installation. Inspect installation after significant rainstorms to check for erosion and undermining. Any failure should be repaired immediately. If washout or breakage occurs, reinstall the material after repairing the damage to the slope or drainage way.

13.1.4 Topsoiling. Determine whether the quality and quantity of available topsoil justifies selective handling. Soils of the textural class of loam, sandy loam, and silt loam are best; sandy clay loam, silty clay loam, clay loam, and loamy sand are fair. Do not use heavy clay and organic soils such as peat or muck as topsoil.

Strip topsoil only from those areas that will be disturbed by excavation, filling, road building, or compaction by equipment. Determine depth of stripping by taking soil cores at several locations within each area to be stripped. Put sediment basins, diversions, and other controls into place before stripping. Select stockpile location to avoid slopes, natural drainage ways, and traffic routes. Use sediment fences or other barriers where necessary to retain sediment.

Protect topsoil stockpiles by temporarily seeding and/or mulching as soon as possible to assure the stored material is not exposed and allowed to erode.

If stockpiles will not be used within twelve months they must be stabilized with permanent vegetation to control erosion and weed growth.

Before spreading topsoil, establish erosion and sedimentation control practices such as diversions, berms, dikes, waterways, and sediment basins.

Where the pH of the existing subsoils 6.0 or less, or the soil is composed of heavy clays, incorporate agricultural limestone in amounts recommended by soil tests or specified for the seeding mixture to be used. Incorporate lime to a depth of at least two inches by disking.

Immediately prior to spreading the topsoil, loosen the subgrade by disking or scarifying to a depth of at least three inches, to ensure bonding of the topsoil and subsoil. If no amendments have been incorporated, loosen the soil to a depth of at least six inches before spreading topsoil.

Uniformly distribute topsoil to a minimum compacted depth of two inches on 3:1 slopes and four inches on flatter slopes.

Do not spread topsoil while it is frozen or muddy or when the subgrade is wet or frozen.

Correct any irregularities in the surface that result from topsoiling or other operations to prevent the formation of depressions or water pockets.

Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compaction, as it increases runoff and inhibits seed germination. Light packing with a roller is recommended where high maintenance turf is to be established.

13.1.5 Temporary Gravel Construction Entrance. The aggregate size for construction of the pad shall be two to three inch stone. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.

The thickness of the pad shall not be less than six inches. Use geotextile fabrics, if necessary, to improve stability of the foundation in locations subject to seepage or high water table.

The width of the pad shall not be less than the full width of all points of ingress or egress and in any case shall not be less than twelve feet wide.

The length of the pad shall be as required, but not less than fifty feet.

Locate construction entrances and exits to limit sediment leaving the site and to provide for maximum utility by all construction vehicles. Avoid entrances which have steep grades and entrances at curves in public roads.

The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights of way. This may require periodic top dressing with additional stone as conditions demand, and repair and/or clean out of any measures used to trap sediment.

All sediment spilled, dropped, washed or tracked onto public rights-of-way shall be removed immediately. Provide drainage to carry water to a sediment trap or other suitable outlet.

When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.

All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, straw bales, or other approved methods.

Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. Replace gravel material when surface voids are visible. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary. Immediately remove all objectionable material spilled, washed, or tracked onto public roadways. Remove all sediment deposited on paved roadways within 24 hours.

13.1.6 Rock, Log and Straw Bale Check Dams. The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Rock dams shall be constructed of two to fifteen inch rock. Keep the center rock (spill way) section at least six inches lower than the outer wall edges. Extend the abutments eighteen inches into the channel bank.

Straw bales shall be placed in a single row, lengthwise, oriented perpendicular to the flow, with the ends of adjacent bales tightly abutting one another. Straw bales shall be extended such that the bottoms of the end bales are higher in elevation than the top of the middle bale spillway to ensure that sediment-laden runoff will flow over the barrier, and not around it.

Each straw bale shall be embedded in the soil a minimum of four inches. Use straw, rocks, or filter fabric to fill any gaps between the bales and tamp the backfill material to prevent erosion under or around the bales. If the straw bales are wire bound, they should be oriented so the bindings are around the sides rather than along the top and bottom. Wire bindings that are placed in contact with the soil soon disintegrate and may allow the bale to fall apart.

Construct an energy dissipater to reduce downstream erosion.

The check dams shall be inspected for damage periodically during the winter and after each significant storm (one inch in 24 hours). Prompt repairs shall be made to ensure that the dam is functioning properly. Any erosion caused by flows around edges of the dam or under the structure shall be corrected immediately.

Remove sediment from behind the dams when they become sixty percent full, or as needed. The removed sediment shall be deposited in an area that will not contribute sediment off site and can be permanently stabilized. Remove check dams and stakes when stabilization is complete.

13.1.7 Straw Bale Dike. The bales shall be placed on the slope contour at the base of the slope or around the perimeter of the construction site. If the dike is constructed at the toe of a slope, place it five to six feet away from the slope if possible.

Do not construct the dike more than one bale high. Bales shall be placed in a row with the ends tightly abutting. Each bale shall be embedded in the soil a minimum of four inches. Use straw, rocks, or filter fabric to fill any gaps between the bales and tamp the backfill material to prevent erosion under or around the bales.

If the bales are wire bound, they should be oriented so the bindings are around the sides rather than along the top and bottom. Wire bindings that are placed in contact with the soil soon disintegrate and may allow the bale to fall apart.

The bales shall be securely anchored in place by two wooden stakes or rebar driven through the bales. The first stake in each bale shall be driven toward the previously laid bale to force the bales tightly together. Drive the stakes at least eighteen inches into the ground.

The straw bale dikes shall be inspected weekly and after each significant storm (one inch in 24 hours). Repairs and/or replacement shall be made promptly. Remove the straw bales when the upslope areas have been permanently stabilized. Remove sediment behind barrier when it reaches a depth of 6 inches.

13.1.8 Silt Fence. The height of a silt fence shall not exceed thirty six inches. Storage height shall never exceed eighteen inches. The fence line shall follow the contour as closely as possible. If possible, the filter fabric shall be cut from a continuous roll to avoid the use of joints. When joints are necessary, filter cloth shall be spliced only at a support post, with a maximum six inch overlap and both ends securely fastened to the post.

Posts shall be spaced a maximum of ten feet apart and driven securely into the ground (minimum of twelve inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six feet. Turn the ends of the fence uphill.

A trench shall be excavated approximately four inches wide and six inches deep along the line of posts and upslope from the barrier.

When standard-strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than thirty six inches above the original ground surface.

The standard-strength filter fabric shall be stapled or wired to the fence, and six inches of the fabric shall extend into the trench. The fabric shall not extend more than thirty six inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

When extra-strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts.

The trench shall be backfilled and the soil compacted over the toe of the filter fabric.

Silt fences placed at the toe of a slope shall be at least six feet from the toe in order to increase ponding volume.

Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized, and any sediment stored behind the silt fence has been removed.

Silt fences and filter barriers shall be inspected weekly and after each significant storm (one inch in 24 hours). Any required repairs shall be made immediately. Sediment shall be removed when it reaches 1/3 height of the fence or nine inches maximum.

13.1.9 Drop Inlet Sediment Barriers.

A. Straw Bale Barrier. Excavate a four inch deep trench around the inlet and make the trench as wide as a straw bale in order to embed the bales properly. Orient the straw bales with the bindings around the sides of the bales so the wire does not come in contact with the soil.

Place bales lengthwise around the inlet and press the ends of adjacent bales together. The bales may be loosely joined if more gravel is utilized.

Drive two two by two inch stakes through each bale to anchor the bale securely in place.

Utilize ¾ inch to two inch gravel to fill the void spaces between the bales if necessary to dewater the ponded area more rapidly.

B. Silt Fence Sediment Barrier. Support posts for a silt fence must be steel fence posts or two inch by four inch wood, length three feet minimum, spacing three feet maximum, with a top frame support recommended. Excavate a trench four inches wide and six inches deep and bury the bottom of the silt fence in the trench. Backfill the trench with gravel or soil. Compact backfill well. The height of the silt fence shall be a maximum of eighteen inches measured from the top of the inlet.

Inspect the barrier after each rain and promptly make repairs as needed. Sediment shall be removed after each significant storm (one inch in 24 hours) to provide adequate storage volume for the next rain. The removed sediment shall be deposited in an area that will not contribute sediment off-site and can be permanently stabilized. For gravel filters, if the gravel becomes clogged with sediment it must be carefully removed from the inlet and either cleaned or replaced.

13.1.10 Curb Inlet Sediment Barriers. Place the barriers on gently sloping streets where water can pond. The barriers must allow for overflow from a severe storm event. Slope runoff shall be allowed to flow over blocks and gravel and not be bypassed over the curb. A spillway shall be constructed with the sandbag structures to allow overflow.

The sandbags should be of woven-type geotextile fabric since burlap bags deteriorate rapidly. Sandbags shall be filled with ¾ inch drain rock or ¼ inch pea gravel.

The sandbag shall be placed in a curved row from the top of the curb at least three feet into the street. The row should be curved at the ends, pointing uphill.

Several layers of bags should be overlapped and packed tightly. Leave a one-sandbag gap in the top row to act as a spillway.

Inspect and clean the barrier after each significant storm (one inch in 24 hours) and remove sediment from behind the structure after every storm. Any sediment and gravel shall be immediately removed from the traveled ways of roads. The removed sediment shall be placed where it cannot enter a storm drain, stream, or be transported off site.