STOLL KEENON OGDEN PLLC

GERALD WUETCHER
DIRECT DIAL: (859) 231-3017
DIRECT FAX: (859) 259-3517
gerald.wuetcher@skofirm.com

300 WEST VINE STREET
SUITE 2100
LEXINGTON, KY 40507-1801
MAIN: (859) 231-3000
FAX: (859) 253-1093

September 15, 2020

Kent A. Chandler, Esq.
Acting Executive Director
Kentucky Public Service Commission
P.O. Box 615
Frankfort, KY 40602-0615

Re: ***Case No. 2019-00375***
Tracy Kay Sanders v. Green River Valley Water District

Dear Mr. Chandler:

Enclosed for filing in the above-referenced case is Green River Valley Water District's Response to Commission Staff's First Request for Information and its Motion for Deviation. This letter and the enclosed document are true and accurate copies in paper medium of the electronic version of the documents that were emailed to the Public Service Commission this day. Please note that Attachment 2D (oversized engineering plans) to the Response has been submitted as a separate document.

Sincerely,

Stoll Keenon Ogden PLLC

Gerald E. Wuetcher

GEW
Enclosure

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

TRACY KAY SANDERS	)	
	)	
COMPLAINANT	)	
	)	
v.	)	**CASE NO. 2019-00375**
	)	
GREEN RIVER VALLEY WATER DISTRICT	)	
DEFENDANT	)	

RESPONSE OF GREEN RIVER VALLEY WATER DISTRICT TO COMMISSION STAFF'S FIRST REQUEST FOR INFORMATION

Green River Valley Water District submits its Response to Commission Staff's First Request for Information.

Dated: September 15, 2020

Respectfully submitted,

Patrick A. Ross
hrh@scrtc.com
Hensley & Ross Attorneys
P.O. Box 350
Horse Cave, Kentucky 42749
Telephone: (270) 786-2155
Fax: (270) 786-2118

Gerald E. Wuetcher
gerald.wuetcher@skofirm.com
Stoll Keenon Ogden PLLC
300 West Vine St. Suite 2100
Lexington, Kentucky 40507-1801
Telephone: (859) 231-3000
Fax: (859) 259-3517

Counsel for Green River Valley Water District

CERTIFICATE OF SERVICE

In accordance with 807 KAR 5:001, Section 6, I certify that a true and accurate copy of this Response (without Attachment 2D) was served by U.S. Mail, postage prepaid, on Tracy Kay Sanders, 1134 Bunnell Crossing Road, Munfordville, Kentucky 42765 on September 15, 2020.

Counsel for Green River Valley Water District

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

TRACY KAY SANDERS	**)**	
	)	
COMPLAINANT	**)**	
	)	
v.	**)**	**CASE NO. 2019-00375**
	)	
GREEN RIVER VALLEY WATER DISTRICT	**)**	
DEFENDANT	**)**	

RESPONSE OF

GREEN RIVER VALLEY WATER DISTRICT

TO

COMMISSION STAFF'S FIRST REQUEST FOR INFORMATION

FILED: September 15, 2020

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF HART)

The undersigned, David Paige, being duly sworn, deposes and states that he is the General Manager of Green River Valley Water District and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

David Paige
General Manager
Green River Valley Water District

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 14th day of September 2020.

Notary Public

My Commission Expires: Jan. 17, 2024

Notary ID: KYNP960

VERIFICATION

COMMONWEALTH OF KENTUCKY)
) **SS:**
COUNTY OF FRANKLIN)

The undersigned, R. Vaughn Williams, being duly sworn, deposes and states that he is the President of Kenvirons, Inc., is a licensed professional engineer in the state of Kentucky and that he has personal knowledge of the matters set forth in the responses for which he is identified as the witness, and the answers contained therein are true and correct to the best of his information, knowledge and belief.

R. Vaughn Williams

Subscribed and sworn to before me, a Notary Public in and before said County and State, this 14 day of September 2020.

Notary Public

My Commission Expires: 11-7-23

Notary ID: #0349960

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00375

Question No. 1

Responding Witness: David Paige

Q-1. Refer to Green River Valley District's Offer of Settlement filed August 25, 2020.

a. State the basis for the estimated cost of the proposed project and provide all workpapers used to arrive at the $110,000 estimated cost.

b. Provide copies of all opinions or studies, including preliminary hydraulic data, that Green River Valley District relied upon when determining this construction project would address the low water pressure problem that is the subject of this complaint.

c. State how Green River Valley District will fund the construction project.

A-1. a. See Attachment 1.

b. See Response to Question 6, Attachment 2C.

c. See Case No. 2020-00026, Green River Valley Water District's Response to Commission Staff's Fifth Request for Information, Question No. 7c. Green River Valley Water District will use existing reserves to fund the proposed construction.

ATTACHMENT 1

KENVIRONS

Green River Valley Water District

Bunnell Crossing Booster Pump Station

Opinion of Probable Cost - Water District Constructing

September 14, 2020

Item No.	Description	Unit	Quantity	Unit Price	Item Price
1	Booster Pump Station	1	LS	$83,000.00	$83,000.00
2	3" x 3" Tapping Sleeve & Valve	3	EA	400.00	1,200.00
3	3" Gate Valve	2	EA	400.00	800.00
4	3" Blowoff Assembly	1	EA	200.00	200.00
5	3" Meter	1	EA	800.00	800.00
6	District's Labor & Equipment	1	LS	12,000.00	12,000.00
	Total Construction Cost				**$98,000.00**

Total Construction Cost	$98,000.00
Engineering	12,000.00
Total Project Cost	**$110,000.00**

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00375

Question No. 2

No Question 2 set forth in the Request

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00375

Question No. 3

Witness: Legal Counsel

Q-3. State whether Ms. Sanders has agreed to the settlement proposal. If not, provide a status update on the settlement negotiations.

A-3. Green River Valley Water District's efforts to contact Ms. Sanders have been unsuccessful. A copy of the Offer of Settlement was sent to Ms. Sanders at the address set forth in her Complaint. Counsel has attempted to telephone Ms. Sanders several times using the telephone numbers that she provided to Green River Valley Water District without success. Counsel also has sent e-mail messages to Ms. Sanders at the e-mail address provided to Green River Valley Water District requesting a response by e-mail or telephone. Counsel has not received any response to this e-mail. Green River Valley Water District respectfully recommends that the Commission issue an Order directing Ms. Sanders to advise the Commission in writing as to whether the Offer of Settlement satisfies her complaint and, if not, to state the reasons why it does not.

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00375

Question No. 4

Responding Witness: David Paige

Q-4. State how Green River Valley District is addressing the low pressure problem at Ms. Sanders's residence currently and how Green River Valley District plans to address the problem until construction is complete.

A-4. Green River Valley Water District has previously installed an individual pump at Ms. Sander's residence to maintain the appropriate pressure level. In her complaint, Ms. Sander indicated that an individual pressure pump was still in service at her residence.

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00375

Question No. 5

Responding Witness: David Paige

Q-5. State the estimated annual cost to operate the proposed pumping station.

A-5. Estimated annual cost is $1,200. This estimate includes cost for electric power and propane for use in auxiliary generator.

GREEN RIVER VALLEY WATER DISTRICT

Response to Commission Staff's First Request for Information
Case No. 2019-00258

Question No. 6

Responding Witness: Vaughn Williams

Q-6. Provide the hydraulic analysis, engineering plans and specifications, and application submitted to the Division of Water in connection with this proposed construction.

A-6. See Attachment 2 to this Response.

ATTACHMENT 2

ATTACHMENT 2A

DIVISION OF WATER APPLICATION

Form DW-1

Commonwealth of Kentucky
Energy and Environment Cabinet
Division of Water

Construction Application
For Drinking Water Distribution

See the instructions for more information about selected portions of this application.
Questions on completing this application? Contact the Water Infrastructure Branch at 502/564-3410, by e-mail at WIBEngineering@ky.gov or visit our website at http://water.ky.gov for more information.

I. Construction Project Information

Project Name: Bunnell Crossing Road Booster Pump Station

Project County: Hart Estimated Project Cost: $ 100,000.00

Project Latitude/Longitude (DMS): 37° 14' 28.8" / -85° 52' 43.8"

Is this a federally funded project: No

- ☐ DWSRF
- ☐ SPAP
- ☐ Other: _____

If yes, has an Environmental Information Document been reviewed and approved? N/A

If the project has been submitted to the State Clearinghouse for review, provide the SAI number: N/A

Identify all other funding sources: N/A

Does the project contain any of the following:

- ☑ Booster Pump Stations
- ☐ Water Storage Tanks
- ☐ Waterlines

Waterline Material	Waterline Size	Linear Feet

Provide a DETAILED description of work to be performed for this project. Attach additional sheets as necessary:

The proposed project includes the construction of a booster pump station to improve water pressure for 8 existing customers along Bunnell Crossing Road.

Identify how the sanitary wastewater produced as a result of this project will be handled:

☐ Sanitary Sewer WWTP: _____

☑ Septic Tank

☐ Other: _____

II. Utility Information

Utility Name: Green River Valley Water District PWSID: KY0500166

Street Address: 1180 East Main Street, P.O. Box 460 County: Hart

City, State, Zip: Horse Cave, KY 42749

Phone #: (270) 786-2134 Fax #: (270) 786-5261 Email: grvwd@scrtc.com

If another utility will serve any portion of the proposed project, provide the name and PWSID No.

Utility Name: _____ PWSID No. _____

If the utility serving the project purchases water from another utility, provide the name and PWSID No. and purchase contract amount.

Utility Name: _____ PWSID No. _____ Purchase Contract Amount: _____

Utility Name: _____ PWSID No. _____ Purchase Contract Amount: _____

Utility Name: _____ PWSID No. _____ Purchase Contract Amount: _____

Is the system currently under any type of waterline or sewer sanctions? _____

☐ If yes, submit an exception request and attach supporting documentation to justify its approval.

III. Design Considerations

A. Plans and Specifications

Plans and specifications shall comply with **401 KAR 8:100** and **"Recommended Standards for Water Works" 2007 Edition (Ten States' Standards)**. All plans must contain a P.E. seal, signature and date of signature with at least one set having an original seal and signature. Provide detailed plans **(no larger than 24" X 36")** which must comply with **401 KAR 8:100**. See the instructions for additional details.

B. Design Engineer

Name: Brandon L. Hamilton, P.E. Firm: Kenvirons, Inc.

Street Address: 770 Wilkinson Blvd.

City, State, Zip: Frankfort, KY 40601

Phone #: (502) 695-4357 Fax #: (502) 495-4363 Email: bhamilton@kenvirons.com

Design Capacities

Identify the number of new connections and the projected average daily demand: No new customers

Identify the number of existing residents, and their projected water demand, that may be served as a result of this project:
8 Existing Customers, Minimal change in existing demand expected

Identify the number of connections in the service area: 6,850

Other Information to be Submitted with the Project

- [x] 1. Provide a copy of the U.S.G.S. 7 ½ minute topographic map or a detailed vicinity map with the location(s) of the proposed project.
- [x] 2. If the project includes a new or upgraded pump station(s), provide the pump sizing calculations and the proposed pump's characteristics curve along with the efficiency, horsepower and NPSHR data. Also, identify each pump station's locations coordinates (DMS).
- [ ] 3. If the project proposes the addition of storage tanks, provide engineering calculations which demonstrates a complete fill and drain cycle every 72 hours. Also, identify each storage tank's location coordinates (DMS).
- [x] 4. Provide engineering calculations or an electronic model demonstrating the availability of 30 psig in the waterline under peak demand conditions.
- [x] 5. Provide engineering calculations or an electronic model that demonstrates if the proposed waterlines are capable of a 2.5 ft/sec flow velocity and show associated residual system pressures.
- [x] 6. Provide a signed letter of acceptance from the utility, which states that the utility has reviewed and approved the plans and specifications and agrees to serve the proposed project upon completion. If another utility will own, operate and maintain any portion of this project provide an acceptance letter from that utility as well.
- [ ] 7. If the utility is a purchaser and the project demand is over 10,000 gallons per day or the utility has exceeded 85% of its purchase contract, provide a valid acceptance letter from the seller.
- [ ] 8. If the project will provide water service to existing residences, provide the names and addresses of all existing residences to be served by the project, if known.
- [ ] 9. If the project is funded by a State Revolving Fund Loan (SRF) provide a completed SRF Plans and Specifications Checklist along with 1 complete printed copy of the project specifications.

IV. Environmental Benefits

Identify the environmental benefit(s) of the project by checking all that apply.

- [ ] Construction of new waterlines serving existing residences previously without public water.
- [x] Modifies/upgrades existing waterlines:
  - [ ] Inadequately sized waterlines.
  - [ ] Leaks, breaks, restrictive flow.
  - [ ] Replaces lead, copper or asbestos cement waterlines.
  - [x] Other: Construction of new booster pump station to improve serivce to existing customers.
- [ ] Provides fire protection.
- [ ] Replaces tanks/pumps due to age/condition.
- [ ] Installation of high efficiency/energy saving pumps.
- [ ] Other. Provide a brief description in the space below. _____

V. Fees

Check or money order must be made payable to "Kentucky State Treasurer" for the total amount. Fees do not apply to projects FUNDED by a municipality, water district, or other publicly owned utility.

Project Category: Water District Total Amount: $ N/A

ATTACHMENT 2B

TECHNICAL SPECIFICATIONS

KENVIRONS

TECHNICAL SPECIFICATIONS

FOR THE

GREEN RIVER VALLEY WATER DISTRICT

BUNNELL CROSSING ROAD BOOSTER PUMP STATION

Prepared By:

KENVIRONS, INC.
770 WILKINSON BLVD.
FRANKFORT, KENTUCKY 40601

PROJECT NO. 2020085

AUGUST 2020

Kenvirons, Inc.

Civil & Environmental Engineering and Laboratory Services

TECHNICAL SPECIFICATIONS

FOR THE

GREEN RIVER VALLEY WATER DISTRICT

BUNNELL CROSSING ROAD
BOOSTER PUMP STATION

Prepared By:

KENVIRONS, INC.
770 WILKINSON BLVD.
FRANKFORT, KENTUCKY 40601

PROJECT NO. 2020085

AUGUST 2020

TABLE OF CONTENTS

SECTION 02001

EARTHWORK

1.0 SCOPE

This section covers the required topsoil removal, excavation, the removal and proper utilization or disposal of all excavated materials, necessary borrow, fill requirements, and the shaping and finishing of all excavation work to the required lines and grades.

2.0 TOPSOIL REMOVAL

All topsoil on areas to receive fill shall be stripped and stockpiled at an approved location.

3.0 CLEARING AND GRUBBING

Work shall consist of cutting and removing designated trees, stumps, brush, logs, removal of fences, or other loose and projecting material. Unless otherwise specified, it shall also include the grubbing of stumps, roots and other natural obstructions which, in the opinion of the Engineer, must be removed to prosecute properly the construction work and operate properly the facility upon the completion of construction.

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 3 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.

Disposal shall be by burning or other methods satisfactory to the Engineer; however, burning will be permitted only when the Contractor has obtained written permission from the local regulatory agency.

The Contractor shall also 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.

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 resulting from the Contractor's operations.

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.

3.1 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.

4.0 STRUCTURAL EXCAVATION

Structural excavation shall consist of and include the removal of all materials encountered or involved in the excavation and subgrade preparation for the placing of structures. The final depths and extent of structural excavation will be determined by the nature of the material encountered; however, after excavation to the limits as shown on the drawings, the Engineer shall inspect the Work and determine if additional excavation is required.

5.0 EXCAVATION CONSTRUCTION METHODS

5.1 OPEN-CUT EXCAVATION - GENERAL

All open cut excavation shall be performed in accordance with this section to the lines, grades, and dimensions shown on the drawings or established by the Engineer.

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 the dry. No excavation shall be made in frozen materials without written approval.

The bottom and side slope of rock or shale upon or against which concrete or pervious blanket material is to be placed shall be excavated to the required dimensions as shown on the drawings or established by the Engineer. No material will be permitted to extend within the neat lines of the structure. If, at any point in rock or shale upon written orders from the Engineer, material is excavated beyond the limits required to receive the structure, the additional excavation shall be filled solidly with concrete. If material is excavated beyond the limits required to receive the structure without written orders from the Engineer, the additional excavation shall be brought back to grade with "Class A" concrete at the Contractor's expense.

5.2 UTILIZATION OF EXCAVATED MATERIAL

All suitable material removed from the excavations shall be used insofar as practicable, in constructing the permanent works and at such other places as directed. The Contractor shall not waste materials removed from excavations and suitable for use in the construction of the permanent works, without a written application to do so and a written approval from the Engineer.

5.3 DISPOSAL OF SURPLUS AND/OR WASTE MATERIAL

All surplus excavated material and/or all waste materials shall be disposed of outside of the floodplain in an area provided by the Contractor and approved by the Engineer.

The surfaces thereof shall be left in a neat and sightly condition and sloped to provide positive drainage. Compaction of the waste materials shall be required.

5.4 BLASTING FOR EXCAVATION

Blasting will not be allowed for this project.

5.5 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.

5.6 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 pleasing appearance and so as not to interfere in any way with the operation, usefulness or stability of the permanent structures.

5.7 PROTECTION OF FINISHED STRUCTURE EXCAVATIONS

It shall be the Contractor's responsibility to maintain finished excavated foundation surfaces for the works in good condition until such time as the structures are placed on or against the surfaces.

5.8 BORROW

Borrow excavation 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.

6.0 STRUCTURE FOUNDATION FILL

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 re-compaction. This operation shall be conducted under the surveillance of the Engineer.

6.1 FILL MATERIAL APPROVAL

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

6.2 PLACEMENT OF FILLS

Where structures or other appurtenances are constructed on fill, the fill shall be placed in layers not over six (6") inches deep, as measured before compaction and be thoroughly compacted.

6.3 COMPACTION

Compaction may be obtained by use of a sheepsfoot 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 95% of the Standard Proctor maximum dry density (ASTM Specifications D- 698). A minimum of two (2) compaction tests per each two (2') feet of fill on a structure location shall be run by an experienced soils engineering technician.

In order to prevent damage to existing structures, heavy construction equipment shall not be allowed to operate within approximately 8 feet horizontally of the existing structure exterior wall.

7.0 BACKFILLING AROUND STRUCTURES

Only suitable material approved by the Engineer shall be used for backfilling around structures.

Backfilling around structures shall have material placed in layers of six (6") 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 (1') foot above any other area. It shall be uniformly compacted throughout the structure depth. Any deviation shall be cause for the Engineer to require the material deposited to be removed and re-compacted 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 or injured. Any pipe or structure injured, 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 re-backfilled.

10.0 BACKFILLING TRENCHES

The backfill shall be in accordance with other applicable sections of these specifications.

11.0 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. Areas to be sown in grasses shall be prepared according to Section 02003. 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.

12.0 MAINTENANCE

All excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. The Contractor shall maintain trench backfill at the original ground surface by periodically adding specified backfill material as necessary or when directed by the Engineer. Such maintenance shall be continued until final acceptance of the project.

13.0 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, trench excavation, borrow excavation, backfill, sheeting, shoring, topsoil, crushed stone or gravel, drainage, pumping, embankment fills 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.

The cost of all initial soils inspections and testing shall be paid by the Owner. If compaction tests do not meet required values, the cost of additional testing as required by the Engineer shall be paid by the Contractor.

END OF SECTION

SECTION 03600

GROUT

1.0 GENERAL

1.1 REFERENCES

A. The following is a list of standards, which may be referenced in this section:

1. American Society for Testing and Materials (ASTM):
   a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   b. C 10 18, Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).
   c. C 1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   d. C 1116, Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
   e. D4580, Measuring Delaminations in Concrete Bridge Decks by Sounding, Practice for.
2. Corps of Engineers (COE):
   a. CRD-C61 1, Flow of Grout for Preplaced Aggregate Concrete.
   b. CRD-C621, Specification for Nonshrink Grout

1.2 SUBMITTALS

A. Shop Drawings:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces wet prior to placing grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Quality Control Submittals:

1. Manufacturer's Written Instructions:
   a. Adding fiber reinforcing to batching.
   b. Cement-water ratio of grout topping.
   c. Mixing of grout.
2. Manufacturer's proposed training schedule for grout work.
3. Manufacturer's Certificate of Compliance:
   a. Grout free from chlorides and other corrosion-causing chemicals.

b. Nonshrink grout properties of Categories H and III, verifying expansion at 3 or 14 days will not exceed the 28 day expansion and nonshrink properties are not based on gas or gypsum expansion.

4. Manufacturer's Certificate of Proper Installation.
5. Statements of Qualification: Nonshrink grout manufacturer's representative.
6. Test Reports:
   a. Test report for 24-hour evaluation of nonshrink grout. Independent testing laboratory to certify that testing was conducted within the past 18 months.
   b. Test results and service report from the demonstration and training session, and from field tests.
   c. Field test reports and laboratory test results for field-drawn samples.

1.3 QUALIFICATIONS

A. Nonshrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1 year experience that has resulted in successful installation of grouts similar to those for this Project.

1.4 GUARANTEE

A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

B. Manufacturer guarantees participation with CONTRACTOR in replacing or repairing grout found defective due to faulty materials, as determined by industry standard test methods.

2.0 PRODUCTS

2.1 NONSHRINK GROUT SCHEDULE

A. Furnish nonshrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Maximum Placing Time	
	40 to 100° F	20 min	Greater Than 20 min
Filing Tie Holes	I	I	I
Blockouts for Gate Guides	I or II		II
Precast Joints	I or II		II
Through-bolt openings	II	II	II
Machine bases 25 hp or less	II	II	II
Patching concrete walls	II	II	II
Machine bases 26 hp and up	III	III	III

Baseplates and/or soleplates with vibration, thermal movement, etc.	**III**	**III**	**III**

2.2 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating flowable fluid.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Test in accordance with AS TM C 1107:
   a. Flowable consistency 140 percent, five drops in 30 seconds, in accordance with ASTM C230.
   b. Flowable for 15 minutes.
4. Grout shall not bleed at maximum allowed water.
5. Minimum strength of grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; SET GROUT.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburg, OH; Sure-Grip High Performance Grout.

B. Category II

1. Nonmetallic, nongas-liberating flowable fluid.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with COE CRD-C621 and ASTM C 1107, Grade B:
   a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C61 1.
   b. Temperatures of 40, 80, and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 2,500 psi at 1 day, 4,500 psi at 3 days, and 7,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. Master Builders Co., Cleveland, OH; Master Flow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.

C. Category III:

1. Metallic and nongas-liberating flowable fluid.
2. Prepackaged aggregate grout requiring only the addition of water.

3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with COE CRD-C621 and ASTM C 1107, Grade B:
   a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C61 1.
   b. Temperatures of 40 and 100 degrees F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in I to 9 yard loads in ready-mix truck.

8. Manufacturers and Products: Master Builders Co., Cleveland, OH; EMBECO 885.

3.0 EXECUTION

3.1 NONSHRINK GROUT

A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's representative training instructions.

B. Form Tie or Through-Bolt Holes: Provide nonshrink grout, Category I and II, Fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes, coordinate dry pack dense grout application with vinyl plug in Section 03 100, CONCRETE FORMWORK and bonding agent in Section 03300, CAST-IN-PLACE CONCRETE.

C. Grouting Machinery Foundations:

1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts.
3. Form with watertight forms at least 2 inches higher than bottom of plate.
4. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative training instructions.

3.2 FIELD QUALITY CONTROL

A. Evaluation and Acceptance of Nonshrink Grout:

1. Provide a flow cone and cube molds with restraining plates onsite. Continue tests during Project as demonstrated by grout manufacturer's representative.

2. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Restraining caps for cube molds in accordance with COE CRD-C621.
3. For large grout applications make three more cubes, one more flow cone test, including bleed test for each additional 25 cubic feet of nonshrink grout placed.
4. Consistency: As specified in Article NONSBRINK GROUTS. Reject grout with consistencies outside range requirements.
5. Segregation: As specified in Article NONSHRINK GROUTS. Reject grout when aggregate separates.
6. Nonshrink grout cubes shall test equal to or greater than minimum strength.
7. Strength Test Failures: Reject nonshrink grout work failing strength tests, remove and replace grout.
8. Perform bleeding test to demonstrate grout will not bleed.
9. Store cubes at 70 degrees F.
10. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with COE CRD-C62 1.

3.3 MANUFACTURER'S SERVICES

A. General:

1. Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative.
2. Provide and conduct onsite, demonstration and training sessions for leech tests, mixing, flow cone measurement, cube testing, application, and curing for each category and type of nonshrink grout.
3. Coordinate necessary equipment and materials are available for demonstration.

B, Training:

1. Grout manufacturer's representative shall train CONTRACTOR to perform grout work.
2. Establish location at site and schedule time for grout manufacturer's demonstration and training session of proposed nonshrink grouts. Mix nonshrink grouts to required consistency, test, place, and cure on actual Project, e.g., baseplates and tie holes to provide actual on-the-job training.
3. Use minimum of five bags for each grout Category H and Category III. Mix grout to fluid consistency and conduct flow cone and two bleed tests, make a minimum of six cubes for testing of two cubes at 1, 3, and 28 days. Use remaining grout for final Work. Training includes methods for curing grout.
4. Mix sufficient grout Category I for minimum of 15 tie holes.
5. Patching through-bolt holes and blockouts for gate guides, and similar items.

6. Transport test cubes to an independent test laboratory and obtain test reports.

3.4 SUPPLEMENTS

A. The supplement listed below, following "END OF SECTION 03600" is part of this Specification.

1. 24-hour Evaluation of Nonshrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

SUPPLEMENT I

_____

(Test Lab Name)

_____

(Address)

_____

(Phone No.)

24-HOUR EVALUATION OF NONSHRINK GROUT TEST FORM

OBJECTIVE: Define standard set of test procedures for an independent testing laboratory to perform and complete within a 24-hour period.

SCOPE: Utilize test procedures providing 24-hour results to duplicate field grouting demands. Intent of evaluation is establish grout manufacturer's qualifications.

PRIOR TO TEST: Obtain five bags of each type of grout.

1. From intended grout supplier for Project.
2. Five bags of grout shall be of same lot number.

ANSWER THE FOLLOWING QUESTIONS FOR GROUT BEING TESTED FROM LITERATURE, DATA, AND PRINTING ON BAG:

A. Product data and warranty information contained in company literature and data? Yes_____ No____

B. Literature and bag information meet specified requirements? Yes_____ No____

C. Manufacturer guarantees grout as specified in Article GUARANTEE? Yes_____ No____

D. Guarantee extends beyond grout replacement value and allows participation with CONTRACTOR in replacing and repairing defective areas? Yes_____ No____

E. Water demands and limits printed on bag? Yes_____ No____

F. Mixing information printed on the bag? Yes_____ No____

G. Temperature restrictions printed on bag? Yes_____ No____

*Rejection of a grout will occur if one or more answers are noted NO.

GROUT TESTING PROCEDURES

A. Bagged Material:

1. List lot numbers.

2. List expiration date.

3. Weigh bags and record weight.

ENGINEER will disqualify grout if bag weights have misstated measure plus or minus 2 pounds by more than one out of five bags. (Accuracy of weights is required to regulate amount of water used in mixing since this will affect properties.)

B. Mixing and Consistency Determination:

1. Mix full bag of grout in 10 gallon pail.

2. Use electric drill with a paddle device to mix grout (jiffy or jiffler type paddle).

3. Use maximum water allowed per water requirements listed in bag instructions.

4. Mix grout to maximum time listed on bag instructions.

5. In accordance with COE CRD-C611 (flow cone) determine time of mixed grout through the flow cone. _____ seconds

6. Add water to attain 20 to 30 second flow in accordance with COE CRD-C61 1.

7. Record time of grout through cone at new water demand. _____ seconds

8. Record total water needed to attain 20 to 30 second flow. _____ pounds

9. Record percent of water. _____ percent

C. When fluid grout is specified and additional water is required beyond grout manufacturer's fisted maximum water, COE CRD-C621 will be run at new water per grout ratio to determine whether grout passes using actual water requirements to be fluid. Use new water per grout ratio on remaining tests.

D. Bleed Test:

1. Fill two gallon cans half full of freshly mixed grout at ambient temperatures for each category and at required consistency for each.

2. Place one can of grout in tub of ice water and leave one can at ambient temperature.

3. Cover top of both cans with glass or plastic plate preventing evaporation.

4. Maintain 3 8 to 42 degrees F temperature with grout placed in ice and maintain ambient temperature for second container for I hour.

5. Visually check for bleeding of water at 15-minute intervals for 2 hours.

6. Perform final observation at 24 hours.

If grout bleeds a small amount at temperatures specified, grout will be rejected.

E. Extended Flow Time and Segregation Test (for Category H and 111):

1. Divide the remaining grout into two 3 gallon cans. Place the cans into the 40-degree F and 100-degree F containers and leave for 20, 40, and 60 minutes. Every 20 minutes remove and check for segregation or settlement of aggregate. Use a gloved hand to reach to the bottom of the can, if more than 1/4-inch of aggregate has settled to the bottom or aggregate has segregated into clumps reject the grout.

2. Right after the settlement test mix the grout with the drill mixer for 10 seconds. Take a COE CRD-C611 flow cone test of grout and record flow time. Maintain this process for I hour at ambient temperatures of 40 and 100 degrees F.

   a. 20 min _____ sec. @ 40 degrees F.
   b. 40 min _____ sec. @ 40 degrees F.
   c. 60 min _____ sec. @ 40 degrees F.
   d. 20 min _____ sec. @ 100 degrees F.
   e. 40 min _____ sec. @ 100 degrees F.
   f. 60 min _____ sec. @ 100 degrees F.

   All Category 11 and III grout that will not go through the flow cone with continuous flow after 60 minutes will be disqualified.

   _____ _____

   Qualified Disqualified

F. 24-hour Strength Test:

1. Using grout left in mixing cans in accordance with COE CRD-C621 for mixing and consistency determination test and for extended time flow test, make minimum of nine cube samples.

2. Store cubes at 70 degrees F for 24 hours.

3. Record average compressive strength of nine cubes at 24 hours.

Grout will be disqualified if 24-hour compressive strengths are under 2,500 psi for grouts claiming fluid placement capabilities.

Grouts that have not been disqualified after these tests are qualified for use on the Project for the application indicated in Nonshrink Grout Schedule.

_____ _____

Signature of Independent Testing Laboratory Date Test Conducted

SECTION 05003

MISCELLANEOUS METALS

1.0 GENERAL

The Contractor shall furnish all labor, materials, equipment and services necessary for fabrication and erection of all miscellaneous steel angles, beams, plates and channels as shown on the Drawings and specified herein and not specifically included under other sections of these Specifications.

1.1 QUALITY ASSURANCE STANDARDS

A. Codes and Standards: All work shall comply with provisions of following, except as otherwise indicated:

1. AISC “Code of Standard Practice for Steel Buildings and Bridges”.
2. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: “This approval constitutes the owner’s acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings.”
3. AISC “Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings”, including “Commentary” and Supplements thereto as issued.
4. AISC “Specifications for Structural Joints using ASTM A 325 or A 490 Bolts” approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
5. AWS D1.1 “Structural Welding Code”.
6. ASTM A 6 “General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use”.

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS “Standard Qualification Procedure”.

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

   a) If recertification of welders is required, retesting will be Contractor’s responsibility.

1.2 SUBMITTALS

Shop drawings, giving complete information necessary for fabrication, layout and installation of all metal work, shall be submitted to the Engineer for approval prior to fabrication.

The preparation of shop drawings for fabricated metal items shall be coordinated by the Contractor with the manufacturers of various equipment in order to comply with details, locations, openings, etc. required by the manufacturers.

Field measurements shall be made to verify all dimensions in the field, which may affect installation of work before shop drawings are made and/or fabrication is performed.

2.0 MATERIALS

2.1 STRUCTURAL METALS

A. Steel wide flange shapes shall conform to the requirements of ASTM A992, grade 50. All other shapes, plates and bars shall be ASTM A36, or ASTM A572, grade 50. (Non-exposed and interior)

B. Aluminum shall conform to the requirements of ASTM B209, alloy 6061-T6.

2.2 ANCHORAGE ITEMS

The Contractor shall furnish all bolts, nuts, shims, pins, screws, straps, nails and other anchors, which may be required by the Drawings or job conditions, to secure all items permanently in place, whether or not specifically called for or shown on the Drawings.

3.0 EXECUTION

3.1 FABRICATION AND INSTALLATION OF METAL WORK

All metal items shall be accurately fabricated and erected with exposed joints close fitting. All joints shall be of such character and so assembled that they will be as strong and rigid as adjoining sections. Joints shall be located where least conspicuous. Items shall have smooth finished surfaces except where otherwise shown or specified.

Where welding is required or permitted, it shall conform to the requirements for shielding metal arc welding of the Standard Code for Arc and Gas Welding in Building Construction of the American Welding Society. Shop drawings shall show welding and shall indicate the size, length, spacing and type of welds.

Joints required to be welded shall be continuously welded or spot-welded as specified and face of welds dressed flush and smooth where exposed to view.

Members or parts to be built in with masonry or concrete shall be in a form affording a suitable anchorage or shall be provided with approved anchors, expansion shields or other approved means of securing members.

Ferrous and non-ferrous metals shall be insulated at all contacts with felt washers, strips or sheets, bitumastic paints, or other approved means.

A. All required anchors, couplings, bolts, and nuts required to support miscellaneous metal work shall be furnished and installed as required.

B. Weights of connections and accessories shall be adequate to safely sustain and withstand stresses and strains to which they will be normally subjected.

C. Connections shall be bolted except where welding is called for in the Drawings. Bolts shall have a minimum of 1/2-inch diameter unless noted or required otherwise.

D. Accurately place all miscellaneous metal items in the locations and to the required elevations.

    1. Adequately brace any items which are cast in concrete masonry work.

E. Use concealed anchors wherever possible.

3.2 CLEANING

Remove and properly dispose of all debris and litter; leave the work area in a clean condition.

END OF SECTION

SECTION 11210

BOOSTER PUMP STATION

1.0 GENERAL

The Contractor shall furnish and install the water booster pump station, with all the necessary piping, controls, and appurtenances as shown on the plans and as specified herein. The water booster pump station shall be complete with all necessary equipment. All tie-ins to existing lines, access entrance, yard piping etc. shall be considered part of the lump sum bid for the pump station.

1.1 REFERENCE STANDARDS

The Work in this Section is subject to the requirements of applicable portions of the following standards:

A. Hydraulic Institute

B. ANSI – American National Standards Institute

C. ASTM – American Society for Testing and Materials

D. IEEE - Institute of Electrical and Electronics Engineers

E. NEMA – National Electrical Manufacturers Association

F. NEC – National Electrical Code

G. ISO – International Standards Organization

1.2 RELATED WORK

A. Section 11900 – INTEGRATION OF TELEMETRY CONTROLS

B. Division 16 – Electrical

2.0 DEFINITIONS

When the term "pumping unit" is used it shall be deemed to mean a pump or pumps, complete with, but not limited to, drive motor, accessories, appurtenances and all associated equipment.

3.0 CONTRACT DRAWINGS

The contract drawings are intended to show a general arrangement of pump equipment, drives, structural supports, foundations, connected piping and valves.

The pump suction and discharge nozzles shown shall be considered minimum sizes unless otherwise specified.

4.0 MANUFACTURER

4.1 QUALITY ASSURANCE

All pumping units shall be of approved design and make and products of manufacturers who have built equipment of similar type, size and capacity.

4.2 ADDITIONAL SUBMITTALS

The Contractor shall submit, upon request, any additional information that the Engineer may deem necessary to determine the ability of the proposed manufacturer to produce the specified equipment.

4.3 REPLACEMENT PARTS CAPABILITY AND SERVICE

Pumping units shall be the products of manufacturers who can produce evidence of their ability to promptly furnish any and all interchangeable replacement parts as may be needed at any time within the expected life of the pumps. Upon request, the Contractor certify and shall submit full details of the proposed manufacturer's ability to promptly fill replacement orders. The manufacturer shall have a fully staffed factory trained service center within three (3) hours of the installation.

4.4 MANUFACTURE INFORMATION

All manufacturer information required by the specifications shall be submitted by the Contractor within thirty (30) calendar days of the date of receipt of the Notice to Proceed.

Any additional information or data, specifically requested by the Engineer, concerning manufacturer's capabilities (especially relating to requirements described hereinbefore), shall be submitted by the Contractor within fourteen (14) calendar days of the receipt of the written request therefore, unless otherwise specified.

Approval of the manufacturers or suppliers will not be given until all information required by the specifications or requested by the Engineer has been submitted and found acceptable.

4.5 DISQUALIFICATION OF MANUFACTURER

A. Failure to successfully comply with the provisions of sub-paragraphs 4.1 through 4.4, inclusive, will constitute grounds for disqualification of pump manufacturer.

B. Poor performance of similar pumping equipment now in operation under the specified conditions of service and pump rating constitute grounds for disqualification of the pump manufacturer, supplier, or both, unless such poor performance has been corrected.

5.0 SUBMITTALS (SHOP DRAWINGS)

5.1 GENERAL

The Contractor shall comply with the provisions in the specifications regarding submittals, unless otherwise specified herein.

5.2 CONTENT OF SUBMITTALS

The following shall be included in submittals as a minimum. However, any additional information or data shall be added if and whenever requested by the Owner or Engineer. Where applicable, submit separate data for each pump.

5.3 DESCRIPTIVE LITERATURE

A. Dimensions

B. Materials of construction (including required coatings)

C. Performance data
   1. Size of pump
   2. GPM
   3. TDH
   4. BHP
   5. Overall pump efficiency (inlet through discharge head)
   6. RPM
   7. Performance curves showing overall pump efficiencies
   8. NPSH curve (if applicable)
   9. Shutoff head
   10. Weight of pump
   11. Head

12. Rated HP of motor
13. Weight of motor

5.4 INSTALLATION INFORMATION

Submit drawings and information necessary for final design of foundations, connecting piping and valves, pump drip and drainage piping, electrical connections, starting, speed regulating and protective equipment, and auxiliary equipment.

Submit drawings showing location, size and full details of foundation bolts for all components for all pumping units.

For all pumping units, a dimensioned and scaled assembly outline drawing or drawings of the complete pump, drive, and all associated equipment furnished shall be submitted for approval. Such drawing or drawings shall show plan, elevation, and any other views or sections requested.

For all pumping units, a scaled cross-sectional drawing of the assembled pump showing full details and materials of construction shall be submitted for approval.

The Contractor shall submit all other drawings, material lists and other information specified, requested and/or necessary to show complete compliance with all details of the contract documents.

5.5 MAINTENANCE AND OPERATIONS MANUAL

Manual shall contain all information necessary for proper operation and maintenance of pumping units, as well as the location of the nearest permanent service headquarters. Three (3) bound copies of the pump station operation and maintenance manual shall be provided.

6.0 TIME OF DELIVERY

Since time is of the essence on all work under this contract, manufacturers or suppliers are hereby notified that they will be required through the Contractor to state and guarantee a firm delivery date for all equipment specified under this section which they offer to furnish.

7.0 MANUFACTURER'S REPRESENTATIVE

For all pumping units the Contractor shall furnish the services of accredited representatives of the pump manufacturer who shall supervise the installation, adjustment, and testing of each pumping unit and give instructions to operating

personnel. Pumping equipment shall be tested for performance according to curves and other approved data as soon as practical after installation. Failure of the equipment to perform as curves indicate and with other approved data shall be sufficient cause for rejection. As one condition necessary to acceptance of any pumping unit, the Contractor shall submit a certificate from the manufacturer, stating that the installation of the pumping unit is satisfactory, that the unit is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit.

8.0 IDENTIFICATION - NAMEPLATE

Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data. Provide an extra nameplate or label with nameplate information for each pump and install the extra label in the pump control panel.

9.0 TOOLS AND ACCESSORIES

The Contractor shall furnish with each type, kind, or size of pumping unit, two sets of any special suitable marked high grade tools, gauges and fixtures which may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be furnished in neat special steel cases fitted with locks and keys, and delivered to the Engineer prior to the initial operation of the equipment.

10.0 GUARANTEE PERIOD

After successful completion of tests and trials under operating conditions on all equipment, the Contractor shall guarantee all equipment and materials from undue wear and tear, from mechanical and electrical defects, and from any failure whatever except those resulting from proven carelessness or deliberate actions of the Owner, for a minimum of one year. This one-year minimum shall not replace a standard manufacturer's guarantee if it exceeds one year.

11.0 PUMP WARRANTY

The Contractor guarantees and warrants that during the first year of operation, the pumps will operate satisfactorily and continuously according to the pump schedule specified herein, and that after due notice has been given by the Owner, he or the pump manufacturer will proceed, within a reasonable time, to adjust, regulate, repair and renew at his own expense such part or parts, equipment, auxiliaries, appurtenances or perform such work as is necessary to maintain the guaranteed capacities, efficiencies and performances.

12.0 EQUIPMENT

12.1 BOOSTER PUMPS

12.1.1 General: The booster pumps shall meet the hydraulic and driver data as set forth in the specification section titled, “Operating Conditions”.

1. A data sheet covering each pump completely filled in.

2. Performance Curve showing expected performance at points other than the design conditions. Curve shall show head, capacity, efficiency and horsepower based on performance and shall cover the complete operating range of the pump from zero capacity to the maximum capacity. The curve is to also include a net positive suction head required curve.

3. Drawings of the proposed equipment giving general dimensions sufficient to determine how the equipment is to be supported and if it will fit within the space available.

12.2 PUMP STATION

Operating Conditions. The pump stations shall be capable of delivering the fluid medium at the following capacities and heads.

Minimum	0 gpm @ 195’ TDH
Design	30 gpm @ 180’ TDH
Maximum	60 gpm @ 130’ TDH
Efficiency at Design	60%
Horsepower	3.0
Electric	3 phase 208-230/460 volt
Speed	3500 rpm

NPSH requirements shall not exceed 6 feet at Design GPM.

Pump assembly shall be **Grundfos Vertical Multi-Stage BoosterpaQ Series Hydro MPC-E (CUE) with CR 10-4** or approved equal.

VERTICAL MULTI-STAGE CENTRIFUGAL PUMPS

Two (2) vertical multi-stage centrifugal water pumps shall be installed in the booster station. Each pump shall meet all the requirements set forth in this Specification under OPERATING CONDITIONS, and as follows:

A. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

B. All pump bearings shall be lubricated by the pumped liquid.

C. Vertical Multi-Stage Pumps shall have the following features:

1. Each pump shall be designed for in-line installation requiring no more than 2.5 square feet of floor space (including motor).
2. The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design.
3. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule.
4. Pump Construction.
   a. Suction/discharge base, pump head: Ductile Iron (ASTM 65-45-12)
   b. Shaft couplings, flange rings: Ductile Iron (ASTM 65-45-12)
   c. Shaft: 431 Stainless Steel
   d. Motor Stool: Cast Iron (ASTM Class 30)
   e. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel
   f. Impeller wear rings: 304 Stainless Steel
   g. Intermediate Bearing Journals: Tungsten Carbide
   h. Intermediate Chamber Bearings: Leadless Tin Bronze
   i. Chamber Bushings: Graphite Filled PTFE
   i. O-rings: EPDM
5. The shaft seal shall be a single balanced metal bellows cartridge with the following construction:
   a. Bellows: 904L Stainless Steel
   b. Shaft Sleeve, Gland Plate, Drive Collar: 316 Stainless Steel
   c. Stationary Ring: Carbon
   d. Rotating Ring: Tungsten Carbide
   e. O-rings: EPDM
6. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. Pumps with motors equal to or larger than 15 HP (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.
7. The maximum working temperature shall be 250 degrees F. The maximum working pressure shall not exceed 232 psig.

PUMP MOTORS

A. Motors are to be provided with the following basic features:

1. Motors shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F. Motors shall be NEMA premium efficiency.
2. Totally Enclosed Fan Cooled Motors furnished with class “F” insulation.
3. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
4. Motors over 50 lbs shall having lifting provisions.
6. Motors shall have a NEMA C-Flange for vertical mounting.
7. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

B. The motor shall be of such size that it will operate continuously without exceeding its horsepower rating, exclusive of service factor, over the entire performance curve.

C. Pump motors and motor accessories shall be manufactured and rated for variable frequency drive (VFD) operation.

C. Pump motor operating power shall be 460 volt or 230 volt as indicated on the Drawings. Station incoming power shall be as indicated on the Drawings. Contractor shall confirm the power supply with the providing utility prior to ordering pumps and electrical equipment.

D. Pump motors shall be equipped with embedded thermostats to protect against winding over temperature condition, minimum 5A, 120V rating.

12.3 CONTROL SYSTEM:

Refer to Section 16900 for control panel requirements. Refer to the Drawings and Division 16 for electrical, control, instrumentation, and telemetry requirements.

12.4 PUMP PRESSURE GAUGES

Each pump shall be provided with pressure gauges according to the schedule. All pressure gauges within the booster pumping station shall have 4-1/2" minimum diameter faces. The case shall be black, cast aluminum, flanged back type with close type ring and clear glass face. The gauge connections shall be at the bottom of the gauge and will be 1/4" N.P.T. The gauge internal construction shall include phospor bronze bourdon tube with a brass movement,

bronze bushed independently mounted. Pressure gauge range and scale graduations shall be in feet of water and psi as follows:

INLET PRESSURE - 0 to 100 psi, 10 psi figure intervals, with graduating marks every 2 psi.

OUTLET PRESSURE - 0 to 200 psi, 10 psi figure intervals, with graduating marks every 2 psi.

12.5 GLOBE STYLE SILENT CHECK VALVE **– N/A**

Globe style silent check valves shall be of silent operating type which reduce or eliminate water hammer shock.

The valve design shall incorporate a center guided, spring loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to that of the pipe size.

The valve shall operate equally well in the vertical or horizontal position with the flow up or down.

All component parts shall be field replaceable and without the need of special tools. A replaceable guide bushing shall be provided and held in position by the valves spring.

The valve disc shall be convex in sizes up to 6” and concave in 8” and larger to the flow direction providing for disc stabilization, maximum strength and minimal flow velocity to open the valve.

When specified, a rubber seal shall be furnished to provide zero leakage. The rubber seal shall be glued or chemically adhered.

The valve shall be equal in all respects to the Model 402BT/BTR as manufactured by the Flomatic Corporation or approved equal.

12.6 SUCTION DIFFUSERS **– N/A**

Two (2) basket style suction diffusers, shall be a part of the station assembly. Strainers shall be Grundfos Series SD or equal as shown on the drawings. Suction diffusers shall be equipped with a removable startup screen in addition to the primary screening element.

12.7 ELECTROMAGNETIC FLOW METER

The meter shall be as specified in Section 13420 – Flowmeters.

13.0 ACCEPTANCE

Any defects in the equipment or failure to meet the guaranteed requirements of these specifications shall be promptly corrected by the Contractor by replacement or otherwise. The decision of the Engineer as to whether or not the Contractor has fulfilled his obligation shall be final and binding on all parties.

14.0 PAYMENT

Payment for the Pump Station and all new work in the Drawings except those items specifically noted to be paid under separate Bid Item(s) shall be provided at the Lump Sum Bid Price. Item shall include all equipment, materials, installation, testing, documentation, instruction and incidental work required to produce a complete and functional station.

END OF SECTION

SECTION 11900

INTEGRATION OF TELEMETRY CONTROLS

1.0 GENERAL

This specification section is to clarify the Contractor's responsibility regarding the telemetry controls.

2.0 INTEGRATION OF TELEMETRY CONTROLS

Green River Valley Water District uses High Tide Technologies, Inc. as their water distribution system telemetry provider. The District will be responsible for furnishing a SCADA RTU panel for the telemetry facilities required for the operational control of the pump station, alarms, data acquisition and integration within the current SCADA system. Contractor shall be responsible for installing the RTU panel, providing all of the conduit and wiring indicated on the Drawings, and providing wiring terminations per diagrams to be furnished by the Water District. Contractor shall also supply electrician support for startup/commissioning of the SCADA system to ensure that all signals are functioning properly.

3.0 PUMP STATION START-UP

The Water District and a representative of High Tide Technologies, Inc. will be present during pump station start-up to coordinate the telemetry equipment operation with the operational elements of the pump station.

END OF SECTION

SECTION 13420

ELECTROMAGNETIC FLOW METER

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the requirements for a flow sensor.

B. Under this item, the contractor shall furnish and install the flow measurement equipment and accessories as indicated on the plans and as herein specified.

1.2 QUALITY ASSURANCE

A. Referenced Standards and Guidelines - Complies with applicable portions of ANSI/AWWA Standards and NSF/ANSI Standard 61, Annex G. There are currently no AWWA standards that specifically address electromagnetic metering.

1. Flow measurement function complies with Industry Standards

a. ANSI B16.5 Class 150 RF
b. AWWA Class B
c. NEMA 4X/6P (IP66/IP67)
d. CSA

1.3 SUBMITTALS

A. The following information shall be included in the submittal for this section:

1. Outline dimensions, conduit entry locations and weight

2. Customer connection and power wiring diagrams

3. Data sheets and catalog literature for microprocessor-based transmitter and transducer

4. Interconnection drawings

5. Installation and operations manual

6. List of spare parts

7. Complete technical product description including a complete list of options provided

8. Any portions of this specification not met must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification

1.4 SYSTEM DESCRIPTION

A. Electromagnetic flow meter is intended for fluid metering in industries including water, wastewater, food and beverage, pharmaceutical and chemical. Measures fluid flow of water or fluids which are highly corrosive, very viscous, contain a moderate amount of solids, or require special handling. No moving parts are in the flow stream. Amplifier can be integrally mounted to the detector or can be remote-mounted. Unit is ideally suited for measuring dynamic, non-continuous flow. In applications where a minimum and/or maximum flow rate must be tracked and monitored, the unit provides pulse signals that can be fed to dedicated batch controllers, PLCs and other more specialized instrumentation.

1.5 DEFINITIONS

A. Amplifier – Device used for increasing the power of a signal. It does this by taking energy from a power supply and controlling the output to match the input signal shape but with larger amplitude.

B. ANSI – (American National Standards Institute) A private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so that American products can be used worldwide.

C. AWWA – (American Water Works Association) An international non-profit professional organization founded to improve water quality and supply.

D. Detector Coils – Also called an “induction loop”, an electromagnetic communication or detection system which uses a moving magnet to induce an electrical current in a nearby wire.

E. Electrode – An electrical conductor used to make contact with a nonmetallic part of a circuit (e.g. a semiconductor, an electrolyte or a vacuum).

F. Modbus RTU – a serial communications protocol published by Modicon (now Schneider Electric) in 1979 for use with its programmable logic controllers (PLCs). This is used in serial communication & makes use of a compact, binary representation of the data for protocol communication.

G. NEMA – (National Electrical Manufacturers Association) Is the 'Association of Electrical Equipment and Medical Imaging Manufacturers' in the United States. Its approximately 450 member companies manufacture products used in the generation, transmission, distribution, control, and end use of electricity. These products are used in utility, industrial, commercial, institutional, and residential applications.

H. NSF International – An independent, accredited organization that develops standards, and tests and certifies products and systems. They provide auditing, education and risk management solutions for public health and the environment.

I. PLCs – (Programmable Logic Controller) A digital computer used for automation of electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines.

J. PTFE – (Polytetrafluoroethylene) A synthetic flouropolymer of tetrafluoroethylene that finds numerous applications. The best known brand name of PTFE is Teflon by DuPont Co.

K. Serial Communications – In telecommunication and computer science, serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels.

PART 2 – PRODUCTS

1.1 APPROVED MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with specifications, provide flow measurement equipment by one of the following:

1. Badger Meter

1.2 OPERATING CONDITIONS

A. System Components

1. Metering Tube (Detector)

a. Consists of stainless steel tube lined with a non-conductive material. Energized detector coils around tube create a magnetic field across the diameter of the pipe. As a conductive fluid flows through the magnetic field, a voltage is induced across two electrodes; this voltage is proportional to the average flow velocity of the fluid.

2. Signal Amplifier

a. Consists of unit which receives, amplifies, and processes the detector's analog signal. Signal is converted to both analog and digital signals that are used to display rate of flow and totalization. Processor controls zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. Integrated LCD display indicates rate of flow, forward and reverse totalizers and diagnostic messages. Display guides user through programmable routines.

B. Operational Requirements

1. Electromagnetic Flow Meter

a. The flow meter system shall operate with a pulsed DC excitation frequency, and shall produce a signal output that is directly proportional and linear with the volumetric flow rate of the liquid flowing through the metering tube. The metering system shall include a metering sensor tube (detector), a signal amplifier, and the necessary connecting wiring. The metering system shall have the ability to incorporate a meter mounted or remote mounted amplifier.

b. Engineering Units:

1) The signal amplifier shall be program selectable to display the following units of measure: U.S. gallons, imperial gallons, million gallons (U.S.), cubic feet, cubic meters, liters, hector-liters, oil barrels, pounds, ounces or acre feet.

c. Operating Principle: Electromagnetic Induction
d. Metering Tube (Detector)

1) The metering tube (detector) shall be constructed of 316 stainless steel, and rated for a maximum allowable non-shock pressure and temperature for steel pipe flanges, according to ANSI B16.5.

2) The metering tube (detector) shall be available in line size from ¼" [6 mm] to 54" [1400 mm].

3) The metering tube (detector) end connections shall be carbon steel or 316 stainless steel flanged, according to ANSI B16, Class 150 and AWWA Class B standards.

4) The insulating liner material of the metering tube (detector) shall be made of a hard rubber elastomer and NSF-listed for meter sizes 4” and above, in conformance with manufacturer’s recommendation for the intended service or an NSF-listed meter option with PTFE liner.

5) The metering tube (detector) shall include two self-cleaning measuring electrodes. The electrode material shall be corrosion resistant and available in Alloy C or 316 stainless steel.

6) The metering tube (detector) shall include a third “empty pipe detection” electrode located in the upper portion of the inside diameter of the flow tube in order to detect an empty pipe condition when the flow tube is running partially empty. Empty pipe detection that is not activated until the pipe is 50% empty is not acceptable.

7) The metering tube (detector) housing shall be constructed of carbon steel, welded at all joints, and rated to meet NEMA 4X/6P (IP66/IP67) ratings.

8) For remote amplifier applications, the metering tube (detector) junction box enclosure shall be constructed of cast aluminum

(powder-coated paint) and shall meet NEMA 4X/6P (IP66/IP67) ratings.

9) When installed in non-metallic or internally lined piping, the metering tube (detector) shall be provided with a pair of corrosion resistant grounding rings. The grounding ring material shall be 316 stainless steel.

10) Fluid Temperature Range

i. For remote amplifier applications, the fluid temperature range shall be 32°F to 178°F [0°C to 80°C] at a maximum ambient temperature of 122°F [50°C] for the hard rubber liner material.

ii. For meter-mounted amplifier applications, the fluid temperature range shall be 32°F to 178°F [0°C to 80°C] at a maximum ambient temperature of 122°F [50°C] for the hard rubber liner material.

e. Signal Amplifier

1) The signal amplifier shall be microprocessor based, and shall energize the detector coils with a digitally controlled pulsed DC. The excitation frequency shall be program selectable for the following: 1Hz, 3.75Hz, 7.5Hz, or 15Hz. (factory optimized to pipe size and application)

2) The signal amplifier electrical power requirement shall be 85-265VAC, 45-65Hz. The power consumption shall not exceed 15W.

3) The signal amplifier shall have an ambient temperature rating of -4°F to 140°F [-20°C to 60°C].

4) The signal amplifier shall include non-volatile memory capable of storing all programmable data and accumulated totalizer values in the event of a power interruption.

5) Automatic zero stability, low flow cut-off, empty pipe detection and bi-directional flow measurement shall be inherent capabilities of the signal amplifier.

6) All signal amplifier outputs shall be galvanically isolated to 250 volts.

7) The signal amplifier and remote junction enclosures shall be constructed of cast aluminum (powder-coated paint) and shall meet NEMA 4X/6P (IP66/IP67) ratings.

8) Outputs:

The signal amplifier shall provide a total of four digital outputs, one analog output and one digital input.

i. Up to four open collector digital outputs, program selectable from the following: Forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, reset output, error alarm and 24V supply.

ii. Up to two active digital (24 Volt) outputs, program selectable from the following: Forward pulse, reverse pulse, AMR pulse, flow set point, empty pipe alarm, flow direction, preset output, error alarm and 24V supply.

iii. Up to two AC solid-state relay outputs, program selectable from the following: Frequency output, flow set point, empty pipe alarm, flow direction, preset amount and error alarm.

iv. One digital input, program selectable from the following: Remote reset, batch reset and positive return to zero.

v. Advanced protocol support using Modbus/RTU.

vi. One analog output programmable and scalable from the following: 0-10mA, 0-20mA, 2-10mA or 4-20mA. Voltage sourced and isolated. Max. loop resistance = 800 ohms.

f. Control and Programming

1) The signal amplifier shall be programmed via three function buttons. The programming functions shall be available in a user-friendly, menu driven software through the four-line LCD interface. The signal amplifier shall accommodate the following languages: English, German, Czech, French or Spanish.

2) Programmable parameters of the amplifier include, but are not limited to: calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow-alarm functions, language

selection, low-flow cutoff, noise dampening factor and excitation frequency selection.

3) The signal amplifier shall have a programming option allowing entry of a selected numeric password value for tamper protection.

g. System Performance

1) The metering system shall operate over a flow range of 0.10 to 39.4 ft/s [0.03 to 12.0 m/s].

2) The metering system shall perform to an accuracy ± 0.25 percent of rate for velocities greater than 1.64 ft/s [0.50 m/s], ± 0.004 ft/s [± 1 mm/s] for velocities less than 1.64 ft/s [0.50 m/s].

3) The metering system shall be capable of measuring the volumetric flow rate of liquids having an electrical conductivity as low as 5.0 micromhos per centimeter.

4) The system measuring repeatability shall be <0.10% of full scale.

h. Indication

1) The signal amplifier shall include a four-line, 20-character, backlit LCD interface to display the following values:

i. Flow rate in selectable rate units
ii. Forward totalizer in selectable volume units
iii. Reverse totalizer in selectable volume units
iv. Net totalizer in selectable volume units
v. Error or alarm messages
vi. Software revision level

PART 3 - EXECUTION

1.1 INSTALLATION

A. Follow manufacturer’s recommendation for installation. Installation will conform to the guidelines provided by the Installation & Operation Manual.

B. Straight pipe requirement shall be an equivalent of three diameters on the inlet (upstream) side, and two diameters on the outlet (downstream) side.

C. For best performance, place meter vertically, with liquid flowing upward and meter electrodes in a closed, full pipe.

1.2 CALIBRATION

A. Each meter shall be hydraulically calibrated in an ISO 9000-certified testing facility, which utilizes a computerized gravimetric testing method with a measuring uncertainty of 0.1%.

B. Each meter shall be provided with a calibration certificate indicating the measured error (percent deviation) at three different flows, respectively equivalent to 25%, 50% and 75% of the nominal flow rate for each size.

1.3 MANUFACTURER'S WARRANTY

A. Terms

1. The manufacturer of the above specified equipment warrants the Product to be free from defects in materials and workmanship appearing within the earlier of either: One (1) year after installation; or one (1) year and six (6) months after shipment from manufacturer.

END OF SECTION

SECTION 15100

WATER LINES

1.0 GENERAL

The Contractor shall furnish all labor, materials, and equipment to install the water lines as shown on the plans and as specified herein.

The water lines may be either pressure-rated plastic pipe (PVC) using the ASTM or AWWA C-900 standard, or ductile iron (DI), all as specified hereinafter and as noted on the plans. The bid documents shall show the anticipated approximate amounts of each type and class of pipe to be provided by the Contractor.

The Owner will obtain all rights-of-way for operations through private property. Owner will also secure building permits and the permits for all pipe laid in highway rights-of-way. Any charges for inspections or other fees required will be the responsibility of the Contractor since the amounts of these are dependent upon the operation of the Contractor.

1.1 KENTUCKY TRASPORATION CABINET BONDING – N/A

The Kentucky Transportation Cabinet will require that the Owner post a bond for all work accomplished on their right-of-way. Each contract on which work is to be performed will be a separate application and will require a separate bond. Each permit will have conditions attached and these conditions will vary depending on the area where work is to be performed. In areas where traffic control may pose a problem, working hours may be limited. A copy of the encroachment permit will be provided to the Contractor. The Contractor will be responsible for knowledge of the permit's content and conditions in order that the construction may be accomplished in accordance with the specified requirements.

Should any additional bonds or requirements be imposed by the Kentucky Transportation Cabinet, the Owner shall also be responsible for the bonding of the additional requirements.

2.0 MATERIALS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

This specification covers rigid, pressure-rated, polyvinyl chloride pipe and fittings, hereinafter called PVC pipe and PVC fittings, for sizes 1/2 inch through 12-inch. Pipe shall be as manufactured by North American, Diamond, J-M, Certainteed, or approved equal.

2.1.1 General.

2.1.1.1 Pipe Markings. Depending on the type of PVC pipe being used, the following shall be marked along the length of each joint of pipe: manufacturer's name, nominal pipe size and size base, material code (PVC 1120), dimension ratio or standard dimension ratio, pressure class or rating, production record code, certification seal (NSF logo), and, for C-900 PVC pipe, specification designation (i.e., AWWA C-900).

2.1.1.2 Underground Marking for PVC Pipe. Underground marking for either ASTM or C-900 PVC pipe shall be both of the following types.

2.1.1.2.1 *Underground Marking Wire*. At all locations where PVC pipe is utilized, a detectable underground marking wire shall be placed in the trench approximately 12-inches above the pipe. The wire used shall be No. 12 insulated copper wire. Extreme care shall be exercised in connecting and taping splices and joints to assure continuity. At each valve box the wire shall be looped to the surface extending 12-inches above the concrete valve box pad (see Std. Dwg. for valve). When the entire project or pipeline segment is complete, including meter installation and leak repairs, the locating wire system shall be checked for continuity.

2.1.1.2.2 *Underground Marking Tape*. At all locations where PVC pipe is utilized, a detectable underground marking tape shall be placed in the trench approximately twelve 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 2 inch width as provided by Lifeguard, Inc. or approved equal. Color of the tape shall be blue.

2.1.2 Polyvinyl Chloride (PVC) Pipe—ASTM Standard.

2.1.2.1 PVC Pipe. PVC pipe shall be extruded from Type 1, Grade 1, polyvinyl chloride material with a hydrostatic design stress of 2,000 psi for water at 73.4°F, designated as PVC 1120, meeting ASTM Specifications D-1784 for material and D-2241 for pipe, latest revisions. Pipe shall also meet all applicable provisions of the Product Standards and shall bear the National Sanitation Foundation (NSF) seal of approval in compliance with NSF Standard No. 14. PVC pipe having a maximum hydrostatic working pressure of 160 psi (SDR-26), 200 psi (SDR-21), 250 psi (SDR-17), or 315 psi (SDR-13.5) shall be used as shown in the Bid Documents and Plans.

Samples of pipe and physical and chemical data sheets shall be submitted to the Engineer for review and determination of compliance with these specifications

before pipe is delivered to job. The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects.
The workmanship, pipe dimensions and tolerances, outside diameters, wall thickness, eccentricity, sustained pressures (ASTM D-1598), burst pressures (ASTM D-1599), flattening, extrusion quality (ASTM D-2152), marking and all other requirements of the Product Standard PS 22-70 shall be conformed to in all respects. No pipe, 2 inches in diameter or larger, with a wall thickness less than 0.090 inches may be used.

Pipe shall be furnished in 20 feet or 40 feet lengths. The pipe may be double plain end or with bell on one end. Male ends of pipe must be beveled on the outside. Pipe shall have a ring painted around the male end or ends in such a manner as to allow field checking of setting depth of pipe in the socket. This requirement is made to assist construction superintendents and inspectors in visual inspection of pipe installation.

Pipe must be delivered to job site by means which will adequately support it, and not subject it to undue stresses. In particular, the load shall be so supported that the bottom rows of pipe are not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical. Pipe must not be exposed to the direct rays of the sun for an extended period of time. If pipe is not to be installed shortly after delivery to the job site, it must be stored in a shaded location and strung as needed.

2.1.2.2 PVC Pipe Jointing. Pipe shall be joined with slip-type joints with rubber gaskets. Pipes with bells shall have all parts of the bell, including the gasket groove, made from the same extruded piece, integral with the pipe, and shall be thickened to meet standard dimension ratios of wall thickness to outside diameter. This manufacturing procedure shall be the normal practice of the pipe manufacturer and proven by past performance of pipe in service. The gasket groove shall be constructed such that gasket rollout will not occur. Rubber gasketing shall conform to ASTM D-3139.

Joint lubricant shall be of a type recommended by the manufacturer for their pipe subject to the Engineer approval. Lubricant shall be NSF approved water soluble, non-toxic and have no objectionable properties.

Due to special requirements for special gaskets for use within 200 feet of underground fuel tanks, gas lines, and/or oil transport lines, PVC pipe shall not be used under these circumstances.

2.1.2.3 Fittings Ductile iron mechanical joint fittings with appropriate adapter as manufactured by Tyler, U.S. Pipe, Clow, Union Foundry or approved equal, shall be used with PVC pipe. All such fittings shall be approved by the pipe manufacturer, and complete data sent to the Engineer, including the manufacturer's approval, for review. Fittings shall comply with AWWA C-110 or

C-153 and shall be manufactured for the size and pressure class of the line on which they are used. Use of transition gaskets will not be allowed unless specifically approved by the pipe manufacturer. Coatings and lining shall be in accordance with section 2.2.7 of the Specifications.

2.1.2.4 Service Connections. All service connections on PVC lines shall be made by means of tees, factory tapped couplings, or bronze service clamps, manufactured specifically for use with PVC pipe as manufactured by Ford or approved equal, and appropriate corporation stop. Whenever possible, corporation stops shall be installed in plastic lines before conducting hydrostatic tests.

2.1.3 Polyvinyl Chloride (PVC) Pipe—AWWA C-900 Standard.

This specification covers the requirements for AWWA approved Polyvinyl Chloride Pressure Pipe for water supply and distribution systems.

2.1.3.1 PVC Pipe—AWWA C-900 Standard. PVC pipe shall meet the requirements of AWWA C-900 or C-905, latest revision and shall be furnished in cast-iron pipe equivalent outside diameters with rubber gasketed joints.

C-900 PVC 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 Testing Laboratory and shall carry 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 DR (Dimension Ratio) 18, or DR 14 as shown on the plans or the bid form.

Pipe and couplings shall meet or exceed the following test requirements:

Hydrostatic Integrity - 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 pipe. The pipe and couplings shall further meet or exceed the pressure test requirements of ASTM D-1598 and D-1599.

Flattening - The pipe shall not split, crack, or break when tested by the parallel-plato method as specified by ASTM D- 2241.

Extrusion quality - The pipe shall not flake or disintegrate when tested by the acetone-immersion method as specified in ASTM D-2241.

Standard length - Pipe shall be furnished in standard laying lengths of 20 ft. ± 1 in. A maximum of 15 percent of each pipe size may be furnished in random lengths of not less than 10 ft. each.

2.1.3.2 C-900 PVC Pipe Jointing. Pipe shall be joined with slip-type joints with rubber gaskets. Manufacturing and installation procedures shall be as recommended by the manufacturer and as described for PVC pipe in section 2.1.2 of this specification.

2.1.3.3 Fittings. Fittings for municipal PVC shall be ductile iron only. Fittings shall be mechanical joint. Fittings shall be manufactured for the size and pressure class of the line on which they are used and shall comply with AWWA C-110 or C-153. Coatings and lining shall be in accordance with section 2.2.7 of the Specifications. Fittings shall be as manufactured by Tyler, Clow, U.S. Pipe, Union Foundry or approved equal.

2.1.3.4 Service Connections. Service connections shall be made by means of bronze service clamps manufactured specifically for use with C-900 PVC pipe and appropriate corporation stops. Clamps shall be Mueller Catalog No. H-161 or approved equal.

2.1.4 Polyvinyl Chlorine (PVC) Pipe – Restrained Joints

2.1.4.1 PVC Pipe. Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to ASTM D2241. The restrained joint pipe system shall also meet all short and long term pressure test requirements of ASTM D2241. Pipe, couplings and locking splines shall be completely non-metallic to eliminate corrosion problems. The pipe and couplings shall be Certa-Lok Yelomine restrained-joint pipe from Certainteed Corporation or approved equal.

Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4° F, in accordance with the requirements of ASTM D2837.

Restrained joint PVC pipe products shall have been tested and approved by NSF International. 2” through 16” PVC pipe and coupling systems up to Class 250 shall be listed in NSF14. All products intended for contact with potable water shall be evaluated, tested and certified for conformance with NSF 61 by an acceptable certifying organization. Copies of agency approval reports or product listings shall be provided to the Engineer.

Nominal outside diameters and wall thicknesses of thrust-restrained pipe shall conform to the requirements of ASTM D2241. Thrust-restrained pipe shall be

furnished in 2”, 3”, 4”, 6”, 8”, 10”, 12” and 16” sizes, with pressure ratings from 90 psi to 315 psi. Pipe shall be furnished in standard lengths of 20 feet.

2.1.4.2 PVC Restrained Joints. Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermostatic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.

Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

2.2 DUCTILE IRON PIPE

These specifications cover ductile iron pipe (3-inch diameter and greater) to be used in water transmission systems with mechanical joints, rubber ring slip type joints or flanged joints.

2.2.1 General. Ductile iron pipe shall be designed in accordance with AWWA and for pressures and conditions as stated in these specifications or called for on the plans. Ductile iron pipe shall conform to AWWA C-151.

2.2.2 Minimum Nominal Thickness. The specified thickness will be determined for the given internal and external loading requirements in accordance with AWWA C-150. The class of pipe, wall thickness, and coatings required will be shown on the plans or the bid form and/or as specified herein for all ductile iron pipe installation.

2.2.3 River Crossing Pipe. River crossing pipe shall be ductile iron, Flex-Lok as manufactured by the American Cast Iron Pipe company or equal conforming to the appropriate requirements of AWWA C150/ANSI A21.50 and AWWA C151/ANSI A21.5 with a minimum thickness class of 54.

2.2.4 Lengths. Pipe may be furnished in 12, 16, 16 1/2, 18 or 20 feet nominal laying lengths.

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

2.2.6 Pipe Joints for Ductile Iron Pipe. Joints for buried pipe shall be either mechanical joint or push-on joint conforming to the requirements of AWWA C-111. Mechanical joint bolts and nuts shall be the low-alloy steel type conforming to AWWA C-111.

Interior piping of vaults, plants, etc. shall be supplied with flanged joints meeting the requirements of AWWA C-115. Special joints, such as the “locked” or “restrained” type, shall be as shown on the plans and/or called for in the bid schedule.

Gaskets resistant to hydrocarbon penetration shall be used within 200 feet of underground fuel tanks, gas lines, and/or oil transport lines. The gaskets shall be approved by the Engineer.

2.2.7 Coatings and Lining. All buried ductile iron pipe shall have manufacturer's outside coal tar or asphaltic base coating and a cement lining and bituminous seal coat on the inside. Cement mortar lining and a bituminous seal coat inside shall conform to AWWA C-104 latest revision.

Where specifically called for on the plans, pipe and fittings housed and in vaults shall be lined and coated on the inside as specified herein for buried ductile iron pipe and fittings, but shall be left uncoated on the outside so that it may be painted without the use of tar stop.

2.2.8 Fittings for Ductile Iron Pipe. Ductile iron mechanical, push-on and flanged joints shall conform to AWWA C-110 for centrifugally cast iron water pipe. Mechanical joints shall also conform in all respects to AWWA C-111. All fittings shall be manufactured for the size and pressure class of the pipeline in which they are to be used. All fittings shall be furnished complete with all joint accessories. All ductile iron pipe fittings for water, sewer, air, gas and force main service shall be coated outside and lined on the inside the same as the line on which they are installed.

2.3 POLYETHYLENE PIPE

This pipe is used primarily for stream crossings and other special applications in locations indicated on the Drawings. The required pressure class shall be as shown on the Drawings.

The pipe shall be PE 3408 high density, high molecular weight polyethylene pipe equal to DRISCOPIPE 1000 as manufactured by Phillips Driscopipe, Inc. The pipe shall meet or exceed the following specifications:

a. ASTM 3350 having a cell classification of PE34534C
b. ASTM F714 - Dimensions and Workmanship
c. AWWA C901 - Potable Water Pipe
d. ASTM D1248 - Type III, Class C, Category 5, Grade P34
e. ASTM D3261 - Fittings Standard
f. NSF - Listed, Standard #14

The pipe shall be joined by the butt fusion technique utilizing controlled temperatures and pressures to produce a fused, leak-free joint that has equal or greater strength than the pipe itself in both tension and hydrostatic loading. The joining system shall be equal to Phillips butt fusion joint system.

Transitions to the continuing pipeline shall be made with the appropriate fittings to maintain the integrity of the piping system as recommended by the pipe manufacturer.

Drawings showing details of the installation shall be submitted to the Engineer for approval prior to installation.

3.0 EXECUTION

3.1 HAULING AND STORAGE

The Contractor shall notify the Engineer when pipe will be received on the job so that proper arrangements may be made for inspecting the unloading and stringing, as well as inspecting and examining the pipe materials.

All pipe shall be covered with tarpaulin during hauling from the manufacturer to the job site. It is acceptable for the front end only to be covered. The intent is to prevent diesel exhaust residue from coating the pipe and/or contaminating the gaskets.

Care must be exercised in the handling of all materials and equipment. The Contractor will be held responsible for all breakage or damage to items caused by his workmen, agents, or appliances for handling or moving. Pipes and other castings shall in no case be thrown or dropped from cars, trucks, or wagons to the ground, but shall be lowered gently and not allowed to roll against or strike other castings and unyielding objects violently.

Valves, castings, fabricated metal, reinforcing steel, etc. shall be yarded or housed in some convenient location by the Contractor and delivered at the construction site as required. All equipment and materials subject to damage from the weather, dampness, changes in temperature, or exposure shall be protected by a dry, weatherproof enclosure until ready for installation or use. The cost of all hauling, handling, and storage shall be included in the prices bid for equipment and materials in place. The Owner takes no risk or responsibility for fire, flood, theft, or damage until after the final acceptance of the Work.

3.2 LINES AND GRADES

The Contractor will be required to accomplish any detailed layout, including that required for establishing the grade of the pipe line.

3.3 TRENCH EXCAVATION

3.3.1 General. This section describes the acceptable methods of trenching for the installation of pressure pipe and casing pipe in an open trench.

Trenching may be accomplished by means of a backhoe, trenching machine or by hand depending on the construction area.

At the Contractor's option, trenching, by a trenching machine or by backhoe is acceptable except as noted below:

Where the pipe line is being constructed close to other utilities, structures, building, or large trees, and it is reasonable to anticipate possible damage from the use of a backhoe, then trenching shall be made by hand methods.

The Contractor shall include in his unit price bid, all trenching necessary for installation of all pipelines as planned and specified. Trenching shall include all clearing and grubbing, including all weeds, briars, trees, stumps, etc. encountered in the trenching. The Contractor shall dispose of any such material by burning, burial, or hauling away (or as noted on the drawings), at no extra cost to the Owner. It shall be the Contractor's responsibility to notify the appropriate State and local Air Pollution Control agencies when he conducts open burning of refuse. Ornamental shrubs shall be removed, protected, and replanted. Trenching also includes such items as minor street, road, sidewalk, pipe and small creek crossings, and cutting, moving or repairing damage to fences, poles, gates and/or other surface structures regardless of whether shown on the plans.

The Contractor shall protect existing facilities against danger or damage while pipeline is being constructed and backfilled, or from damage due to settlement of this backfill. In case of damage to any existing structures, repair and restoration shall be made at once and backfill shall not be replaced until this is done. In all cases, restoration and repair shall be such that the damaged structures will be in as good condition and serve its purpose as completely as before and such restoration and repair shall be done without extra cost to the Owner. The use of trench-digging machinery will be permitted except where its operations will cause damage to trees, buildings or existing structures above or below the ground. At such locations hand methods shall be employed to avoid such damage. All excavated material shall be piled in a manner that will not endanger the work and will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

All excavation shall be open trenches, except where the drawings call for tunneling, boring, or jacking under structures, railroads, sidewalks and roads. The construction procedure for these types of excavation is described elsewhere in these specifications.

All trench excavation shall be termed unclassified and costs shall be included in the unit price bid for the pipe.

3.3.2 Clearing. The Contractor shall accomplish all clearing and/or grubbing as required for the construction under this contract. Clearing and grubbing shall include the cutting and removal of trees, stumps, brush, roots, logs, fences and other loose or projecting material and natural obstructions which, in the opinion of the Engineer, must be removed to properly construct and operate the facilities. Ornamental shrubs, plantings, fences, walls, etc. shall be removed and replanted or replaced or protected from the construction activity. Clearing and/or grubbing shall be incidental to the various bid items and no additional compensation will be paid for same.

3.3.3 Trench Depth. Trenches shall be excavated to the line and grade required for the installation of pipe at the elevations indicated on the plans. The minimum depth of cover shall be 30 inches above the top of the pipe, unless shown otherwise on the plans or on the Standard Details. When the pipe is laying in or on solid rock, the minimum depth of cover shall also be 30 inches above the top of the pipe. No additional compensation will be made for extra depth where required by the plans or due to Contractor error. Excavation, except as required for exploration, shall not begin until the proposed work has been staked out. Materials which are not required for backfill and site grading shall be removed and disposed of as directed by the Engineer. Hauling, bedding, and backfilling shall be considered incidental to the various bid items and will not be paid for directly. Excavation shall be of sufficient depth to allow the piping to be laid on the standard pipe bedding in accordance with Section 3.4. The trenches shall be excavated to a minimum of six inches below the bottom of the pipe barrel in rock. In all cases where lines are under traffic a minimum cover of forty-two inches (42") shall be provided. Should it be necessary to avoid existing utilities, culverts, outlets, or other structures, the water line shall be carried deeper at no additional expense to the Owner.

Where the plans call for extra trench depth, this extra depth shall be provided at no extra cost.

3.3.4 Trench Width. Trench widths shall exceed the minimum width that will provide free working space on each side of the pipe and to permit proper backfilling around the pipe as shown in the accompanying table and unless specifically authorized by the Engineer, shall not be excavated to wider than two feet (2’) plus the nominal diameter of the pipe at the top of the trench. Before laying the pipe, the trench shall be opened far enough ahead to reveal any obstruction that may necessitate changing the line and grade of the pipe. Should the Contractor fail to accomplish this, and changes are required, they shall be at his sole expense. In rock, all ledge rocks, boulders and large stones shall be removed to provide six inches (6”) of clearance on each side and below all pipe and fittings.

Minimum Trench Width

Size	Width
Up to 4" Pipe	1'-6"
6" Pipe	2'-0"
8" Pipe	2'-0"
10" Pipe	2'-4"
12" Pipe	2'-6"
14" Pipe	2'-6"

Size	Width
15" Pipe	2'-8"
16" Pipe	2'-8"
18" Pipe	3'-0"
20" Pipe	3'-2"
21" Pipe	3'-4"
24" Pipe	3'-8"

3.3.5 Shoring, Sheeting, and Bracing of Excavation. Where unstable material is encountered, or where the depth of the excavation in earth exceeds five feet (5'), the sides of the trench or excavation shall be supported by substantial sheeting, bracing, or shoring. The design and installation of all sheeting, sheet piling, bracing or shoring shall be based on computations of pressure exerted by the materials to be retained under retaining conditions. Adequate and proper shoring of all excavations will be the entire responsibility of the Contractor. The Standards of the Federal Occupational Safety and Health Act and the Kentucky Department of Labor shall be followed.

The Engineer will not be responsible for determining requirements for bracing or sheeting.

3.3.6 Removal of Water. The Contractor shall provide for adequate removal of all water and the prevention of surface water from entering the excavation. The Contractor shall maintain dry conditions within the excavations until the backfill is placed. No additional compensation will be paid for replacement and/or stabilization of prepared excavations due to flooding and/or deterioration from extended exposure. All water pumped or drained from the excavation shall be disposed of in a suitable manner without damage to adjacent property or to other work under construction.

3.3.7 Pavement Removal. Pavement removal shall be as indicated on the plans or directed by the Engineer. When so required, or when directed by the Engineer, only one-half (1/2) of the street crossings or road crossings shall be excavated before placing temporary bridges over the side excavated, for the convenience of the traveling public. All backfilled ditches shall be maintained in such a manner that they will offer no hazard to the passage of traffic. The convenience of the traveling public and the property Owners abutting the improvements shall be taken into consideration. All public or private drives shall be promptly backfilled or bridged at the direction of the Engineer. Pavement replacement shall be in accordance with Section 15120 of these specifications. Excavated materials shall be disposed of so as to cause the least interference and in every case the disposition of excavated materials shall be satisfactory to the Engineer.

3.3.8 Traffic Maintenance. The Contractor shall be held responsible for any damage that may occur to persons or property by reason of the failure of the Contractor to properly guard and flag all open trenches or obstructions along the routes of the water lines. The Contractor at his own expense shall maintain warning signs, barricades and watchmen or flag men to control traffic at such times as his work would interfere with the flow of traffic. No excavation shall begin that may present a safety hazard unless the signs, barricades, lights, etc. are available to protect the open excavation at the conclusion of the day. The Contractor will comply with all Federal and State Occupational Safety and Health requirements for this type of construction. The Contractor shall also comply with all local and Kentucky Department of Highways requirements for signing and traffic control.

3.3.9 Line Location. The location of pipelines and their appurtenances as shown are those intended for the final construction. However, conditions may present themselves before construction on any line is started that would indicate desirable changes in location. In such cases, the Owner reserves the right to make reasonable changes in line and structure locations without extra cost, except as may be determined by extra units of materials and construction actually involved. The Owner is under no obligation to locate pipelines so they can be excavated by machine.

3.4 BEDDING OF PIPELINE

In all cases the foundation for pipe shall be prepared so that the entire load of the backfill on top of the pipe will be carried uniformly on the barrel of the pipe. The bells of the pipe shall not carry any of the load of the backfill. The Contractor should refer to the Standard Details for pipe bedding shown in the plans. The bedding specifications shall govern the backfill from the bottom of the trench up to the centerline or spring line of the pipe.

All ductile iron pipe shall be installed in accordance with Standard ANSI/AWWA C150-A21.50 Laying Condition Type 3 unless otherwise noted.

3.4.1 Stable Earth Foundation. On all PVC pipelines, the trench bottoms shall be smooth and free of frozen material, dirt clods and stones over 1/2" diameter. Bottom dirt left by trenching equipment will usually provide adequate material to level the trench bottom and provide bedding support for the pipe barrel. If the trench bottom is free of dirt, soft material may be shoveled off the side walls or shoveled under the pipe to insure proper pipe barrel bedding. In areas where the trench bottom is hard, a layer of soft backfill must be provided to insure the pipe barrel is properly cushioned. See the Plans for proper bedding material depth.

If the foundation is good firm earth the pipe may be laid directly on the undisturbed earth provided the pipe barrel is supported for its full length.

Bedding of No. 9 stone, fine gravel, sand or compacted finely graded select earth shall be used to correct irregularities in the subgrade.

As an alternative to the above method, excavation may be undercut to a depth below the required invert elevation that will permit laying the pipe on a bed of granular material or finely graded select earth to provide continuous support for the pipe barrel. Bedding depth shall be as shown on the plans.

The bedding is not a separate pay item and shall be included as incidental expense in the unit price for the pipe bid per foot of pipe.

3.4.2 Trenches In Rock. All installation in rock will utilize the undercutting method. Bedding will be with 6 inches crushed stone or suitable earth material.

3.4.3 Unstable Trenches. If unstable material is encountered which may not provide a suitable foundation for the pipe, the unstable material will be removed and an adequate layer of encasement concrete or other special bedding shall be placed for the pipe foundation in accordance with the Standard Details in the plans. Such “special pipe foundation” shall only be installed if directed by the Engineer in writing or on the plans.

3.5 PIPE LAYING

3.5.1 General. Proper instruments, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Each pipe manufacturer shall have an experienced representative on the job for at least one day at the commencement of jointing and laying operations.

Before any length of pipe is placed in the trench, a careful inspection shall be made of the interior of the pipe to see that no foreign material is in the pipe. In order to properly remove any foreign materials, a swab of necessary length is to be available at all times.

All pipe shall be lowered carefully into the trench, properly aligned and properly jointed by use of suitable tools and equipment, in such a manner as to prevent damage to water line materials and protective coatings and linings. Excessive scratching of the exterior surface of the pipe will be cause for rejection of the pipe.

Under no circumstances shall pipeline materials be dropped or dumped into the trench. The pipe and fittings shall also be inspected for the purpose of determining if they are sound and free from cracks. Laying of pipe shall be commenced immediately after excavation is started. Pipe shall be laid with bell ends facing in the direction of laying.

When pipe laying is not in progress, the open ends of pipe shall be closed by approved means to prevent entrance of trench water into the line. Whenever water is excluded from the interior of the pipe, adequate backfill shall be deposited on the pipe to prevent floating. Any pipe which has floated shall be removed from the trench and re-laid as directed by the Engineer. No pipe shall be laid in water or on frozen trench bottom, or whenever the trench conditions or the weather are unsuitable for such work.

If any defective pipe and fittings shall be discovered after the pipeline is laid, they shall be removed and replaced with a satisfactory pipe or fitting without additional charge to the Owner. Open ends of unfinished pipe lines shall be securely plugged or closed at the end of each day's work or when the line is left temporarily at any other time.

3.5.2 Laying Ductile Iron Pipe. Ductile iron pipe shall first be thoroughly cleaned at joints, then joined according to instructions and with tools recommended by the manufacturer. Three (3) copies of instructions shall be furnished to the Engineer and one (1) copy shall be available at all times at the site of the work. The lining inside ductile iron pipe must not be damaged by handling.

All pipes must be forced and held together, or "homed" at the joints, before sealing or bolting. Pipe must be aligned as each joint is placed, so as to present as nearly true, straight lines and grades as is practical, and all curves and changes in grades must be laid in such a manner that the manufacturer's recommended maximum deflection is not exceeded at any joint.

Cutting of pipe may be done by wheeled pipe cutters or saws as the Contractor may elect, but the Contractor will be held responsible for breakage or damage caused by careless cutting or handling.

All ductile iron pipe shall be installed per AWWA C150 Laying Condition Type 3 unless otherwise noted, six inches (6”) crushed stone bedding or suitable earth shall be used in rock. No pipe shall be laid resting on rock, blocking, or other unyielding objects. Jointing before placing in trench, and subsequent lowering of more than one section jointed together may be allowed, subject to the Engineer approval and direction.

When using pipe with push-on joints care must be exercised to make certain that the correct gasket is being used for the type of joint installed and that the gasket faces the proper direction. Before inserting the gasket, the groove and bell socket should be carefully cleaned of all dirt. If sand or dirt is permitted to remain in the groove, leaks may occur. Lubricant must be applied to bell socket, gasket and plain-end of pipe as required by manufacturer. Plain-end must be beveled before joint is made. Deflection required at the joint shall be obtained after the joint is made.

3.5.3 Laying Plastic Pipe. The trench bottom must be smooth and uniform and the alignment must conform to the Plans. Bedding and cover as specified herein and shown in the Standard Details is required.

To make a clean and unobstructed joint, it is necessary to wipe the ring, groove and pipe spigot free from all foreign materials at the time of assembly. The ring must be positioned properly in the fitting to receive the pipe by a worker who is not in contact with the lubricant. In general, the lubricant is applied to the spigot (not the ring or groove). However, the manufacturer's instructions are to be followed in all cases. Only an approved lubricant may be used in accordance with the manufacturer's recommendations. All plastic pipe shall be joined by hand.

Where good bedding conditions are obtained PVC pipe smaller than 4 inches may be assembled outside the trench in longer sections (as conditions allow) and then lowered into the trench. At any time when improper bedding is discovered or the pipe is severely deflected the pipe will be removed from the trench and the condition corrected. Pipe in sizes 4 inch and above may be assembled outside the trench but must be lowered into the trench as each joint is assembled. Regardless of installation methods all joints must be inspected after laying in trench for proper insertion and alignment. Field cuts and bevels will be allowed in accordance with the manufacturer's recommendations for these operations. A new reference mark shall be installed before joining any field cut pipe. The same requirements for clearance from rock or other objects, thrust blocking and deflections shall apply to PVC pipe as for other pipe materials.

C-900 PVC pipe of all sizes must be assembled in the trench in strict accordance with the manufacturer's requirements.

3.5.4 Installation of River Crossing Pipe. The ball joint pipe shall be assembled and installed in accordance with manufacturer's recommendations. Installation shall be made at time of low flow, using cofferdams as necessary to divert stream flow. The ball joint pipe shall be laid and allowed to settle before joining to the pipe on each side of the stream. The ball and joint pipes shall be tested separately once in place to detect any leaks or bad joints. After connecting to the land pipe, it shall be tested the same as specified for the other water mains. See the Drawings for additional installation requirements.

3.6 BACKFILLING

Backfilling must be started as soon as practicable after pipe has been laid. The Engineer shall be given a minimum of 8 hours for inspection before backfilling. The backfill shall be crushed rock, sand, or finely divided earth free from debris, organic material and stones, placed simultaneously on both sides of pipe to the same level by hand.

In backfilling of the lower part of the trench beginning at the top of the bedding, the backfill material shall be carefully selected and walked-in around the pipe in 6" layers to a point 8 inches higher than the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipe line will not be disturbed and injurious side pressures do not occur.

After the above specified backfill is hand placed, rock may be used in the backfill in pieces no larger than 18 inches in any dimension and to an extent not greater than one-half (1/2) the backfill materials used. If additional earth is required, it must be obtained and placed by the Contractor. Filling with rock and earth shall proceed simultaneously, in order that all voids between rocks may be filled with earth. Above the hand placed backfill, machine backfilling may be employed without tamping, (if not contrary to specified conditions for the location) provided caution is used in quantity per dump and uniformity of level of backfilling. Backfill material must be uniformly ridged over trench and excess hauled away, with no excavated rock over 1-1/2 inch in diameter or pockets of crushed rock or gravel in top 6 inches of backfill. Ridged backfill shall be confined to the width of the trench and not allowed to overlap onto firm original earth and its height shall not be in excess of needs for replacement of settlement of backfill. All rock, including crushed rock or gravel from construction, must be removed from yards and fields. Streets, roadways and walks shall be swept to remove all earth and loose rock immediately following backfilling.

In the case of street, highway, railroad, sidewalk and driveway crossings or within any roadway paving or about manholes, valve and meter boxes, the backfill must be machine tamped in not over 4-inch layers, measured loose in accordance with the standard details. Where backfill is under paved driveways, streets, highways, railroads, sidewalks, paved parking areas and other areas where settlement is not allowed, flowable fill only shall be used up to the paving surface. Crushed stone shall be Kentucky Department of Highways Standard Specification No. 57. Tunnels shall be backfilled in not over 3-inch layers, measured loose, with selected material suitable for mechanically tamping. If material suitable for tamping cannot be obtained, sand, gravel or crushed rock shall be blown, packed or sluiced to complete fill all void spaces.

Where local conditions permit, pavement shall not be placed until 30 days have passed since placing backfill. As appropriate for roads, parking areas and sidewalks, crushed stone or flowable fill shall temporarily be placed to the top of trench. Backfills shall be maintained easily passable to traffic at original ground level, until acceptance of project or replacement of paving or sidewalks.

The Kentucky Transportation Cabinet requires that water and sewer lines—when placed within the limits of the roadway embankment and/or beneath the roadway itself—be backfilled with flowable fill as defined by Section 601.03.03.B(5) of their "Standard Specifications for Road and Bridge Construction". The Cabinet

typically requires that flowable fill be used to backfill the trench and/or bore pit up to the subgrade elevation and extending to the outside edge of the shoulder.

Railroad Company and Highway Department requirements in regard to backfilling will take precedence over the above general specification where they are involved.

The Contractor shall protect all sewer, gas, electric, telephone, water and drain pipes or conduits, power and telephone poles and guy wires from danger of damage while pipelines are being constructed and backfilled, or from danger due to settlement of his backfill.

In case of damage to any such existing structures, repair and restoration shall be made at once and backfill shall not be replaced until this is done. In all cases, restoration and repair shall be such that the damaged structure will be in as good condition and serve its purpose as completely as before uncovering and such restoration and repair shall be done without extra charge.

No extra charge shall be made for backfilling of any kind, except as provided in the Bid. Backfilling shall be included as a part of the unit price bid for which it is subsidiary. No extra charge shall be made for supplying outside materials for backfill.

Before completion of contract, all backfills shall be reshaped, holes filled and surplus material hauled away, and all permanent walks, street, driveway and highway paving, and sod, replaced and reseeding performed.

The line Contractor shall be responsible for clean-up, grading, seeding, sodding or otherwise restoring all areas that he disturbs.

Any deficiency in the quantity of material for backfilling the trenches or for filling depressions caused by settlement, shall be supplied by the Contractor.

3.7 TIE-INS TO EXISTING PIPELINES

This work shall consist of connecting new water pipes to the existing system where shown on the plans and shall include the necessary fittings, tapping sleeves, valves and necessary equipment and material required to complete the connection.

Knowledge of pipe sizes in the existing system may not be accurate, therefore, it is recommended that the Contractor check outside diameters of existing pipe and types of pipe prior to ordering the required accessories. No additional payment will be allowed for matching pipe and/or accessories when the proper size is not ordered.

Neither the Owner nor the Engineer can guarantee the location of the existing lines. The Contractor shall verify the location of all existing water mains and valves pertaining to the proposed improvements before excavation is started.

The necessary regulation or operation of the valves on existing mains, to allow for the connections being made, shall be supervised by the Engineer. Before shutting down an existing water main or branch main for a proposed connection, prior approval for a specific time and time interval shall be obtained from a representative of the Owner. At no time shall an existing main be shut down without the Owner's knowledge and permission.

Excavation to existing water mains shall be carefully made, care being exercised not to damage the pipe. The excavation shall not be of excessive size or depth beneath the pipe. The sides of the excavation shall be as nearly vertical as possible.

The Contractor shall be responsible for any damage to the existing system and any such damage shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

The Contractor shall verify, by field inspection, the necessary sizes, lengths and the types of fittings needed for each inter-connection. Typical connections are shown on the plans and any modifications or changes shall be subject to the approval of the Engineer. The exact length of the proposed water main needed for this work shall also be determined by field measurement as required.

The probing required to locate existing mains is not a separate pay item.

3.8 PIPE ENTERING STRUCTURES

Ductile iron, steel or PVC pressure pipe, 4-inch diameter or larger, entering structure below original earth level, unsupported by original earth for a distance of more than six feet (6'), shall be supported by #57 crushed stone. Costs for the support shall be included in the unit price for the pipe.

3.9 OWNERSHIP OF OLD MATERIALS

Pipe – Unless otherwise indicated, all existing pipe that is to be abandoned that interferes with construction or is easily removed shall become the property of the Contractor. All pipe that is not easily removed or not required to be removed as a result of the new construction, shall be abandoned in place by this Contractor.

Pipe Line Fittings and Appurtenances – All pipe line fittings, valves, hydrants and other like appurtenances that are removed as a result of new construction shall be removed by this Contractor but shall become the property of the Owner. All such fittings and appurtenances shall be delivered to a point by the Contractor.

Said point shall be on the Owner's property and shall be designated by the Engineer.

Other Materials – All other materials or items that are to be removed, demolished, or abandoned as a part of this contract shall become the property of the Contractor and shall be disposed of by him.

3.10 THRUST BLOCKS AND ANCHORAGE

Thrust blocks shall be installed whenever the pipe line changes direction, as at tees, bends, crosses, stops, as at a dead end; or at valves. The locations of thrust blocks depend on the direction of thrust and type of fitting. Their size and type depends on pressure, pipe size, kind of soil, and the type of fitting. Where thrusts act upward (as at vertical curves) the weight of the pipe, the water in the pipe and the weight of the soil over the pipe should be determined to make certain that the total weight is sufficient to resist upward movement. If there is not enough soil or if it will not compact over the pipe or it is too soft to resist movement, then ballast or concrete may be placed around the pipe in sufficient weight and volume to counteract the thrust. Where a fitting is used to make a vertical bend, the fitting may be anchored to a concrete thrust block designed to key in to undisturbed soil and to have enough weight to resist upward and outward thrust, since the new placed backfill may not have sufficient holding power.

Thrust blocks shall be constructed of not less than Class B concrete conforming to KTC Specification 601 and placed between the fitting and the trench wall. It is important to place the concrete so it extends to undisturbed (freshly cut) trench wall.

3.11 MAINTENANCE OF FLOW OF DRAINS AND SEWERS

Adequate provision shall be made for the flow of sewers, drains and water courses encountered during construction. Any structures which are disturbed shall be satisfactorily restored by the Contractor.

3.12 INTERRUPTION OF UTILITY SERVICES

No valve, switch or other control on any existing utility system shall be operated for any purpose by the Contractor without approval of the Engineer and the Utility. All consumers affected by such operations shall be notified by the Contractor as directed by the Engineer and Utility before the operation and advised of the probable time when service will be restored.

3.13 FENCING

Where water supply line is being constructed in fields where stock is being grazed, Contractor shall provide temporary fence as approved by the Engineer around open trenches to prevent stock from falling in trenches. Where trenching operations should isolate grazing stock from their source of water, Contractor will either provide temporary bridging over trench or else provide water for such stock.

Where trench crosses near sound existing corner posts and existing fence is in good condition, fence may be taken loose, rolled back and stored until pipe line is completed at this point, then replaced by stretching tightly and thoroughly stapling. Additional posts will be provided and additional new fence shall be provided when it is necessary to place the fence crossed by the water line in a condition equal to existing fence before water line was constructed.

Where it is necessary to cut existing fence, new end posts shall be installed on each side of the water line and the old fence thoroughly stapled to these new posts before cutting. After pipe line is completed at this point, a new fence of galvanized wire (No. 9 gauge with No. 11 filler wires) shall be stretched between these new end posts and thoroughly stapled to existing posts and any new intermediate posts necessary to provide a good fence. Replacement of fences shall be on a replacement in-kind basis, and shall be considered incidental to laying of the lines and any additional cost shall be included in the unit price bid per linear foot of pipe.

3.14 PROTECTION OF ADJACENT LANDSCAPE

Reasonable care shall be taken during construction of the water 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 to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

In the course of construction, the Contractor may deflect horizontal alignment of the water line to avoid trees and to keep from damaging their roots. The Contractor shall be fully responsible for settling all claims by private property owners concerning damage to trees and shrubs.

3.15 COORDINATION WITH UTILITIES

The Plans show the general location of existing utilities such information having been determined from the utilities. However, such information shall be considered general and is not guaranteed by Owner, Engineer or the Utility.

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 utilities 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.

Repairs to any utilities damaged by the Contractor shall normally be performed by the utility at the Contractor's expense, unless the Contractor and the utility negotiate other understandings and/or procedures.

3.16 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 Section 9, Explosives, of the "Manual of Accident Prevention in Construction", published by the Associated General Contractors of America, Inc. Soil particle velocity shall not exceed limit set by Kentucky law. All explosives shall be stored in conformity with said 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 product lines or other utilities. Any damage done by blasting is the responsibility of the Contractor and shall be promptly and satisfactorily repaired by him.

The Contractor shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping, as defined in the above manual, will not be permitted as a method of 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 the 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 since this information that may stand in his defense.

4.0 PAYMENT

Payment for supplying, transporting and storing pipe, trenching, bedding, pipe installation, fittings, thrust-blocking, pipe locating wire and tape, testing, backfilling (including flowable fill, if required), disinfection, seeding, crop damage, regular stream crossings, clean-up, tie-ins to other structures and other incidental items in this section shall be made on the basis of the unit price per linear foot for the type and size of pipe installed. Payment will include all those items not specifically covered by another proposal. Pipe will be measured along the centerline of the pipe as installed with no deduction for valves and fittings.

END OF SECTION

SECTION 15101

WATERLINE ACCESSORIES

1.0 GENERAL

The Contractor is to supply and install all valves, hydrants, blow-offs and other equipment at the locations shown on the plans in complete accordance with these specifications.

2.0 GATE VALVES

All gate valves shall be the resilient seat-type, iron body, non-rising stem, fully bronze mounted, and suitable for working water pressures of not less than 200 psi for installations on PVC pipe and not less than 250 psi for installations on DI pipe. Valves shall be of standard manufacture and of the highest quality both of materials and workmanship and shall conform to the latest revision of AWWA C-509 Standard. Valves shall be furnished with flanged connections for exposed piping and push-on or mechanical joint connections for buried service. Gate valves shall have a clear water way equal to the nominal diameter, and shall be opened by turning counter-clockwise. The operating nut or wheel shall have an arrow cast in the middle, indicating the direction of opening. Each valve shall have the maker's initials, pressure rating and the year in which manufactured, cast on the body. Prior to shipment from the factory each valve shall be tested by hydraulic pressure of at least 300 pounds per square inch. The valves shall be Mueller or Kennedy brand or approved equal.

Underground valves shall be nut operated, unless otherwise shown on the plans. Valve supplier shall furnish two standard stem iron wrenches for turning nut operated valves. All underground valves which have nuts deeper than thirty inches (30'') below the top of valve box shall have extended stems with nuts located within two feet (2') of valve box cap. Buried service valves shall have either epoxy-coated or tar-coated exteriors.

The valve maker is to supply the Engineer, through the bidder, within one week after award is made, complete catalogs or other material giving complete details and dimensions of valves and accessories.

Gate valves installed in underground piping systems may be installed in the vertical position for sizes to 12-inch. Gate valves 14-inch and larger shall be installed in the horizontal position with bevel gear operators unless otherwise noted on the drawings. Gear operators shall be the totally enclosed type, oil filled and designed for buried and submerged service. Gear housing shall be ductile iron. Gears shall be steel. Pinion shafts shall be stainless steel. Shaft bearings shall be Teflon with "O"-Ring bearings.

3.0 FIRE HYDRANTS

3.1 WORK INCLUDED

Under this Item, the Contractor shall provide all labor, tools, equipment and materials to furnish and install hydrants with gate valves as shown on the drawing and as directed by the Engineer.

3.2 MATERIALS

All fire hydrants shall have a six inch bell connection, shall have two hose outlets and one pumper connection, shall be designed for 250 pounds working pressure or 300 pounds hydrostatic pressure and shall conform to the latest specifications of the AWWA C502. All working parts shall be bronze. Both hose outlets shall be 2 1/2 inch with NST threads and the pumper outlet shall be 4 1/2 inch with NST thread. Hydrants shall be designed so that no water will be lost when they are broken off and so they can be repaired with a repair kit. Design, materials, and workmanship shall be similar and equal to the latest stock pattern ordinarily produced by the manufacturer. Length of barrel shall be such to provide a 3 1/2 foot bury depth. Working drawings and full description of hydrants shall be submitted to the Engineer before ordering. All hydrants shall have a 5 1/4 inch valve opening against pressure. The hydrants shall be Mueller or Kennedy brand or approved equal. All hydrant extensions will be the responsibility of the Contractor.

3.3 PAINT

Hydrants shall be painted one coat of red paint and two finish coats of approved paint of color directed by the Engineer. All hydrants are to receive the final coat of paint after field installation.

3.4 INSTALLATION

Hydrants shall be set at such elevations that the connecting pipe will have the same depth of cover as the distribution main. The back of the hydrant opposite the pipe connection shall be firmly wedged against one and one-half square feet or enough of the vertical face of the trench with concrete to prevent the hydrants from blowing off the line. In addition, all fittings, valves and hydrants shall be joined by the use of all-thread rods, nuts and "DUC-LUG" offsets as shown on the attached drawing to prevent movement of the hydrant. If the character of the soil is such, in the opinion of the Engineer, that the hydrant cannot be securely wedged, bridle rod collars shall be used which shall be not less than three-fourths inch stock and shall be protected by a coat of acid resistant paint.

Not less than seven cubic feet of No. 9 stone shall be placed around the base of the hydrant to insure drainage. Before the No. 9 stone is placed and before it is

backfilled the drain hole shall be inspected and thoroughly cleaned if necessary. The backfill around the hydrant shall be thoroughly compacted to the grade line in a manner satisfactory to the Engineer. Hydrants shall have the interior cleaned of all foreign matter before installation.

All hydrants will be installed with the pumper connection facing the main access road or as directed by the Engineer.

Stuffing boxes shall be tightened and the hydrants shall be inspected in open and closed position to see that all parts are in working condition.

4.0 AIR VALVES – N/A

4.1 AIR RELEASE VALVES

A valve designed to allow exhaust of small pockets of air from the water main while in use shall be installed where shown on the plans or where directed by the Engineer. The air release valve shall have a 3/4” iron pipe thread inlet, cast iron body construction, bronze trim, with all internal parts of stainless steel. The valve shall have a minimum orifice size of 3/32”. Valves shall be suitable for a working water pressure of 250 PSIG. The air release valve shall be mounted on 3/4” bronze riser pipe. The riser pipe shall be connected to the water main by use of a service clamp and a corporation stop. The riser shall also have a 3/4" bronze ball valve with stainless steel handle and be suitable for a 250 PSIG working water pressure. Air release valves shall be as manufactured by DeZurik Models 65 or 50, or approved equal.

Air release valves will be installed in the same type of box used for meter installation. The box must allow for adequate cover over the pipe at the installation.

In locations where the air release valve can not be placed directly above the water main, such as roadway drainage ditches, then a section of service tubing shall be used to locate the valve as directed by the Engineer. The service tubing shall be installed with a continuous upward slope to eliminate air pockets. Additional payment for the tubing shall be made based on the linear foot bid for service tubing. Tubing shall also be rodded through the box to support the valve. No additional payment will be made for the tubing supports.

5.0 VALVE BOXES

All valves (gate, air release, check, etc.) installed underground shall be installed in an approved valve box. Each gate valve shall be installed in a vertical position with a valve box. Valve boxes shall be of a cast iron, two or three-piece, slip-type consisting of a base, a center section and a top section with a cover marked "water". Where valve box is constructed in a paved area the box shall be a screw type box. The entire assembly shall be adjustable for elevation and shall be set vertically and be properly adjusted so that the cover will be in

the same plane as the finished street surface (no more than 1/2" above ground in yards or pastures or 2" in unsodded areas). The assembly must provide for the required cover over the pipe at the installation site and shall rest on concrete pads as shown in the Standard Details. The Contractor shall furnish two valve wrenches for the project.

6.0 BLOW-OFF ASSEMBLY

Blow-off assembly shall be installed in accordance with the details and the specifications at locations shown on the plans and in other locations as directed by the Engineer. The gate valve is included in the unit bid price for blow-off assembly. The Contractor should refer to the Standard Details for blow-off installation.

The blow-off pipe from the main to the flush valve shall be connected to the main by means of a tee. Do not use a corporation stop for this connection. The gate valve included in the blow-off connection shall be a resilient seat gate valves in conformance with AWWA C509.

7.0 TAPPING SLEEVE AND VALVE

Tapping sleeves shall be as manufactured by Mueller or approved equal, and shall be rated for a minimum working water pressure of 250 psi. Contractor shall ascertain the type and size of pipe to which the connection is to be made prior to selection. The valve shall be as specified under Section 2.0 of this specification.

8.0 TIE IN CONNECTIONS

All tie-in connections shall include any fittings suitable to make the required connection. The fittings shall be mechanical joint, ductile iron type as specified in other sections.

9.0 END CAPS

All end caps installed to deaden existing lines shall be installed in accordance with the details shown on the plans as appropriate.

10.0 MEASUREMENT AND PAYMENT

Payment for the pressure reducing station shall include all work and materials necessary for a complete and working installation at the unit bid price. Payment for all valves, tapping sleeve and valves, tie-in connections, and fire hydrants or blow-off assemblies will be made at their respective unit bid prices.

END OF SECTION

SECTION 15102

SPECIAL ITEMS OF CONSTRUCTION

1.0 GENERAL

These specifications govern special crossings, installations and construction procedures required to deal with unusual construction items or special requirements of governing agencies.

2.0 STATE HIGHWAY CROSSINGS

In all cases, these crossings will be made in compliance with the requirements of the State Highway Department. Such requirements will normally be described by the appropriate District Highway Office. In general, unless otherwise shown on the plans or directed otherwise by the Engineer, the crossing of all State Highways shall be accomplished by boring under the roadway. In addition, the crossing of service lines 1-1/2 inches and greater under rigid and flexible surfaced paved roads shall be accomplished by boring and jacking a casing pipe under said roadway. In certain cases, as shown on the plans, service lines of all sizes will require casing pipe installed with the crossing.

2.1 OPEN TRENCH CROSSINGS

The trench shall be excavated to a minimum width that will allow the pipe installation. The trench walls shall be kept as nearly vertical as possible. The minimum specified cover above the pipe shall be maintained. The Miscellaneous Detail Drawings show the requirements for open trench crossings.

The backfill in the trench under any roads, driveways, or parking areas where the open trench method is used shall be of the type shown in the Miscellaneous Details and shall be deposited and compacted in uniform layers not to exceed the depth shown in the Miscellaneous Details.

The surface of the road, driveway, or parking area shall be replaced with the same type of material as specified under pavement replacement.

2.2 BORING AND JACKING

The work is herein defined as the operations in which both the boring by auger and the jacking of the casing pipe are done mechanically and in which the diameter of the casing pipe is too small to permit hand working at the heading of the casing pipe. Two basic methods are; (1) pushing the casing pipe into the fill or earth simultaneously as the boring auger drills out the ground; and (2) drilling the hole through the fill or earth and pushing the casing or carrying pipe into the hole after the drill auger has completed the bore.

A suitable approach trench shall be opened adjacent to the slope of the embankment, or adjacent to point of bored and jacked section as shown on the plans. The approach trench shall be long enough to accommodate the selected working room. Guide timbers or rails for keeping the casing pipe on line and grade shall be accurately set and maintained in the bottom of the approach trench and with heavy timber back-stop supports installed at the rear of the approach trench to adequately take thrust of the jacks without any movement or distortion. It is paramount to the securing of acceptable tolerance limits of workmanship in the boring and jacking operation that extreme care be taken in the setting of all guides, rails and jacks to the end that the casing pipe in final position be within the limits of acceptability for the placing and laying of the carrier pipe. The minimum cover of forty-two inches (42”) under the roadway must be maintained. Additional depth may be required as shown on the plans.

In general, the diameter, thickness, style, joints and materials selected for casing pipe shall be as shown on the plans and shall be considered as "minimum" requirements, all subject to prior approval of the Engineer. In all cases, the approval for construction by agreement with the private company and/or construction permit issued by the State, County, or Municipal agency will be required before construction starts.

Steel casing pipe for road and railroad crossings using the boring and jacking method shall be steel, plain end, uncoated and unwrapped, and shall be furnished in at least 18-foot lengths. Steel pipe shall meet the requirements of ASTM Specification A-120 and AWWA C200. Pipes up to and including 4 inches in diameter shall be Schedule 40. Pipe larger than 4 inches shall have a wall thickness equal to or greater than 0.312 inches under railroads and 0.250 for all other uses. The inside diameter of all casing pipes shall be a minimum of four (4") inches greater than the largest outside diameter of the carrier pipe, joint or coupling.

The steel casing pipe shall be bored and/or jacked in place at the locations as shown on the plans or as directed by the Engineer. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. Any field welding shall be performed by a certified welder and shall be in accordance with AWWA C206. The casing pipe may be extended beyond the boring limits by open trenching as shown in the Standard Details. This would apply when the casing is required from right-of-way to right-of-way or ditch line to ditch line. Open trenching at jacked or bored locations will be allowed no closer than 3 feet from edge of pavement.

Positioning guides (insulators) shall be utilized on all carrier pipe which is within the casing pipe. Positioning shall be accomplished by the use of prebuilt spacers such as those manufactured by CALPICO or an approved equal. The Contractor shall submit the type of position guide proposed for use for the approval of the

Engineer. Spacing of the positioning guides shall be in accordance with the Standard Drawings.

The ends of the casing pipe shall be plugged and made watertight in a manner acceptable to the Engineer prior to backfilling. Casing seals as manufactured by Pipeline Seal & Insulator, Inc. (PSI), Advance Products & Systems, Inc. (APS) or equal shall be used.

Where road crossings are made using plastic pipe or copper, the location of joints under the roadway should be avoided by using lengths of adequate dimension for the crossing. This principle also applies to other types of pipe where sufficiently long lengths are available.

3.0 RAILROAD CROSSINGS

At all railroad crossings, cover pipe (casing) for water lines (carrier pipe) shall be jacked or pushed beneath tracks and the carrier pipe jointed and pushed through the cover pipe. Detailed drawings of railroad crossings including the length of casing and depth below track are shown in the plans. Contractor shall obtain and pay for services of a representative of the railroad to direct the Contractor's operations while on the railroad property when required by the railroad.

4.0 STREAM CROSSINGS

4.1 NO-FLOW CONDITION

Where required on the plans or instructed by the Engineer, the Contractor shall construct a special creek crossing as shown in the Miscellaneous Detail Drawings. Crossings shall be scheduled for construction in times of no flow or very low flow, if practicable, otherwise the stream shall be directional bored. Concrete shall not be placed under water and Contractor shall provide suitable pumps to keep water out of trench excavation during stream crossing construction. Special creek crossings shall be designated as Type A or Type B as contained in the Miscellaneous Detail Drawings.

4.2 NORMAL EARTHEN STREAM CROSSING

Where the stream crossing is made in earth or other beds which are stable (no casing or anchorage required), then the pipe will be laid in a narrow trench at the depth specified in the Miscellaneous Details to maintain the required cover between pipe and stream bed. Initial backfill will be mechanically compacted. Trench backfill in any stream crossing area from one foot (1') above the top of the pipe shall consist of trench excavated rock, if available. No extra payment will be made above normal construction for this type of creek crossing.

4.3 BLUE LINE STREAM CROSSINGS

All crossing of streams that appear as a blue line on a USGS 7.5 minute topographical map shall be accomplished in accordance with:

GENERAL CERTIFICATION
NATIONWIDE PERMIT #12
UTILITY LINE BACKFILL AND BEDDING

This document is bound in back of the specifications. The Contractor shall read, understand, and comply with the requirements and procedures.

Stream size, for purposes of this specification, is differentiated as large or small. A stream is classified as small when the distance across the stream channel at top of banks is 15 L.F. or less. A stream is classified as large when this measurement is greater than 15 L.F.

It is the intent of the plans to identify a stream crossing at each blue line stream. Small stream crossings may frequently be accomplished by trenching when the stream is in a no-flow condition. If the stream is in a flow condition, irregardless of the size classification, the crossing shall be accomplished by directional boring or other method that complies with the General Certification and is approved by the Engineer. Specific details for stream crossings are contained in the Miscellaneous Detail Drawings.

See Section 15 for Basis of Payment.

4.4 BYPASS TEST METER

At locations as indicated on the Plans, where a new creek crossing is installed, a bypass test meter shall be installed. The meter shall be installed as a normal water meter with taps on each side of a valve, as shown in the Miscellaneous Detail Drawings.

5.0 RIVER OR LAKE CROSSINGS

Crossings in rivers or lakes where the pipe cannot be laid in a trench shall normally be made with ductile iron pipe having ball and socket joints or polyethylene pipe or directional bored as indicated on the Drawings. Details for any required installations of this type including pipe required; number, size and location of anchors; and, installation technique are shown in the plans and Miscellaneous Detail Drawings. See Section 15100 for installation requirements.

6.0 BRIDGE CROSSINGS

Wherever possible bridges will not be utilized for stream crossings. However, where it is necessary for the water line to be attached to bridges, the pipe shall

be securely fastened to bridge stringers or beams using supports as dimensioned and located in the plans. The carrier pipe shall be insulated with Vermiculite or other approved material to prevent freezing. Expansion joints to allow for movement of the bridge will be required as shown on the plans.

7.0 FREE BORE

7.1 WORK INCLUDED

Under this item, the Contractor shall provide all labor, tools, equipment and materials to install the free bore at all bituminous and concrete driveways and/or county road unless otherwise directed by the Engineer.

7.2 INSTALLATION

The Contractor shall provide a jacking pit and bore through the earth at the proper line and grade. The augured hole shall be as small as practical to allow the carrier pipe to pass through.

This bid item does not apply to service tubing.

7.3 MEASUREMENT AND PAYMENT

The unit price bid per linear foot for free boring, as measured from edge of pavement to edge of pavement, regardless of size of bore, shall constitute full compensation for the work specified.

8.0 WATER LINE AND SEWER LINE SEPARATION

8.1 GENERAL

Wherever sewer lines cross, or are adjacent to, each other, special precautions shall be taken.

8.2 PARALLEL WATER AND SEWER LINES

Water lines must, if possible, be located a minimum lateral distance of 10 feet from any existing or future sewer lines measured from outside diameters. Where water lines and sewer lines must be placed in the same trench, the water line must be located on a shelf, 2 feet above and 2 feet to the side of the sewer line. Whenever this condition cannot be met, and upon direction from the Engineer, the water line shall be uncovered and encased with concrete per the standard encasement detail.

8.3 CROSSING WATER AND SEWER LINES

Wherever sewer lines and water lines cross, it is desirable, if practical, that the sewer line be at least 24 inches below the water line.

Where it is not practical to provide such a separation, care shall be taken to ascertain that the existing water line or existing sewer line is in good sound condition and that no evidence of joint leakage is known in that vicinity. If any such evidence does exist, the existing line shall be exposed by the Contractor at least 10 feet each side of the new pipe crossing, carefully examined and any defects positively corrected. The Owner will arrange for examining and correcting any defects in the existing lines, but the Contractor shall cooperate in every way possible.

When the water line must be below or less than 2 feet above the sewer line, the Contractor shall encase the water line 5 feet in each direction from the crossing as directed by the Engineer. This encasement should only be accomplished when directed by the Engineer and shall be accomplished in accordance with the details shown on the drawings. The encasement is a separate pay item.

9.0 CLEANUP, SEEDING AND SODDING

9.1 GENERAL

Upon completion of the installation of the work, the Contractor shall remove all debris and surplus construction materials resulting from the work. The Contractor shall fine grade all the disturbed surfaces around the area of the work in a uniform and neat manner leaving the construction area in a condition as near as possible to the original ground line or to the lines as directed by the Engineer. The Contractor shall provide effective cleanup of the work as it progresses. Procrastination of cleanup will not be tolerated.

9.2 ROUGH GRADE WORK AND CLEANUP

Rough Grade Work and Cleanup (Rough Cleanup) shall be defined to include the final backfill and windrowing of the ditch line, disposal of excess excavated material, level grading of the disturbed areas adjacent to the ditch line, filling and leveling street and driveway cuts, cleaning up and removal of rubbish, repair of fences and structures, and any other such work that may be required to result in a neat, orderly project area. Rough Cleanup shall be performed as other construction progresses and must be completed within **one week** of the adjacent pipeline construction.

Rough Cleanup is not a separate pay item. The cost for this work shall be included in the unit bid price for water lines. If Rough Cleanup is not performed

as specified, the Owner, after notification to the Contractor, will refuse payment for additional pipeline installation until the Rough Cleanup is accomplished.

9.3 FINAL CLEANUP

Final cleanup, grade work and seeding shall be performed on each line when backfilled trenches have had adequate time to settle, but at least within **30 days** from the date each line is constructed. Final grade work and seeding on Kentucky Transportation Cabinet rights-of-way shall be done in accordance with said Cabinet's specifications and the permit granted to the Owner specifically for this project.

Where work was performed on private property in lawns, earth of good quality, free from rock shall be spread over the disturbed area and graded and compacted to match adjacent ground contours. The graded and seed bed area shall be prepared with a power landscape rake and further hand raked if necessary, until smooth and free from rock, potholes, and bumps. The disturbed area shall then be seeded with the seed variety used on the original lawn (e.g., a bluegrass lawn shall be reseeded with bluegrass seed). In the case of no preference by the Owner, the mixture of grasses shall consist of one-third (1/3) Rye grass, one-third (1/3) Kentucky Fescue and one-third (1/3) Kentucky Bluegrass by weight and shall be applied in accordance with the supplier's recommendations. The area shall be fertilized with 12-12-12 fertilizer applied at a rate of 6 pounds per 1,000 square feet of area. After the seed and fertilizer have been applied, the Contractor shall then lightly cover the seed by use of a drag or other approved device. The seeded area shall then be covered with clean straw to a depth of approximately one (1) inch.

Where work was performed on private property and not in lawns the trench line shall be graded and filled if necessary to match adjacent contours. All rock larger than 1-1/2" in diameter shall be removed from the disturbed area. In general, pasture and fallow land shall be fertilized and seeded with Kentucky 31 Fescue and plowed fields shall be left unseeded, however, the desire of each property owner shall govern regarding seeding. The entire pipeline length that is seeded shall be strawed.

In all cases on private property the rate of seed and fertilizer application shall be that recommended by the material supplier or the University of Kentucky Cooperative Extension Service for new plantings of the variety of grass seed used. If the trench line settles following final grade work or if grass seed fails to germinate within a reasonable time, the Contractor shall regrade or reseed the area in question as specified above and as directed by the Engineer.

Final cleanup will not constitute a separate pay item.

10.0 PAVEMENT AND OTHER STRUCTURE REPLACEMENT

The Contractor shall replace all pavement cut or disturbed, with pavement similar in all respects to existing pavement in accordance with the Standard Details and at those locations approved by the Engineer. Every effort shall be made to avoid cutting the pavement. In restoring pavement, new pavement is required, except that granite paving blocks, sound brick or sound asphalt paving blocks may be reused. No permanent paving shall be placed within thirty (30) days after the backfilling has been completed. All concrete and asphalt paving materials shall be in conformance with the Miscellaneous Details shown in the plans. The pipeline trench through all paved areas (parking lots, driveways, roads, etc.) shall be fully backfilled with crushed stone.

10.1 CLASSIFICATIONS OF PAYMENTS

A. Concrete Pavement Replacement - This pavement replacement shall be Portland cement concrete construction in accordance with the requirements shown in the Standard Details. It shall include all pavement replacement on concrete surfaced roads, concrete driveways, concrete sidewalks and concrete parking areas, both public and private.

B. Heavy-Duty Bituminous Pavement Replacement - This type of asphalt pavement replacement shall be bituminous concrete surface over concrete base in accordance with the details. This type of pavement replacement shall be used on all heavily trafficked roads having an existing pavement greater than 2", whether public or private, or in other locations as directed by the Engineer.

C. Light-Duty Bituminous Pavement Replacement - This type of pavement replacement shall be bituminous concrete constructed in accordance with the details. This item shall include all light-duty bituminous concrete roadways, bituminous driveways and bituminous parking lots, both public and private.

D. Crushed Stone Surface Replacement - This type of surface replacement shall include all graveled roadways, driveways, parking areas, or other gravel surfaced areas, both private and public. This type of surfacing may also be required as a base course for other pavement replacement.

10.2 MATERIALS

The crushed stone backfill as noted on the drawings shall be dense graded aggregate per Kentucky Department of Highways Specifications or as noted on the Drawings. The Contractor shall continuously be responsible for the

maintenance of the aggregate and the surface of the trenches until the pavement replacement is completed.

Portland cement concrete for pavement replacement shall contain a minimum of 6 sacks of cement per cubic yard, the maximum free water content shall be 6 gallons per sack of cement, the slump shall be between 2 and 4 inches, and the concrete shall have minimum 28-day compression strength of at least 3,500 PSI. Cement, aggregate and water shall be described in these specifications for Class "A" concrete. A set of cylinders shall be made and tested for each 25 cubic yards of concrete placed, or fraction thereof, to supply representative sampling and testing of the concrete, upon the direction of the Engineer. The Contractor shall produce a broomed, or burlaped uniformly smooth and nonskid surface, consistent with the existing pavement.

Bituminous materials and mixes shall be consistent with the recommended practice of the asphalt institute and it shall conform to the requirements of the Kentucky Department of Highways for prime coat and Class 1 bituminous concrete. The bituminous concrete shall consist of a binder or base course and a surface course.

10.3 INSTALLATION OF PAVEMENT REPLACEMENT

The Contractor shall cut back the surfacing adjacent to the trench for 12 inches on both sides of the trench and shall cut down the dense graded aggregate he has placed to a depth required for either type of pavement replacement. The resulting surface shall be rolled to yield a smooth, dense surface and a uniform depth.

The concrete shall be placed in accordance with standard practice, with the welded wire mesh if required in proper position and thoroughly vibrated into place. The Contractor shall produce a surface consistent with the existing pavement. The Contractor shall apply a liquid curing component, sprayed on the surface of the concrete, and shall provide adequate protection to the pavement until it has set.

For bituminous concrete, the Contractor shall clean and broom the prepared surface, then apply the prime coat at the rate of 0.20 to 0.25 gallons per square yard, with a pressure distributor or approved pressure spray method. When the prime coat has become tacky but not dry and hard, the bituminous binder course, or base course, whichever applies, shall be placed and compacted. The Contractor shall then apply the surface course. It is recommended, but not required, that the base course remain in place for approximately one week before placing the surface course. The finished course shall be compacted and the completed surface shall match the grades and slopes of the adjacent existing surfacing and be free of offsets, depressions, raised places and all other irregular surfaces.

10.4 SEASONAL AND WEATHER LIMITATIONS FOR PAVEMENT REPLACEMENT

In the event the progress and scheduling of the work is such that the bituminous pavement replacement would occur in the winter months, during adverse cold weather and/or during such times the asphalt plants are not in operation, then the final pavement replacement shall be postponed until favorable weather occurs in the spring and the asphalt plants resume normal operations. No bituminous concrete shall be laid when the temperature is below 40°F except by written permission of the Engineer.

Concrete pavement shall not be placed when the temperature is such that the pavement placed will freeze before it has had adequate time to set and shall be placed in conformance with the temperature conditions approved by the Engineer.

The Contractor shall be responsible for replacement of pavement which he has placed which has been damaged by cold weather or freezing without additional compensation.

In the meantime, the Contractor will be required to maintain the temporary surfacing until the permanent pavement is placed. Such labor, materials and equipment as is required for temporary maintenance of the streets, roadways and driveways shall be provided at the Contractor's expense and is not a pay item. The Contractor will be required to use a cold mix asphaltic concrete as a temporary surface for trenches under heavy traffic use.

10.5 GUARANTEE

The one year guarantee as specified in the contract documents is also applicable to trench settlement and pavement replacement.

11.0 SIDEWALK AND DRIVEWAY REPLACEMENT

Sidewalks and driveways will be replaced if damaged by the Contractor in any way. Payment will be made for those pavements necessarily damaged by the line installation in accordance with the Standard Details. No pavements are to be replaced over a backfilled trench for at least 30 days after filling. Pavements damaged otherwise are to be replaced immediately at the Contractor's expense.

Materials and dimensions are to be at least equal to existing pavement and are to conform to the Standard Details.

12.0 PAYMENT FOR WATER

All water used from the Utility shall be metered with meters supplied by the Contractor. The Contractor shall pay for such water monthly at the rates

published by the water utility. Unmetered water lost through water line breakage shall also be paid at the rates published by the water utility. The quantity lost shall be computed on the basis of a discharge velocity of 7 feet/second, the diameter of the line, and the estimate duration of free uncontrolled discharge.

13.0 FINAL CLEAN-UP

The Contractor shall provide effective cleanup of the work as it progresses. Procrastination of cleanup will not be tolerated. At the time of final inspection, no trenches shall show any undue evidence of the previous construction. All areas shall be left free of ruts due to construction equipment and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded up and shall be completely restored, and all yards and fields shall be reseeded so land may be cultivated, mowed, etc. Straw and fertilizer shall accompany the seeding. If necessary to hasten proper restoration of terraces, principally along ditch lines, the Contractor shall sod such areas at the Engineer's direction. For all line segments, final cleanup shall be performed within 30 days from day of installation.

14.0 PROTECTION OF ADJACENT LANDSCAPE

Reasonable care shall be taken during construction of the water 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 to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

In the course of construction, the Contractor may deflect horizontal alignment of the water line to avoid trees and to keep from damaging their roots. The Contractor shall be fully responsible for settling all claims by private property owners concerning damage to trees and shrubs.

15.0 PAYMENT

Casing pipe will be paid according to the unit bid price for boring or open cutting, as appropriate. The price shall include, as necessary, the cost of the casing pipe, the cost of boring or cutting, and the cost of special requirements for the road or railroad crossing. Carrier pipe will be paid according to Section 15100.

The unit price bid per linear foot for free boring, as measured from edge of pavement to edge of pavement, regardless of size of bore, shall constitute full compensation for the work specified.

Payment for special creek crossings will be at the unit price bid per linear foot for that item and shall include encasement pipe, crushed stone, concrete, solid rock

excavation and all other work necessary for a satisfactory installation. The carrier pipe installed in the casing shall be paid separately under the unit price bid for pipe installed.

Payment for Bypass Test Meter or Leak Detection Test Meter shall include a meter setting (5/8'' x 3/4'') and taps on both sides of a gate valve. The gate valve, sized for the line, is a separate pay item, covered in Section 15101.

Additional costs for normal earth creek crossings shall be included in the unit price bid for pipe installation and no special payment will be made for these crossings.

Payment for asphalt and concrete pavement replacement will not be based on the quantities purchased by the Contractor. Payment for surfacing will be paid on the basis of linear feet installed in accordance with the Standard Drawings with a maximum width of pipe diameter plus twenty-four inches (24"). Crushed stone sub-grade under paving shall be included in paving price and not paid for separately. Any additional cost estimated by the Contractor must be included in the cost of pipe in place.

Sidewalk /driveway crossings when included as a bid item shall include the extra cost of free-boring or the removal and disposal of existing pavement and replacement with new construction. Payment for pavement replacement will be on the basis of linear feet installed. Width for payment for a standard trench crossing is shown in the Standard Details. When sidewalk/driveway crossings or replacement are not included as a bid item, their costs shall be considered subsidiary to the bid for pipe installation.

Where required by the Special Provisions or the Bid Proposal, the cost of pavement replacement, boring, crossings of all types and other incidental construction shall be included in the unit price bid for pipe line installation and shall comprise total compensation for all such work.

All clean-up associated with installing water lines is incidental to the cost of installing the water lines. There is no separate pay item for clean-up.

END OF SECTION

SECTION 15103

PRESSURE TESTING AND STERILIZATION

1.0 TESTING

After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure test of at least 1.5 times the working pressure at the point of testing, but in no case less than that required by other Sections herein. In addition, a leakage test shall be conducted concurrently with the pressure test.

1.1 PRESSURE TEST

A. Test pressure shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section.
2. Not exceed pipe or thrust restraint design pressures at the lowest point along the test section.
3. Be of at least six (6) hour duration unless otherwise stipulated by Owner.
4. Not vary by more than plus or minus 5 psi.
5. Not exceed twice the rated pressure of the valves or hydrants when the pressure of the test section includes closed gate valves or hydrants.
6. Not exceed the rated pressure of resilient seat butterfly valves when used.

B. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and 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.

C. 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 Engineer.

D. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe,

fittings, valves, hydrants or other appurtenances that are discovered during or following the pressure test shall be repaired or replaced with sound equipment and materials, and the test shall be repeated until all test results are satisfactory in the opinion of the Engineer.

1.2 LEAKAGE TESTING

A. 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 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

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

L = ND(P exp 1/2)/133,200

in which L is the allowable leakage, in gallons per hour; N is the length of pipeline tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

1. Allowable leakage at various pressures is shown in Table K-1.
2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed.
3. When hydrants are in the test section, the test shall be made through the open isolation valve and against the closed hydrant valve.

C. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified in Section 1.03.B the Contractor shall, at his own expense, locate and repair the defective material until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage.

Table K-1
Allowable Leakage Per 1,000 Ft. Of Pipeline (GPH)

Avg. Test Pressure (psi)	Nominal Pipe Diameter (Inches)								
	2	3	4	6	8	10	12	14	16
450	0.32	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55
400	0.30	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40
350	0.28	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25
300	0.26	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08
275	0.25	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99
250	0.24	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90
225	0.23	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80
200	0.21	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70
175	0.20	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59
150	0.19	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47
125	0.17	0.25	0.34	0.50	0.67	0.84	0.01	1.18	1.34
100	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20

Avg. Test Pressure (psi)	Nominal Pipe Diameter (Inches)							
	18	20	24	30	36	42	48	54
450	2.87	3.18	3.82	4.78	5.73	6.69	7.65	8.60
400	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225	2.03	2.35	2.70	3.38	4.05	4.73	5.41	6.03
200	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

2.0 STERILIZATION

2.1 GENERAL

It is the intent of this Section to present essential procedures for disinfecting new and repaired water mains. This Section is patterned after AWWA C651. The basic procedure comprises:

A. Preventing contaminating materials from entering the water mains during construction or repair and removing by flushing materials that may have entered the water main.

B. Disinfecting any residual contamination that may remain.

C. Determining the bacteriologic quality by laboratory test after disinfection.

2.2 PREVENTIVE MEASURES DURING CONSTRUCTION

A. Precautions shall be taken to protect pipe interiors, fittings, and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipe laying is not in progress, for example at the close of the day's Work, all openings in the pipe line shall be closed by water tight plugs. Joints of all pipe in the trench shall be completed before Work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

   If dirt that, in the opinion of the Engineer, will not be removed by the flushing operation (Section 2.3) enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a five (5%) percent hypochlorite disinfecting solution.

B. Packing Materials and Joints—No contaminated material or any material capable of supporting prolific growth of micro-organisms shall be used for sealing joints. Packing material shall be handled in such a manner as to avoid contamination. Where applicable, packing materials must conform to AWWA standards. Packing material for cast iron pipe must conform to AWWA C600. Yarning or packing material shall consist of molded or tubular rubber rings, rope of asbestos or treated paper. Materials such as jute or hemp shall not be used. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. It shall be delivered to the job in enclosed containers and shall be kept clean.

2.3 PRELIMINARY FLUSHING

The main shall be flushed prior to disinfection unless disinfected by the method in Section 2.04.B.1. It is recommended that the flushing velocity be not less than 2.5 ft/sec. The rate of flow required to produce this velocity in various diameters is shown in Table K-2. No site for flushing should be chosen unless it has been determined that drainage is adequate at the site.

Table K-2
Required Openings To Flush Pipelines
(40-PSI Residual Pressure)

Pipe Size (in.)	Flow Required to Produce 2.5 fps Velocity (gpm)	Orifice Size (in.)	Hydrants Required	
			Number of Hydrants	Nozzle Size (in.)
4	100	15/16	1	2 1/2
6	220	1 3/8	1	2 1/2
8	390	1 7/8	1	2 1/2
10	610	2 5/16	1	2 1/2
12	880	2 13/16	1	2 1/2
14	1,200	3 1/4	2	2 1/2
16	1,565	3 5/8	2	2 1/2
18	1,980	4 3/16	2	2 1/2

2.4 FORM OF CHLORINE FOR DISINFECTION

The most common forms of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmospheric pressure), calcium hypochlorite granules, and sodium hypochlorite solutions.

A. Liquid Chlorine

1. *Use*: Liquid chlorine shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical, and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine-gas directly from the supply cylinder is unsafe and shall not be permitted.

   NOTE: The preferred equipment consists of a solution fed chlorinator in combination with a booster pump for injecting the chlorine-gas water mixture into the main to be disinfected. Direct

feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

B. Hypochlorites

1. *Calcium Hypochlorite*: Calcium hypochlorite contains seventy (70%) percent available chlorine by weight. It is either granular or tabular in form. The tablets, 6-8 to the ounce, are designed to dissolve slowly in water. Calcium hypochlorite is packaged in containers of various types and sizes ranging from small plastic bottles to one hundred (100) pound drums.

   A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

2. Sodium Hypochlorite: Sodium hypochlorite is supplied in strengths from five and one-quarter (5.25%) to sixteen (16%) percent available chlorine. It is packaged in liquid form in glass, rubber, or plastic containers ranging in size from one (1) quart bottles to five (5) gallon carboys. It may also be purchased in bulk for delivery by tank truck.

   The chlorine-water solution is prepared by adding hypochlorite to water. Product deterioration must be reckoned with in computing the quantity of sodium hypochlorite required for the desired concentration.

3. *Application*: The hypochlorite solutions shall be applied to the water main with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump, for example, a hydraulic test pump. Feed lines shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypochlorite solution is applied to the main.

2.5 METHODS OF CHLORINE APPLICATION

A Continuous Feed Method: This method is suitable for general application.

1. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipe line. The water shall receive a dose of

chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/L available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods and AWWA M12—Simplified Procedures for Water Examination.

NOTE: In the absence of a meter, the rate may be determined either by placing a pitot gauge at the discharge or by measuring the time to fill a container of known volume.

Table K-3 gives the amount of chlorine residual required for each one hundred (100) feet of pipe of various diameters. Solutions of one (1%) percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately one pound (1 lb.) of calcium hypochlorite in eight and five tenths (8.5) gallons of water.

Table K-3
Chlorine Required To Produce 50 mg/L Concentration
In 100 Ft. Of Pipe (By Diameter)

Pipe Size (in.)	100 Percent Chlorine (lb)	1 Percent Chlorine Solutions (gal)
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

2. During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least twenty-four (24) hours during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this twenty-four (24) hour period, the treated water shall contain no less than 25 mg/L chlorine throughout the length of the main.

B. Slug Method: This method is suitable for use with mains of large diameter for which, because of the volumes of water involved, the continuous feed method is not practical.

1. Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate (see section 2.5.1.1) into the newly laid pipe line. The water shall receive a dose of chlorine also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipe line is maintained at no less than 300 mg/L. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/L for at least three (3) hours. The application shall be checked at a tap near the upstream end of the line by chlorine residual measurements.

2. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated as to disinfect appurtenances.

2.6 FINAL FLUSHING

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/L. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipe line.

2.7 BACTERIOLOGIC TESTS

1. After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one (1) sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main. From unchlorinated supplies at least two (2) samples shall be collected at least twenty-four (24) hours apart.

2. Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been

collected, the gooseneck assembly may be removed, and retained for future use.

2.8 REPETITION OF PROCEDURE

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the sample tests indicate that disinfection has been effective, the main may be placed in service.

2.9 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

The procedures outlined in this Section apply primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

A. Trench "Treatment": When an old line is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

B. Main Disinfection: The following procedure is considered as a minimum that may be used.

1. *Swabbing With Hypochlorite Solution*: The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a five (5%) percent hypochlorite solution before they are installed.

2. *Flushing*: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.

3. *Slug Method*: Where practicable, in addition to the procedures of section 2.9.2.1, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in section 2.5.2, except that the dose may be increased to as much as 500 mg/L, and the contact time reduced to as little as one-half (1/2) hour. After

chlorination, flushing shall be resumed and continued until discolored water is eliminated.

C. Sampling: Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

3.0 PAYMENT

No separate payment shall be made for testing and sterilization of water lines. Items described in this Section shall be incidental to the cost of installing the water line.

END OF SECTION

SECTION 16020

PUMPING STATION ELECTRICAL

1.0 GENERAL

1.1 SCOPE OF WORK

A. Provide all labor, material, tools, approvals, utility connection fees, excavation, backfill, and other services and equipment necessary to install the electrical system as shown on the Contract Drawings and as specified herein.

B. Each Contractor bidding on the work included in these Specifications shall view the building site and carefully examine the contract Drawings and Specifications, so that he/she may fully understand what is to be done, and to document existing conditions.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contractors bidding work under this Contract shall read and understand Division Zero and Division 1 - General Requirements. If any discrepancies are discovered between this Division and the General Requirements, the above mentioned documents shall overrule this section.

B. Section 16900 – Control Panel

1.3 SUBMITTALS

A. Provide shop drawings including descriptive literature and/or installation, operation and maintenance instructions. Shop drawings shall be submitted for all equipment proposed to be furnished under this Division.

B. Electrical submittals shall be submitted after the pumping/process equipment has been approved. Otherwise the Contractor is responsible for any changes and costs incurred as a result of changes necessary to the electrical equipment.

C. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted.

D. Where wiring diagrams are not shown on the Contract Drawings, they are to be provided by the supplier of the equipment served.

1.4 SYMBOLS AND ABBREVIATIONS

A. The symbols and abbreviations generally follow standard electrical practice, however, exceptions to this shall be as shown on the Contract Drawings.

1.5 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate the electrical work with that of other trades to ensure proper final location of all electrical equipment and/or connections.

1.6 CODES

A. Comply with the latest revision of the following codes:

1.	Kentucky Building Code	KBC
2.	National Electrical Code	NEC
3.	National Electrical Safety Code	NESC
4.	Underwriters Laboratories, Inc.	UL
5.	National Fire Protection Association	NFPA
6.	National Electrical Manufacturers Association	NEMA
7.	Occupational Safety and Health Administration	OSHA
8.	Insulated Cable Engineers Association	ICEA
9.	Instrument Society of America	ISA
10.	American National Standards Institute, Inc.	ANSI
11.	Anti-Friction Bearing Manufacturers Association, Inc.	AFBMA
12.	Federal Communications Commission	FCC

C. Comply with any other applicable federal, state, or local laws and ordinances.

D. Where the Engineer’s design requires a higher standard than the applicable code, the Engineer’s design shall be followed.

1.7 INSPECTIONS AND PERMITS

A. Inspection of the electrical system on all construction projects is required. If the local government has appointed a state licensed inspector, the Contractor shall be required to use that person to perform the inspections. If a locally mandated inspector does not exist, the Contractor shall select and hire a state licensed inspector, who has jurisdiction before any work is concealed.

B. At the time of completion of the project, there shall be furnished to the Owner and Engineer a certificate of compliance, from the agency having jurisdiction pursuant to all electrical work performed.

C. All permits necessary for the complete electrical system shall be obtained by the Contractor from the authorities governing such work.

1.8 STORAGE

A. All work, equipment, and materials shall be protected against dirt, water, or other injury during the period of construction. Complete replacement with new equipment is required for any damaged materials.

B. Sensitive electrical equipment such as motor starters, controls, transmitters, etc., delivered to the jobsite, shall be protected against injury or corrosion due to atmospheric conditions or physical damage by other means. Protection is interpreted to mean that equipment shall be stored under roof, in a structure properly heated in cold weather and ventilated in hot weather. Provision shall be made to control the humidity in the storage are at 50 percent relative. The stored equipment shall be inspected periodically, and if it is found that the protection is inadequate, further protective measures shall be employed.

1.9 MATERIALS

A. All materials used shall be new and at least meeting the minimum standards as established by the NEC and/or National Electrical Manufacturers Association. All materials shall be UL listed for the application where a listing exists. All equipment shall meet applicable FCC requirements and restrictions.

B. The material and equipment described herein has been specified according to a particular trade name or make to set quality standards. However, each Contractor has the right to substitute other material and equipment in lieu of that specified, other than those specifically mentioned at matching or for standardization, providing such material and equipment meets all of the requirements of those specified and is accepted, in writing by the Engineer.

C. The reuse of salvaged electrical equipment and/or wiring will not be permitted unless specified herein or indicated on the Contract Drawings.

D. All salvaged or abandoned electrical materials shall become the property of the Contractor and shall be removed from the job site upon completion of the project, unless otherwise noted on the Contract Drawings or specified herein.

1.10 ERRORS, CORRECTIONS, AND/OR OMISSIONS

A. Should a piece of utilization equipment be supplied of a different size or horsepower than shown on the Contract Drawings, the Contractor shall be responsible for installing the proper size wiring, conduit, starters, circuit breakers, etc., for proper operation of that unit and the complete electrical system at no extra cost to the Owner.

B. It is the intent of these Specifications to provide for an electrical system installation complete in every respect, to operate in the manner and under conditions as shown in these Specifications and on the Contract Drawings. The Contractor shall notify the Engineer, in writing, of any omission or error at least 10 days prior to opening of bids. In the event of the Contractors failure to give such notice, he/she may be required to correct work and/or furnish items omitted without additional cost.

C. Necessary changes or revisions in electrical work to meet any code or power company requirement shall be made by the Contractor without additional charge.

1.11 GUARANTEES AND WARRANTIES

A. The Contractor shall guarantee all work including equipment, materials, and workmanship. This guarantee shall be against all defects of any of the above and shall run for a period of 1 year from the date of acceptance of the work, concurrent with the one-year guarantee period designated for the general construction contract under which electrical work is performed.

B. Repair and maintenance for the guarantee period is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine. (That is oiling, greasing, etc.) The Engineer shall be the judge of what shall be considered as routine maintenance.

1.12 TESTING

A. After the wiring system is complete, and at such time as the Engineer may direct, the Contractor shall conduct an operating test

for acceptance. The equipment shall be demonstrated to operate in accordance with the requirements of these Specifications and the Contract Drawings. The test shall be performed in the presence of the Engineer or his authorized representative. The Contractor shall furnish all instruments and personnel required for the tests, as well as the necessary electrical power.

B. Before energizing the system, the Contractor shall check all connections and set all relays and instruments for proper operation. He shall obtain all necessary clearances, approvals, and instructions from the serving utility company prior to placing power on the equipment.

C. Cost of utilities for testing done prior to beneficial occupancy by the Owner shall be borne by the Contractor.

1.13 CLEANUP

A. Cleanup shall be performed as soon as possible after the electrical installation is complete. All control panels, switches, etc., shall be free from tags, stickers, etc. All painted enclosures shall be free from scratches or splattered paint. The interior of all enclosures shall be clean from dust, wire strippings, etc. Surplus material, rubbish, and equipment shall be removed from the jobsite upon completion of the work.

B. During construction, cover all Owner equipment subject to damage.

1.14 EXCAVATION AND BACKFILL

A. Excavation for conduits shall be of sufficient width to allow for proper jointing and alignment of the type conduit used. Conduit shall be bedded on original ground unless indicated otherwise on the Drawings. Where conduit is in solid rock, a 6 inch earth cushion must be provided. Conduit shall be laid in straight lines between pull boxes and/or structures unless otherwise notes on the Contract Drawings. The cost of solid rock excavation shall be included in the lump sum bid.

B. Backfill shall be hand placed, loose granular earth for a height of 6 inches above the top of the largest conduit. This material shall be free of rocks over ½ inches in diameter. Above this, rocks up to 3” diameter may be included but must be mixed with sufficient earth to fill all voids.

1.15 POWER COMPANY COORDINATION

A. The Contractor is responsible for coordinating all activities onsite by the power company.

B. The Contractor is required to meet all requirements and special provisions of the power company. The Contractor shall coordinate with the utility prior to bidding the project. No extras will be allowed for provisions required by the power company.

1.16 TEMPORARY ELECTRICAL POWER

A. The Contractor shall be responsible for providing temporary electrical power as required during the course of construction and shall remove the temporary service equipment when no longer required.

1.17 OVERCURRENT PROTECTION

A. Circuit breakers or fused switches shall be the size and type as written herein and shown on the Contract Drawings. Any additional overcurrent protection required to maintain an equipment listing by an authority having jurisdiction shall be installed by the Contractor at no extra cost to the Owner.

1.18 TRAINING

A. Provide onsite training on major items of equipment. The training shall be conducted by a qualified representative of the manufacturer and shall be sufficient in content and length such that the Owner's personnel are fully qualified to operate, maintain, and troubleshoot the equipment. O&M manuals must be approved before training can commence. Only one training class is required for each item of equipment. Coordinate the time/date with the Owner.

B. An official training report shall be submitted to the Engineer. It shall be signed by Owner's personnel.

1.19 RECORD DRAWINGS

A. The Contractor shall maintain 1 set of the Contract Drawings on the job in good condition for examination at all times. The Contractor's qualified representative shall enter upon these Drawings, from day to day, the actual "as-built" record of construction and/or alteration progress. Entries and notes shall be made in a neat and legible manner and these Drawings delivered to the Engineer after

completion of the construction, for use in preparation of Record Drawings. Underground lines must be dimensioned to permanent structures.

1.20 MAINTAINING CONTINUOUS ELECTRICAL SYSTEM AND SERVICE

A. Existing service continuity shall be maintained at all times. In no way shall be installation and/or alteration of the electrical work interfere with or stop the normal operation of the existing facilities, except where prior arrangements have been made. Provide all equipment necessary (including temporary switchgear, controls, and rental power generation equipment if necessary) to ensure that the existing system remains operational until the new system is fully functional.

1.21 GROUNDING AND BONDING

A. All metallic conduit, cabinets, equipment, and service shall be grounded in accordance with NEC requirements. All supporting framework in contact with electrical conduit, cable, and/or enclosures, shall be properly grounded.

1.22 SERVICE ENTRANCE

A. Conductors and terminations for service entrances shall be furnished and installed by the Contractor. Voltage, phase, and number of wires shall be as shown on the Drawings. Clearances for overhead entrance wires shall be per power company, NEC, and NESC requirements.

1.23 CONTRACTOR LICENSING

A. The Contractor performing the electrical work on this project shall be a licensed electrical contractor in the State of Kentucky.

1.24 ELECTRICAL COMPONENT MOUNTING HEIGHTS

A. Mounting heights shall be as shown on the Contract Drawings. Operators and control devices shall not be mounted higher than 6'6" above finished floor or grade.

1.25 EQUIPMENT IDENTIFICATION

A. All starters, feeder units, disconnects, instruments, etc., shall be marked to indicate the motors, circuit, they control or monitor. Marking is to be done with engraved laminated nameplates.

Nameplates shall be fastened to equipment with stainless steel screws, one each side. In no way shall be installation of the mounting screws void the NEMA enclosure rating of the equipment in which they are installed. If there are more than one number, the equipment shall be number consecutively and labeled as such. Nameplate background color shall be white, with black engraved letters.

B. Disconnect switches, control panels, transfer switches, panelboards etc. shall be labeled with orange OSHA-compliant vinyl self-adhesive signs that list the maximum voltage contained inside the cabinet or panel.

1.26 EQUIPMENT CONFIGURATION/PROGRAMMING

A. Any equipment furnished by the Contractor is required to be configured or programmed by the Contractor or his subcontractor/vendor. Any necessary studies or engineering necessary to configure or program this equipment shall be provided by the Contractor as needed to place the equipment into successful operation. Engineer or Owner will not be responsible for equipment configuration or programming.

B. If a manufacturer or manufacturer's representative is required to startup/commission the equipment in these Specifications, then it is required that the Contractor provide the services of the manufacturer to configure/program the equipment. This includes the provision of any necessary studies or engineering necessary for the configuration/programming.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Rigid Aluminum Conduit - "Allied," "Wheatland," "Indalex," or equal.

2. PVC Conduit – "Allied," "Carlon," "Cantex," or equal.

3. Liquid-tight Flexible Metal Conduit – "Allied," "Anaconda," or equal.

B. Wires and Cables

1. Building Wire (Types THWN and THW) - “Collyer,” “Rome,” “American,” “Carol,” or equal.

2. Instrumentation Cables - “Eaton-Dekoron,” “Manhatton,” “American,” “Belden,” “Okonite,” or equal.

C. Boxes - “Appleton,” “Crouse-Hinds,” “Hoffman,” “Rittal,” or equal.

D. Wire Connections and Connecting Devices

1. Termination and Splice Connectors - “3M Scotchlok,” “Anderson,” “T&B,” “Burndy,” or equal.

2. Connectors, Lugs, etc. - “T&B,” “Anderson,” “Burndy,” or equal.

E. Grounding Equipment - “Cadweld,” “ITT Blackburn,” “Copperweld Bimetallics Group,” “Cathodic Engineering Equipment Co.,” or equal.

F. Motor Control Equipment - “Square D,” “Allen Bradley,” “Eaton Cutler-Hammer,” “G.E.,” or equal.

2.2 MATERIALS

A. Conduit and Fittings

1. Aluminum Conduit

a. Aluminum conduit shall be extruded from alloy 6063 and shall be the rigid type, non-toxic, corrosion resistant, and non-staining. It shall be manufactured per UL standards as well as listed/labeled by same.

b. Fittings, boxes, and accessories used in conjunction with aluminum conduit shall be die cast, copper free type. They shall be resistant to both chemical and galvanic corrosion. All covers shall have neoprene gaskets. Aluminum fittings containing more than 0.4 percent copper are prohibited.

c. Aluminum conduit proposed for concrete slab or underground applications shall be UL listed for the purpose and factory pre-coated. Corrosion-resistant taping is allowed for stub-outs out of the ground.

2. Polyvinychloride (PVC) Conduit - PVC conduit and fittings shall be Schedule 80 heavy wall and UL listed. Expansion joints shall be used as recommended by the manufacturer in published literature. PVC systems shall be 90 degrees Celsius minimum UL rated, have a tensile strength of 7,000 psi @ 73.4 degrees Fahrenheit, flexural strength of 11,000 psi and compressive strength of 8,000 psi.

3. Liquid-tight Flexible Conduit - Flexible conduit shall be the metallic liquid-tight type UA constructed from flexibly or spirally wound electro-galvanized steel with light gray PVC coating. Connections shall be by means of copper-free aluminum fittings.

4. Locknuts shall be bonding type with sharp edges for digging into the metal wall of an enclosure. Myer-style aluminum hubs shall be used rather than locknuts for all NEMA 4X and exterior penetrations.

5. Bushings shall be metallic insulating type, consisting of an insulating insert molded of locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.

6. Corrosion-Protection Tape: The corrosion protection tape shall be Scotchrap 51 or equal with 20mil thickness PVC tape and high-tack adhesive. Degreasing and priming of the conduit is required prior to applying the corrosion-protection tape.

B. Conductors (600 Volts and Below)

1. All conductors shall be insulated so that they are rated at 600 volts.

2. Insulated conductors shall be minimum #12 AWG for power or #14 AWG for control and shall be stranded.

3. All conductors brought to the job site shall be new and unused and where no special factory cut lengths are involved, shall be delivered to the job site in standard coils. Contractor shall provide verification to the Engineer of wire condition before wire is installed.

4. All conductors shall be soft drawn, 98% conductivity copper

conforming to the latest ASTM Specifications and the requirements of the National Electrical Code.

5. Conductors shall be insulated with type THWN insulation and all conduits shown on the Drawings are sized accordingly.

C. Instrumentation Cable - Instrumentation cable shall have individually shielded and twisted pairs or triads. Conductors shall be tinned copper, and the cable shall include a separate drain conductor. Voltage rating shall be 600 Volt. Conductor colors shall be black and white. Shielding shall be a combination braid/foil with 100% coverage. Insulation shall be PVC or XLPE. Conductors shall be #18AWG minimum, but no smaller than the size indicated on the Drawings. Insulation shall be polyethylene, rated for underground wet location use, and resistance at 68 degrees Fahrenheit between conductors and between conductors and ground should be at least 500 megaohms per 1,000 feet.

D. Boxes and Enclosures

1. Junction boxes for outdoors surface mounting shall be stainless NEMA 4 or 3R, with at least 5 ½ full threads for each conduit opening, and shall be suitable for surface mounting as required with drilled external, cast mounting extensions. Box covers shall be hinged or cap screw retained as required, of the same material as the box and provided with stainless steel hardware.

E. Wire Connections and Connecting Devices

1. Terminals and spice connectors from #22 to #4 AWG shall be compression type with barrels to provide maximum conductor contact and tensile strength. Performance, construction, and materials shall be in conformance with UL standards for wire connectors and rated for 600 Volts and 105 degrees Celsius.

2. Lugs and splice connectors from #6 AWG to 1000 kcmil shall be compression types with barrels to provide maximum conductor contact and tensile strength. They shall be manufactured from high conductivity copper and entirely tin plated. They shall be crimped with standard industry tooling. The lugs and connectors must have a current carrying capacity equal to the conductors for which they are rated and must also meet all UL requirements. All lugs above #4/0

shall be 2 hole lugs with NEMA spacing. The lugs shall be rated for operation through 35 KV. The lugs shall be of closed end construction to exclude moisture migration into the cable conductor.

F. Wiring Devices

1. General – All receptacles shall be heavy duty specification grade duplex receptacle, Nema 5-20R, 20A, 125V, 3-wire. Provide weatherproof cover where indicated on the Drawings.

2. Duplex outlet (interior) - “Hubbell” catalog series 5362, or equal.

3. Ground fault interrupting receptacles shall be required where shown on the Contract Drawings, and shall be indicated by the abbreviation “GFI” beside the circuit symbol on the Contract Drawings. They shall be rated 20 amps (125 volts) and shall be of the duplex, feed through type, capable of protecting all downstream receptacles on the same circuit. They shall be UL listed and shall comply with UL 943 and interrupt the current between 4-6 milliamps of ground fault leakage. Appropriate plates shall be furnished and installed. The 20 ampere rating shall apply not only to device internals but to the faceplate as well. Receptacle shall be Hubbell GFI 5352, or equal.

4. Weatherproof covers shall be Hubbell WP series, Thomas and Betts 2CKG, or equal. They shall be weatherproof-in-use with cast aluminum construction. Mounting screws shall be stainless. Protection shall be Nema 3R.

5. General – Switches shall be industrial grades, 120/227VAC, 20A

   a. Single pole (exterior) - “Hubbell” cat. no. 1222-gray, or equal.

G. Panelboards

1. Shall be UL listed with copper bussing.

2. Enclosure shall be NEMA 1.

3. Circuit breakers shall be bolt-in.

4. Panelboards rated for 120/208V service shall have an interrupting capacity of not less than 10,000A, RMS symmetrical.

5. Panelboards rated for 480V service shall have an interrupting capacity of not less than 14,000A, RMS symmetrical.

6. Panelboards shall have an integral TVSS surge suppressor. See requirements below.

H. Motors

1. Ratings and Electrical Characteristics:

a. Time: All motors shall be rated for continuous duty.
b. Temperature: Maximum ambient temperature of 40 degrees C. and an altitude of 3,300 feet or less, according to service factor and insulation class employed.

c. Voltage: All single phase motors shall be rated 115/208/230 volts and all polyphase motor 230/460 volts. All motors shall be capable of normal operation at balanced voltages in the range of + 10 percent from rated winding voltage.

d. Frequency: All AC motors shall be rated for 60 Hz. operation. All motors shall be capable of normal operation at frequencies 5 percent above or below the normal rating of 60 Hz.

e. Locked Rotor Current: Locked rotor current shall be in accordance with NEMA standards.

f. Efficiency: NEMA premium efficiency is required.

g. Speed: Slip shall not exceed 4 percent at full load.

h. Service Factor: The service factor shall be 1.15 unless requirements of the driven load necessitate a higher service factor.

i. Insulation Class: Insulation shall be NEMA Class F or Class H. All motors shall be inverter-duty and suitable

for operation on variable frequency drives.

j. Design Level: Motors shall be NEMA design B, except as otherwise noted.

k. Enclosure: Motors for process equipment 2 HP and smaller shall be totally enclosed. All motors for process equipment larger than 2 HP shall be TEFC (totally enclosed fan cooled), suitable for use indoors or outdoors, except as otherwise noted.

l. Winding Overtemperature Sensors: These are required to be provided on the pump motors.

m. All submersible motors shall be equipped to detect seal failure.

2. Tests, Nameplates and Shop Drawings:

a. Test: Tests shall be required on integral horsepower motors only. A factory certified test report of "electrically duplicate motors previously tested" shall be supplied on all motors under 200 horsepower. The test shall be certified by the factory and shall contain a statement to the effect that complete tests affirm the guaranteed characteristics published in the manufacturer's catalogs or descriptive literature. Tests shall be in accordance with IEEE test procedures.

b. Nameplates: Each motor shall have a permanently affixed nameplate of brass, stainless steel, or other metal of durability and corrosion resistance. The data contained on the nameplate shall be in accordance with NEMA standards. Provide a spare nameplate with each motor and mount the nameplate in the starter cabinet. A Brady label with equivalent nameplate information will be accepted in lieu of an actual spare nameplate.

3. Efficiency Requirements

a. The following motor full load efficiency requirements shall be met as a minimum for totally enclosed 3 phase integral horsepower motors (per NEMA test Methods):

Horsepower	Nominal 3600 RPM (Minimum %)	Nominal 1800 RPM (Minimum %)	Nominal 1200 RPM (Minimum %)
1	75.5	82.5	80.0
1.5	82.5	84.0	85.5
2	84	84.0	86.5
3	85.5	87.5	87.5
5	87.5	87.5	87.5
7.5	88.5	89.5	89.5
10	89.5	89.5	89.5
15	90.2	91.0	90.2
20	90.2	91.0	90.2
25	91.0	92.4	91.7
30	91.0	92.4	91.7
40	91.7	93.0	93.0
50	92.4	93.0	93.0
60	93.0	93.6	93.6
75	93.0	94.1	93.6
100	93.6	94.5	94.1
125	94.5	94.5	94.1
150	94.5	95.0	95.0
200	95.0	95.0	95.0

b. Motors shall be energy efficient and shall be documented in the shop drawings submittal in sufficient detail to allow the Engineer complete review of what is offered. Motors shall meet NEMA premium efficiency standards.

I. Surge Protection Devices

1. Distribution Equipment TVSS:

a. The TVSS shall be suitable for application in category C3 environments as described in ANSI/IEEE C62.41. The TVSS shall be of parallel design and provide protection, line to ground, neutral to ground, and line to neutral for wye or delta distribution systems. The

TVSS shall be compatible with the indicated electrical system, voltage, current and distribution configuration.

b. TVSS shall comply with ANSI/IEEE C62.1, C62.41, and C62.45. The TVSS shall be capable of surviving 1,000 sequential category C3 surges without failure following IEEE test procedures established in C62.45.

c. The TVSS shall have LED indicators that provide indication of suppression failure. It shall also have a surge counter. It shall also have a relay contact that provides remote indication of surge protection failure.

d. The TVSS maximum continuous operating voltage (MCOV) shall be capable of sustaining 110 percent of the nominal RMS voltage continuously without degradation.

e. TVSS shall have surge current capacity of 100kA minimum per mode (480V unit) or 50kA (120/240V unit) with a response time no greater than 5 nanoseconds, for any of the individual protection modes, under laboratory conditions with optimum lead lengths.

f. The TVSS UL 1449 surge suppression rating for any suppression mode shall not exceed:

Electrical System Voltage	Phases	UL 1449 Surge Suppression Ratings
120/240	1	330V
120/240	3	330V
120/208	3	330V
208	3	700V
277/480	3	700V
480	3	1500V

J. Safety Switches

1. All safety switches shall be heavy-duty load break type with a quick-make, quick-break, switch mechanism. The switches shall be fused or unfused as indicated on the Drawings. The handle position shall give visual indication of open and closed switch position. Padlocking capability shall be provided for locking the switch in the "OFF" (open)

position. Switches are required to be UL98 listed and shall comply with NEMA KS-1 latest version.

2. The switch jaws shall be multi-spring type for positive grip of the switch blades and shall be provided with arc suppressors. The fuse clips shall be spring reinforced, positive pressure type of electrolytic copper. Fuse clips shall be rejection type.

3. The switch shall be provided with cover-blade interlock so that the cover cannot be opened when the switch blades are closed, nor can the switch blades be closed with the cover open. Interlock bypassing devices shall be included for use by authorized personnel. Note: where indicated, safety switches shall have integral electrical interlocks. Contacts shall be open when the switch is in the off position.

4. Enclosures shall be NEMA 1 where used inside the building and NEMA where used outside unless otherwise shown on the Drawings.

5. Each safety switch shall be provided with ground lugs as required to accept grounding conductors as shown on the Drawings. The grounding lugs shall be factory installed and shall have direct metal-to-metal contact with the switch enclosure.

6. Double throw fused safety switches shall be furnished where indicated. They shall be lockable in any position and shall be service-entrance rated.

K. Portable Generator Receptacle

1. Generator receptacle shall be Crouse-Hinds Arktite and shall match Owner's existing receptacle at Sandgap pump station. It shall be rated 200A to match the existing receptacle. Shall be UL1682 and 514 compliant.

2. Provide a heavy-duty, surface mounted generator receptacle with back box and all accessories.

3. The generator receptacle shall be the "Style 2" metallic type with factory installed jumper to bond the metallic housing to the grounded conductor.

4. The generator receptacle shall have reversed contacts such

that personnel will not be exposed to live voltage even if the generator is running.

5. The receptacle shall be a 4-wire, 4-pole model.

7. The receptacle shall be NEMA 4 weatherproof with a cap for protection while not in use.

L. Generator Lug Cabinet – Shall be NEMA 3R, 100A, 480V, 3 phase, 3 wire plus ground, UL1773 listed.

M. Motor Control – See Section 16900 for requirements.

N. Overcurrent Protection

1. Main 3-Phase Breakers – Shall be thermal-magnetic, molded-case, Type FA or KA as needed, Square D or equal. Provide service-entrance rated where indicated on the Drawings as being used in a service entrance application.

2. Power Fuses – Fuse blocks must have protective cover. Fuses may only be used where indicated on the Drawings. Otherwise, use circuit breakers.

O. Lighting

1. All fixtures shall be delivered complete with suspension and mounting accessories, ballasts, diffusers, reflectors, etc., all wired and assembled. All accessory wiring shall be furnished and installed as shown on the Contract Drawings.

2. All supports required for luminaires shall be furnished and installed by the Contractor.

P. Supporting Devices – All strut, channel, conduit clamps/straps, and other supporting devices shall be either stainless steel or aluminum. All hardware such as nuts, bolts, anchors, washers, etc. shall be stainless steel.

Q. General Purpose Dry-Type Transformers

1. Transformers 25 KVA and larger shall have a minimum of 4 (2 above, 2 below) 2 ½ percent full capacity primary taps.

2. Transformers shall be 150 degrees Celsius temperature rise above a 40 degrees Celsius ambient. All insulating

materials are to be in accordance with the latest NEMA Standards for a 220 degrees Celsius UL recognized insulation system.

3. Transformer coils shall be of the continuous wire wound construction and shall be impregnated with non-hygroscopic, thermo-setting varnish. The coils shall also have a final wrap of electrical insulating material to prevent mechanical injury to the wire as well as increasing the electrical breakdown strength.

4. All cores shall be constructed of high grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. The core laminations shall be clamped together with steel angles. The completed core and coil shall then be bolted to the base of the enclosure but isolated from the base by means of rubber, vibration absorbing mounts. There shall be no metal-to-metal contact between the core and coil to the enclosure. The vibration isolation system shall be designed to provide a permanent fastening of the core and coil to the enclosure. To further facilitate vibration and noise isolation, the final section of conduit to the transformer shall be flexible.

5. Transformers shall be in heavy gauge, sheet steel, ventilated enclosures. The ventilating openings shall be designed to prevent accidental access to live parts in accordance with UL, NEMA, and National Electrical Code Standards for ventilated enclosures. Transformers shall be designed so they can either be floor or wall mounted.

6. The entire transformer enclosure shall be degreased, cleaned, phosphatized, primed, and finished in the same color as the motor control equipment.

7. The maximum temperature of the top of the enclosure shall not exceed 50 degrees Celsius rise above a 40 degrees Celsius ambient.

8. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with NEMA and NEC Standards.

9. The transformer shall be marked “DANGER HIGH

VOLTAGE" with labels specified in the section on marking, this Division.

10. The transformers shall be manufactured to requirements of applicable standards, especially as they apply to noise level, surface temperatures, and Energy code requirements.

R. Pressure Switches

1. Pressure switches shall be industrial type NEMA 4X epoxy-coated aluminum body with UL listing.

2. The pressure switch shall have a single pole double throw relay output. The setpoint shall have an adjustable range suitable for operation in the conditions shown on the Drawings and in the equipment specifications.

3. The switch shall be rated for operation in –25°F to 130°F ambient. Setpoint shall drift no more than 1.5% for a 50°F ambient temperature change.

4. Setpoint repeatability shall be within 1.5% of adjustable range, maximum.

5. Electrical connection shall be either a ½" or ¾" threaded connection.

6. Pressure connection shall be NPT.

7. The pressure switch shall be Omega, or equal.

S. Electromagnetic Flowmeter and Transmitter

1. The electromagnetic flow meter shall consist of a flow sensor based on Faraday's Law of Electromagnetic Induction and microprocessor-based signal converter & transmitter.
2. The sensor flow tube liner material shall be EPDM rubber. Measurement and grounding electrodes shall be 316 stainless steel. Flow tube shall have corrosion resistant epoxy coating. Flow meter shall be approved by NSF for drinking water.
3. Operating temp: Operating Temp: -5 to +120° F minimum acceptable band
4. Display: Background illumination with alphanumeric 3-line, 20-character display to indicate flow rate, totalized values, settings, and faults

5. Power supply: 115/230 VAC as indicated on Contract Drawings.
6. Outputs: 4-20 mA into 800 ohms max. One relay rated at 42 VAC/2 A, 24 DC/1A. Provide Digital pulse for external display of flow rate or totalizer.
7. Flow Range: 1.5 fps to 33 fps for accuracies stated below.
8. Accuracy: 0.5% of actual flow.
9. Separation: Allowable distance of 900 feet between signal converter and sensor without the use of any additional equipment
10. Provide Bi-directional flow capabilities
11. Totalizer: Two eight-digit counters for forward, net, or reverse flow.
12. The transmitter shall be mounted integrally as indicated on the Drawings.
13. Insertion type or doppler type flow meters will not be accepted.

T. Door Contact Switches

1. The contact shall be a hermetically sealed reed switch nominally 3" L x 1" H x 0.50" D with matching actuating magnet. Mounting holes shall be on approximately 2" centers. Contact and magnets shall be in brushed anodized aluminum tube housing. Contact shall be sealed in polyurethane potting compound. Right angle mounting bracket shall be furnished with contact.

2. The contact shall be a Form C (SPDT) reed contact. For doors, the contact shall be biased such that contact will be difficult to defeat with an external magnet and three feet of flex stainless steel conduit shall be permanently attached to the contacts. Contacts in cabinets need not have the biased feature and can be provided with vinyl-jacketed cable.

3. The contact shall be GE Sentrol, or equal.

V. Pressure Cell & Transmitter

1. The pressure transmitters shall be High Tide Technologies, Inc. units furnished by Owner and installed by Contractor. Install per the detail on the Contract Drawings.

3.0 EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTION

A. Conduit

1. PVC conduit shall be utilized below grade, and aluminum conduit shall be used above grade. The transition from PVC to aluminum shall occur below grade prior to the elbow. The aluminum conduit shall be taped with corrosion-prevention tape from the transition point to 6” above finished grade.
2. The Contractor shall be responsible for setting of all sleeves for his work. Passage of conduit through masonry and concrete walls shall be provided with steel pipe sleeves. Sleeves shall be flush with each face of the wall. Seal space between sleeve and conduit with oakum and waterproof mastic.
3. All conduit 1-1/4 inches and larger shall be sleeved.
4. Concrete encasements of underground conduit – not applicable on this project.
5. During construction, all new conduits shall be kept dry and free of moisture and debris. Before the wire is pulled in, all conduits shall be swabbed to clear all moisture and debris which may have unavoidably accumulated.
6. Rigid conduits, where they entered panelboards, cabinets, pull boxes or outlet boxes shall be secured in place by galvanized, double locknuts (one inside and one outside) and bushings. Conduit bushings shall have insulating material which has been permanently fastened to the fittings. Bushings for conduit 1-1/2 inches trade size and larger shall be complete with grounding lug and shall be bonded to the box by means of bare copper wire. Myers hubs shall be utilized rather than locknuts for all exterior and NEMA 4/4X penetrations.
7. All field bends shall be made with standard tools and bending equipment manufactured especially for this purpose. Bends in metallic conduit shall be made while cold and in no case shall the conduits be heated. Conduits shall not be bent through more than 90 degrees.
8. Size of conduits shall not be less than that required by the National Electrical Code. The Contractor shall install larger size conduits than detailed where there is more than 100 feet of unbroken run or where the total of the angles through which the conduit has been bent during a single run exceeds

270 degrees.

9. In general, flexible conduit is prohibited. Where absolutely necessary, it shall be liquid-tight, with maximum lengths of 3 feet.

10. All conduit joints shall be made up tight and no running threads shall be permitted on threaded connections. No kinked, clogged or deformed conduits shall be permitted on the job.

11. During construction, all installed conduits shall be temporarily capped or corked.

12. All moisture proofing or other material for thread protection shall be removed from conduit threads prior to installation. No material of insulating quality shall be used on the conduit threads or other places which will reduce the overall conductivity of the conduit system.

13. Raceways shall be securely and rigidly fastened in place with conduit clamps or approved conduit hangers. Bolts, screws, etc. used in securing the work shall be stainless steel and of ample size for the service. Assembly bolts, nuts, washers, etc., shall be stainless steel. Raceways shall NOT be welded to steel structures.

14. Horizontal and vertical conduit runs shall be supported by one hole straps with clamp backs, special brackets, or other approved devices with suitable bolts, expansion shields where required. All mounting hardware shall be stainless steel.

15. The use of perforated iron straps or wire for supporting conduits will not be permitted.

16. Conduit shall not be installed horizontally in concrete slabs.

17. Depth of bury for all conduit shall be as indicated but not less than 30 inches below finished grade.

18. All conduit shall have an insulated ground wire pulled to all equipment.

19. All conduits penetrating enclosures shall have duct seal applied to seal the conduit and prevent moisture from

entering the enclosure.

B. Wire and Cable (600 Volts and Below):

1. All wiring shall be installed in conduit. Wire shall not be installed until all work of any nature that may cause injury to the wire is completed.

2. Mechanical means shall not be used in pulling in wires No. 8 or smaller.

3. Approved wire pulling lubricant shall be used as required to prevent insulation damage and over stressing of the wire while pulling through conduit. In no case shall conductors be greased or coated with any substance injurious to the conductor insulation or sheath.

4. All wiring in control equipment, cabinets, etc., shall be neatly wrapped, taped, or laced into groups to provide a neat and orderly appearance in the equipment.

5. Where the wire is shown larger than that required for the load, it is done so for voltage drop or other purposes and must be installed as shown. Where the wire is stranded, the removal of strands in order to install the wire into a lug provided on any equipment will not be permitted. A larger lug shall be installed which will accept the wire size indicated.

6. For the wiring of circuits consisting of AWG No. 10 or smaller wire, self-insulated pressure connectors (wirenuts) shall be utilized for all splices or joints.

7. Hazardous locations – not applicable on this project.

8. Each wire shall be labeled at both termination points. Individual conductor or circuit identification shall be carried throughout, with circuit numbers or other identification clearly stamped on terminal strips and shown in wiring diagrams.

9. In all junction boxes, cabinets, control compartments and terminal boxes where no terminal board is provided, each wire, including all power wires, shall be properly identified by plastic coated, self-adhesive, wire marker.

10. In cases similar to the above where the terminal boards are

provided for the control, indicating, and metering wires, all wires including motor leads and other power wires shall be identified by wire markers as specified above.

11. Equipment ground wire insulation shall be colored green or green with two or more yellow stripes. Isolated grounding conductors shall be green with striping that identifies the conductor as "isolated ground" and different from the equipment (bonded) ground.

12. In general and unless otherwise shown on the drawings, no two wires of the same color shall be run in the same conduit except such as control wiring, switch legs, neutral, and ground. Where a conduit run is shown on the drawings to have two or more wires connected to the same phase and, therefore, are the same color, pressure sensitive, plastic marked wire marker identification tape shall be used wherever the wire is accessible (junction boxes, panels, device boxes, etc). The numbers shall in each case, correspond to the circuit number and panelboard from which the circuit emanates. Control wiring inside any compartment which may be energized from a source outside the compartment shall have insulation. Where yellow insulated wires are used inside any cabinet, compartment, etc., a machine engraved, laminated plastic identification marker shall be installed on the outside of the compartment.

13. Insulation on ungrounded conductors larger than AWG #10 and on grounded (neutral) and grounding (equipment ground) conductors larger than AWG #6 may be black with color coding accomplished with the use of colored plastic tape. Tape shall be installed on the conductors wherever they are visible and shall be wrapped at least three (3) turns around the conductor.

14. All wiring on this project, except control wiring, shall reflect the phase relationship as follows:

    480 volt system: brown, orange and yellow for ungrounded conductors, gray with brown tracer for neutral conductors.

    208Y/120 volt system: black, red and blue for ungrounded conductors, white for neutral conductors.

120/240 volt, 3-phase 4-wire,delta system: black, red for ungrounded conductors, orange for ungrounded conductor connected to "high leg", white for neutral.

C. Grounding

1. Ground rods shall be driven vertically into the earth to at least one foot below finished grade. Where a counterpoise or grounding grid is indicated and where rock is encountered at a depth of less than four (4) feet, rods shall be buried in a trench at not less than two feet below finished grade, and at equal angles from any two adjacent sides on the outside of the counterpoise or grid. In these cases, at the Contractor's option, equal lengths of bare conductor of the same size as the counterpoise or grid may be used in place of ground rods.

2. Conductors connecting the main ground bars in switchgear to the earth shall be continuous without joints or splices. Connections to the grounding system at the switchgear shall be made with pressure connectors such as defined in Article 100, "Connector, Pressure (Solderless)", of the National Electrical Code.

3. Connections to ground rods and all other ground connections below grade shall have a minimum mechanical contact surface area between the conductor and the ground rod of not less than three (3) square inches.

4. All connections made below finished grade shall be exothermic.

5. Installation of grounding conductors shall be such that they are not exposed to physical damage. All connections shall be firm and tight. Conductors and connectors shall be so arranged and provided so that there is no strain upon the connection. Buried equipment grounding conductors shall be buried at least 24 inches below finished grade and shall not be buried below concrete pads, paving, etc. except where running a tap to the grid or where shown on the contract drawings. Where buried below concrete or paving, grounding conductors shall be in rigid conduit unless shown on the drawings as a part of a grid.

6. Resistance measurements shall be made between the main

grounding bar in the switchgear and a good earth ground. If this resistance is not equal to or less than 5 Ohms, an additional grounding electrode system in the form of ground rods installed and connected together in a 10 feet by 10 feet grid shall be added. The rods shall be connected together and this grid connected to the system with AWG #3/0 bare tinned copper. The number of rods shall be as required to register the resistance value mentioned above. Measurements shall be made in normally dry conditions and, in no case, less than 48 hours after rainfall. Submit a ground test report to the Engineer using the "Fall of Potential" method and appropriate ground testing instrumentation.

7. Where a bare conductor is the only conductor installed in conduit or other raceway, and this conductor is serving as a grounding conductor, it shall be bonded to the raceway that contains it at each end of the raceway. The bond shall be made using a grounding type bushing and bonding jumper. The size of the jumper shall be the maximum size that the grounding bushing lug will accept and it shall be connected to the bushing with the lug and to the grounding conductor with a split bolt connector.

8. All metal electrical equipment cabinets (wireways, panels, switchgear, device boxes, junction and pull boxes, motor control panels, etc.) shall be securely bonded to a grounding conductor running through any conduit terminating at the cabinet or enclosure by use of a grounding lug bushing and jumper wire to the enclosure wall. Switchgear, panelboards and motor control equipment shall be provided with an equipment ground bus (including lugs or screw terminals) securely bonded to the enclosure. Junction boxes and other enclosures shall utilize an equipment ground bus or lug as required to securely bond the equipment grounding conductor to the enclosure. The grounding conductor shall be connected with pressure connectors at the main switchgear to the main grounding system. Where screw terminals or set screw lugs are used, sufficient lugs shall be provided such that not more than one conductor is installed into each lug or terminal.

9. No raceway (including rigid steel conduit, EMT, etc.) shall serve as a grounding conductor.

10. All main feeder circuits and all branch circuits shall contain a grounding conductor sized according to Table 250-95, Article

250 of the National Electrical Code or as shown on the drawings. This grounding conductor shall be connected to the main grounding conductor in the switchgear from which the circuit emanates. Individual components of the system served by the main feeder circuit shall have their enclosures connected to the main feeder grounding conductor with pressure connectors.

11. The grounding conductor serving motor circuitry shall be connected inside the entrance compartment to the motor frame with a bolted solderless pressure connector. Bolts, nuts, washers and other assorted hardware shall be bronze, cadmium plated steel, or other corrosion resistant material. The motor ground connection shall be to the motor frame and independent of the mounting bolts or sliding base.

12. Grounded and Grounding Conductor: Connections to the grounding conductor and/or the neutral (grounded) conductor shall be made in such a manner that removal of any device or equipment will not interrupt the continuity of these conductors to any device downstream from the device removed.

D. Lighting

1. The Contractor shall furnish all light fixtures, lighting equipment, components, hangers, etc., as shown on the Contract Drawings and shall install them at the locations shown on the Contract Drawings.

2. Mounting heights specified as indicated shall be to bottom of fixture. Coordinate exact mounting of lighting fixture with type, style and pattern of ceiling being installed.

3. Clean interior lighting fixtures of dirt and debris upon completion of installation. Protect installed fixtures from damage during remainder of construction period.

4. No light fixtures shall be hung or installed until after painting is completed, however, the Contractor shall provide temporary lighting.

END OF SECTION 16020

SECTION 16483

ADJUSTABLE FREQUENCY DRIVES

1.0 GENERAL

1.1 SCOPE

A. This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three-phase, Adjustable Frequency Drives (AFD) as specified herein and as shown on the Contract drawings.

1.2 RELATED SECTIONS

A. Section 16020 General Electrical Requirements

1.3 REFERENCES

A. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards.

1. Underwriters Laboratories (UL508C: Power Conversion Equipment)

2. NEMA ICS 7.0: Industrial Controls & Systems for AFD.

3. IEC 61800-2 and –3. EN 50082-1 and –2: Fulfill all EMC immunity requirements

1.4 SUBMITTALS

A. The following information shall be submitted to the Engineer for approval:

1. Dimensioned outline drawing
2. Schematic diagram
3. Power and control connection diagram(s)
4. Descriptive bulletins
5. Product sheets

B. O&M manuals are required in accordance with Section 16010 requirements. As-built wiring diagrams and as-built parameter settings list are required.

1.5 QUALIFICATIONS

A. For the equipment specified herein, the manufacturer shall be ISO 9001 certified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. A copy of these instructions shall be included with the equipment at time of shipment.

2.0 PRODUCTS

2.1 MANUFACTURERS

A. Danfoss or equal
B. Allen Bradley
C. Square D
D. Naming specific venders does not imply acceptance of their standard products nor relieve them from meeting these specifications in their entirety.

2.2 ADJUSTABLE FREQUENCY DRIVES (AFD)

A. Where shown on the drawings, adjustable frequency drives shall have the following features:

1. The AFD shall be rated for the voltage indicated on the Drawings. The AFD shall provide microprocessor-based control for three-phase induction motors. The AFD may be either variable torque rated or constant torque rated for pumping duty. The controller's full load output current rating shall be based on 50° C (CT) / 40° C (VT) ambient and 10 kHz switching frequency below 40-HP (CT) / 50-HP (VT) and 3.6 kHz switching frequency 40-HP (CT) / 50-HP (VT) and above to reduce motor noise and avoid increased motor losses.
2. The AFD shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source AFDs are not acceptable. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors, GTO's or SCR's are not acceptable. The AFD shall run at the above listed switching frequencies.
3. The AFD shall have efficiency at full load and speed that exceeds 95% for AFD below 15-HP and 97% for drives 15-HP and above. The efficiency shall exceed 90% at 50% speed and load.

4. The AFD shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.
5. The AFD shall have a one (1) minute overload current rating of 150% and a two (2) second overload current rating of 250% for constant torque drives. The AFD shall have a one (1) minute overload current rating of 110% for variable torque drives.
6. The AFD shall be capable of operating of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the AFD.
7. The AFD shall have an integral EMI/RFI filter as standard.
8. The AFD shall have a standard 3% nominal impedance integral AC three-phase line reactor.
9. The AFD shall be able to start into a spinning motor. The AFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the AFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
10. Standard operating conditions shall be:
    a. Incoming Power: As indicated voltage (+10% to -15%) and 50/60 Hz (+/-5 Hz)
    b. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
    c. Speed regulation of +/- 0.5% of base speed.
    d. Load inertia dependant carryover (ride-through) during utility loss.
    e. Insensitive to input line rotation.
    f. Humidity: 0 to 95% (non-condensing and non-corrosive).
    g. Altitude: 0 to 3,300 feet (1000 meters) above sea level.
    h. Ambient Temperature: -10 to 50 °C (CT), -10 to 40 °C (VT).
    i. Storage Temperature: -40 to 60 °C.
11. Control Functions
    a. Frequently accessed AFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the AFD. The AFD shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
    b. The keypad shall include a Local/Remote pushbutton selection. Both start/ stop source and speed reference shall be independently programmable for Keypad, Remote I/O, or Field Bus.

c. Upon initial power up of the AFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
d. The drive shall have an Ethernet communications port.
e. The operator shall be able to scroll through the keypad menu to choose between the following:
   i. Monitor
   ii. Operate
   iii. Parameter setup
   iv. Actual parameter values
   v. Active faults
   vi. Fault history
   vii. LCD contrast adjustment
   viii. Information to indicate the standard software and optional features software loaded.
f. The following setups and adjustments, at a minimum, are to be available:
   i. Start command from keypad, remote or communications port
   ii. Speed command from keypad, remote or communications port
   iii. Motor direction selection
   iv. Maximum and minimum speed limits
   v. Acceleration and deceleration times, two settable ranges
   vi. Critical (skip) frequency avoidance
   vii. Torque limit
   viii. Multiple attempt restart function
   ix. Multiple preset speeds adjustment
   x. Catch a spinning motor start or normal start selection
   xi. Programmable analog output
   xii. DC brake current magnitude and time
   xiii. PID process controller

12. The AFD shall have the following system interfaces:
    a. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
       i. Remote manual/auto
       ii. Remote start/stop
       iii. Remote forward/reverse
       iv. Remote preset speeds
       v. Remote external trip
       vi. Remote fault reset
       vii. Process control speed reference interface, 4-20mA DC
       viii. Potentiometer and 1-10VDC speed reference interface
       ix. RS-232 programming and operation interface port
       x. Serial communications port

B. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.

1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:
   a. Fault
   b. Run
   c. Ready
   d. Reversed
   e. Jogging
   f. At speed
   g. Torque Limit Supervision
   h. Motor rotation direction opposite of commanded
   i. Over-temperature
2. Programmable open collector output with available 24VDC power supply and selectable with the following available at minimum:
   a. Fault
   b. Run
   c. Ready
   d. Reversed
   e. Jogging
   f. At speed
   g. Torque Limit Supervision
   h. Motor rotation direction opposite of commanded
   i. Over-temperature
3. Programmable analog output signal, selectable with the following available at minimum:
   a. Motor current
   b. Output frequency
   c. Frequency reference
   d. Motor speed
   e. Motor torque
   f. Motor power
   g. Motor voltage
   h. DC-bus voltage
   i. AI1 (Analog Input 1)
   j. AI2 (Analog Input 2)
   k. PT100 temperature
   l. FB digital input 4 (Field Bus Input)
4. Monitoring and Displays
   a. The AFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
      i. Run

ii. Forward
iii. Reverse
iv. Stop
v. Ready
vi. Alarm
vii. Fault
viii. Input/Output (I/O) terminal
ix. Keypad
x. Bus/Communication
xi. Local (LED)
xii. Remote (LED)
xiii. Fault (LED)

5. The AFD keypad shall be capable of displaying the following monitoring functions at a minimum:
   a. Output frequency
   b. Frequency reference
   c. Motor speed
   d. Motor current
   e. Motor torque
   f. Motor power
   g. Motor voltage
   h. DC-bus voltage
   i. Unit temperature
   j. Calculated motor temperature
   k. Voltage level of analog input
   l. Current level of analog input
   m. Digital inputs status
   n. Digital and relay outputs status
   o. Analog Input
6. Protective Functions
   a. The AFD shall include the following protective features at minimum:
      i. Over-current
      ii. Over-voltage
      iii. Inverter fault
      iv. Under-voltage
      v. Input phase loss
      vi. Output phase loss
      vii. Under-temperature
      viii. Over-temperature
      ix. Motor stalled
      x. Motor over-temperature
      xi. Motor under-load
      xii. Logic voltage failure
      xiii. Microprocessor failure

b. The AFD shall provide ground fault protection during power-up, starting, and running. AFD with no ground fault protection during running are not acceptable.

7. Diagnostic Features
   a. Fault History
      i. Record and log faults
      ii. Indicate the most recent first, and store up to 30 faults
8. Additional required features to be included in the AFD:
   i. The operator shall be able to scroll through the keypad menu to choose between the following screens:
      - Parameters
      - Keypad control
      - Active faults
      - Fault history
      - System menu
      - Monitor
      - Operate menu
9. Enclosure
   a. The AFD enclosure shall be NEMA 1 minimum as indicated on the Drawings. The AFD shall have complete front accessibility with easily removable assemblies.
10. Spare Parts
    a. The main logic board, keypad and power supply board shall be supplied as spares, one for each different part number supplied.
11. The AFD manufacturer shall maintain, as part of a national network, engineering service facilities within 100 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.

3.0 EXECUTION

3.1 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.

1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
2. After all tests have been performed, each AFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.
3. After the burn-in cycle is complete, each AFD shall be put through a motor load test before inspection and shipping.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 INSTALLATION

A. Install per manufacturer's instructions.
B. Configure parameters according to actual driven motor nameplate data.
C. Set the minimum and maximum speeds as directed by the motor manufacturer.

3.3 FIELD QUALITY CONTROL

A. Provide the services of a qualified manufacturer's employed Field Service Engineer to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of AFD on the job site. Sales representatives will not be acceptable to perform this work. The manufacturer's service representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper AFD operation.

B. The Contractor under the technical direction of the manufacturer's service representative shall perform the following minimum work.
   1. Inspection and final adjustments.
   2. Operational and functional checks of AFD and spare parts.
   3. The Contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the AFD in accordance with those instructions.

C. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

3.4 MAINTENANCE / WARRANTY SERVICE

A. Warranty shall be a minimum of two years from the date of start-up and include all parts, labor, and travel time.

3.5 TRAINING

A. The Contractor shall provide a training session for up to 5 owner's representatives for ·one normal workday. Training and instruction time shall be in addition to that required for start-up service.

B. The manufacturer's qualified representative shall conduct the training.

C. The training program shall consist of the following:
   1. Instructions on the proper operation of the equipment.
   2. Instructions on the proper maintenance of the equipment.

END OF SECTION

SECTION 16900

CONTROL PANELS

1.0 GENERAL

1.1 SCOPE OF WORK

A. Pump control panel shall be provided as specified herein and as shown on the Contract Drawings.

1.2 RELATED WORK

A. Drawings and General and Supplementary Conditions of the Contract and Division 1 Specifications sections apply to this Section.

1.3 SUBMITTALS

A. Panel and enclosure plan and elevation drawings depicting all components and wiring duct

B. Complete wiring diagrams

C. Catalog cut-sheets on all components, with options clearly indicated and non-applicable items clearly excluded

D. Shop Drawings shall be clearly marked and or highlighted as to which product, type, option, etc. is being submitted. Product literature with one or more styles / configurations for a single product shall have a written description of use for each of the styles / configurations represented on the literature. For example: Device boxes – Styles shall be listed as: For masonry walls, for electrical devices, for ceiling mounted light fixtures, etc

E. O&M manuals shall be submitted in accordance with Section 16020. They shall include all field modifications made such that the wiring diagrams exactly match the field-installed equipment and control panels. They shall also include complete cut-sheets, product data, operation, and maintenance information.

1.4 REFERENCES

A. NFPA 79 – All control panels shall comply with NFPA 79.

B. NEC – All control panels shall comply with NEC article 409.

C. UL508 – All control panels shall be listed to UL508 and shall bear the UL label.

1.5 GENERAL REQUIREMENTS

A. All control panels furnished under this Contract shall be manufactured in accordance with industry standards and as herein specified. The Contractor shall coordinate all subcontractors and vendors to ensure that the control panels are furnished and meet the requirements specified herein.

B. Control panels shall be as manufactured by ControlWorks, Inc., Quality Controls, ADGO, or other UL or ETL qualified panel vendor. Panel construction shall comply with OSHA requirements and shall be either UL or ETL listed.

C. Control panels to be furnished on this project shall be wired to function according to schematics shown on the Contract Drawings. All Control Panels shall be manufactured using “relay logic” as shown on schematics (control circuits) located in the Contract Drawings. In addition to the requirements shown on the Contract Drawings, the panels shall adhere to additional requirements as written herein, and in the utilization equipment specifications.

D. Interior enclosures shall be dead front with all operators’ devices accessible without opening the enclosure door.

E. All components shall be mounted with threaded screws to a subpanel inside the enclosure such that they are replaceable without removing the subpanel. All wiring must be stranded and protected by a circuit breaker. Supplementary circuit breakers may be utilized for circuits that require wiring smaller than 14 gauge. Wiring ducts for cable/conductor management are required to be utilized for routing of conductors and cables. Ducts are also required to be provided for field-wiring at the top and bottom of the panels. All field wires should terminate at a terminal strip upon entering the control panel enclosure.

F. All terminal strips and lugs shall be of a type UL listed to terminate the size and quantity of wires encountered. Where conduits enter the boxes, if they are NEMA 4 or 3R, sealing locknuts or hubs must be used to maintain the box rating. The exterior of steel panels shall be painted ANSI 49 light gray, lacquer or enamel.

G. Enclosures for interior use in dry areas shall be NEMA 12

enclosed, unless otherwise indicated.

H. Elementary control schematics and connection diagrams showing the spatial relationship of components and wiring shall be submitted for review. Also, a bill of materials, drawing of device arrangement on front, and enclosure fabrication drawings shall be submitted. Further, descriptive literature is required on all components. A copy of the as-built wiring diagrams and BOM shall be stored in a pocket inside the control panel enclosure.

I. Sleeve type wire markers or other “permanent” type marker shall be installed on all wires, keynoted back to the elementary schematic or the connection diagram, and all terminals identified.

I. Short circuit ampacity: The minimum short circuit ampacity of the control panel shall be as follows. Provide current-limiting fuses if needed to meet this requirement:

1. 480V control panels: 14kA

2. 208/240V control panels: 5kA

3. 120V control panels: 5kA

2.0 PRODUCTS

2.1 ENCLOSURES

A. Control panel enclosure shall be wall-mount type where sized at 30” width x 42” height or less. Otherwise, it shall be floor-mount type. All panels indicated on the Drawings to be floor-mounted shall be floor-mounted regardless of size. Enclosures shall be single or double-door as required. Enclosure shall include an IEC style rotary lockable disconnect for single phase power supply. Enclosures shall be manufactured by Hoffman, or equal.

B. Enclosure NEMA rating shall be NEMA 12 minimum. The enclosure shall be sized to provide 25% spare panel space. Seams shall be continuously welded and ground smooth.

C. Enclosure door shall have a 3-point latch. Screw clamps are not acceptable. The latch handle shall have a padlock hasp.

D. The enclosure shall have an interior pocket for holding wiring diagrams, and an interior sub-panel for mounting control equipment.

2.2 WIRING REQUIREMENTS

A. Wire and cable shall comply with Section 16020 except Type MTW conductors shall be used inside the control panel for control circuits. Control circuit wiring shall be 18 gauge or larger.

B. Control wiring shall be terminated using crimp-type ferrule, fork, or ring terminals. Power wiring shall utilize compression lugs.

C. Wiring shall extend to terminal blocks for connection to external equipment.

2.3 TEMPERATURE CONTROL DEVICES

A. Not required for this project.

2.4 VARIABLE FREQUENCY DRIVES

A. See Section 16483 for requirements. The drives are required to be mounted external from the pump control panel.

2.5 POWER SUPPLIES

A. DC Power Supplies

1. DC power supplies shall be switched mode and Din-rail mountable.
2. Input power range shall be from 85-264 VAC.
3. Output voltage range shall be as needed with a tolerance of 1%. Output voltage shall be adjustable up and down at least 10% from the nominal value.
4. The power supply shall include an internal input fuse.
5. Power supply shall have a “DC Ok” signaling LED.
6. Operating temperature rating shall be –25 C to +70 C and up to 95% relative humidity.
7. Output power shall be buffered for full output power ridethrough for 20 milliseconds in the event of a power outage.
8. The power supply shall be able to supply 150% of its continuous capacity for short periods of time.
9. The power supply shall have internal short circuit protection with automatic recovery.

10. The power supply shall be Phoenix Contact, Sola, Allen-Bradley, or equal.

2.6 OVERCURRENT PROTECTION

A. Main Single-Phase Breakers – Shall be Din-rail mountable with clear “on,” “off,” and “tripped” positions, Square D QOU or equal. Where a substantial number of breakers are used, provide a panelboard mounting base.

B. Supplementary Protectors – Shall be Din-rail mountable UL489 listed. Trip rating shall match load served.

C. Power Fuses – Utilize Class J fuses and fuse blocks. Fuse blocks must have protective cover. Fuses may only be used where indicated on the Drawings. Otherwise, use circuit breakers.

2.7 MISCELLANEOUS PANEL COMPONENTS

A. Terminal Blocks, #10 conductor size and smaller.

1. Terminal blocks shall be Din-rail mountable IEC style with minimum width of 6.2 mm. They shall be rated for conductors from #10 to #24 AWG. Current rating shall be 30A, minimum. Terminal blocks shall be finger-safe. Double level terminal blocks may be utilized where necessary to conserve space.
2. Screw clamp terminal blocks are required. Terminal blocks that rely upon spring pressure only for conductor termination are not acceptable.
3. Provide cross connection bridges, partition plates, end anchors, zack strip labels, and all other components necessary for a complete installation. Each block shall be labeled with a machine-printed label. No more than 2 conductors may be landed under on single terminal block terminal screw.
4. Utilize the following terminal block colors:
   a. 120V Power – Black
   b. 120V Control – Red
   c. 120V Neutral – White
   d. Equipment Grounding – Green or Green/Yellow
   e. DC Positive – Blue
   f. DC Negative/Grounded – Gray
   g. Conductor energized from remote source: Yellow
5. Terminal blocks shall be manufactured by Phoenix Contact, Allen-Bradley, or equal.

B. Fuse blocks (control circuits) – Fuse blocks shall be finger safe and shall have LED indication when the fuse is blown. Fuses may be used only where indicated on the Drawings; otherwise use circuit breakers.

C. Conductor Labels – Shall be the heat-shrink type, machine printed. Brady, or equal.

D. Component nameplates – Shall be engraved, rigid, laminated plastic with adhesive back and letter height of 3/16" minimum. Nameplates shall be white with black letters.

E. Provide a surge protector in the control panel, Edco HSP series or equal.

F. Pilot Devices

1. Selector switches shall be NEMA 12, 30mm, oil-tight construction, and of the quick-make, quick-break type.

2. Pushbuttons shall be NEMA 12 oil-tight, 30mm.

3. Pilot lights shall be 30mm, push-to-test, NEMA 12 LED type.

4. Elapsed time meters shall be non-resettable.

5. Timing relays shall have an adjustable time range suitable for the application, with the time delay occurring after energization.

G. Control Relays

1. Control relays shall be magnetic, general purpose, "ice cube" type with 3-pole (minimum), double throw contacts rated at 5 amperes (minimum), 120 volts (minimum). Coils shall be rated to operate at the indicated control voltage.

2. Provide proper bases, mounting track, etc. for a complete installation. All relays shall be have a retainer clip, manual operator, and pilot light. Coils connected to solid-state digital outputs shall have transient surge protection.

3.0 EXECUTION

3.1 LABELING

A. Provide labels for all conductors and components.

B. Legends for starter nameplates shall be taken from the one line diagram in the Contract Drawings. Wire and miscellaneous component labels shall match the O&M manual wiring diagrams.

3.2 GROUNDING

A. Enclosures shall be grounded in accordance with the NEC.

B. Each analog signal loop shall be grounded at a single point for the loop at the location of the DC power supply for the loop.

3.3 PROTECTION

A. All electrical and electronic components of the Control Panel shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and surges in nearby electrical systems. Provide a surge protection device (SPD).

3.4 INSTALLATION/ERECTION

A. Equipment furnished under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, manufacturer Shop Drawings, and manufacturer installation instructions.

END OF SECTION

ATTACHMENT 2C

HYDRAULIC SUBMITTAL PACKAGE

KENVIRONS

HYDRAULIC ANALYSIS

FOR

GREEN RIVER VALLEY WATER DISTRICT

BUNNELL CROSSING ROAD
BOOSTER PUMP STATION

Prepared By:

KENVIRONS, INC.
770 WILKINSON BLVD.
FRANKFORT, KENTUCKY 40601

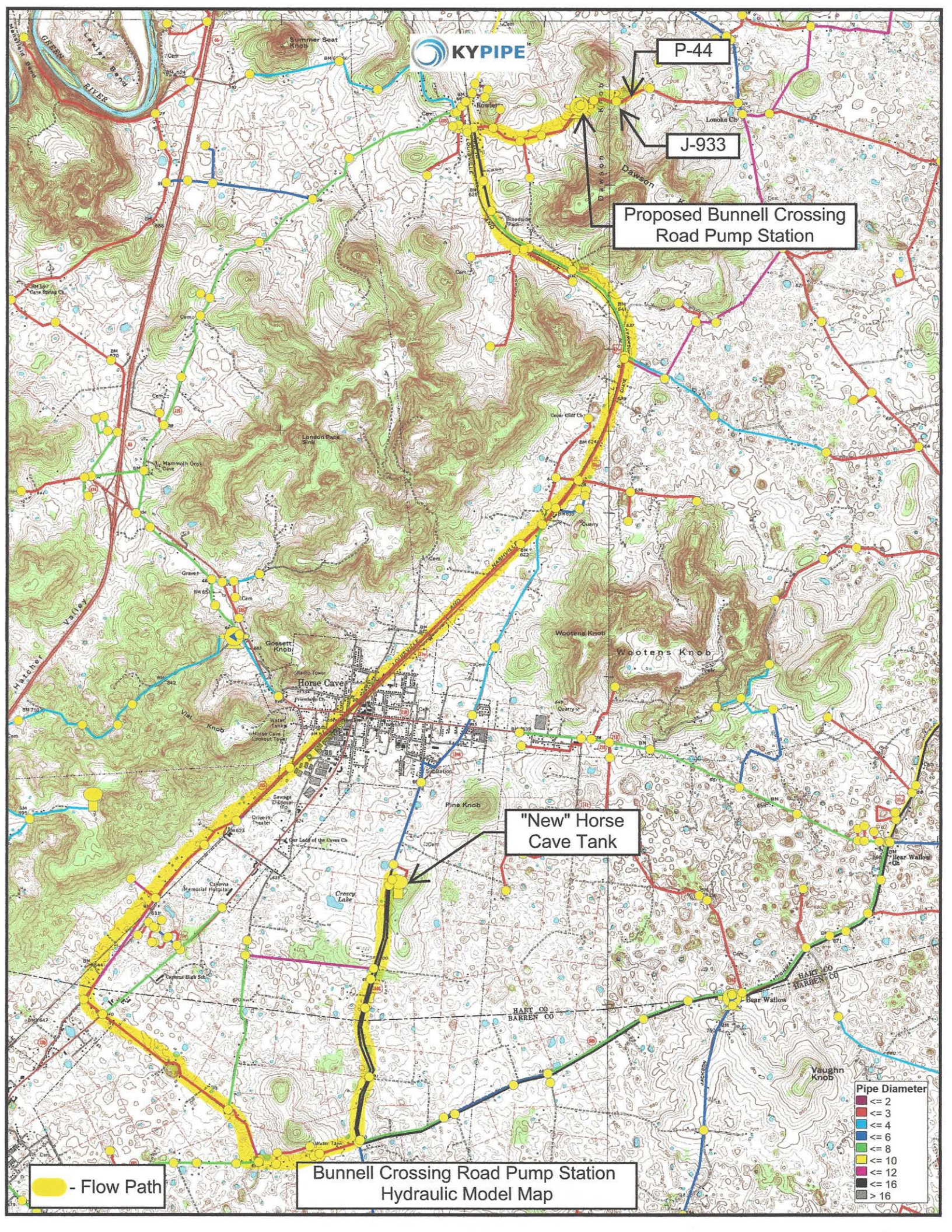
PROJECT NO. 2020085

AUGUST 2020

STATE OF KENTUCKY
BRANDON L. HAMILTON
35473
LICENSED PROFESSIONAL ENGINEER
2020.08.24 11:08:12-04'00'

Kenvirons, Inc.

Civil & Environmental Engineering and Laboratory Services


KYPIPE
P-44
J-933
Proposed Bunnell Crossing
Road Pump Station
"New" Horse
Cave Tank
Pipe Diameter
<= 2
<= 3
<= 4
<= 6
<= 8
<= 10
<= 12
<= 16
> 16
- Flow Path
Bunnell Crossing Road Pump Station
Hydraulic Model Map

C H A N G E S F O R N E X T S I M U L A T I O N (time = 20.0000 hours)

UNIT COST OF POWER FOR THIS SIMULATION PERIOD = 0.100 $/kW-Hr

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

Time: 20.000

TIME FROM INITIATION OF EPS = 20.0000 HOURS (8.00PM, DAY: 1)

RESULTS OBTAINED AFTER 3 TRIALS: ACCURACY = 0.25681E-04

1 pump on at 75% Speed

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-38	MM-14	MM-15	-372.24	4.22	0.00	1.06	0.35	0.35
P-42	O-Bunnell	J-32	29.82	0.17	0.00	1.35	2.83	2.83
P-43	J-29	J-933	28.46	2.22	0.00	1.29	2.59	2.59
P-44	J-30	J-933	-28.00	3.27	0.00	1.27	2.52	2.52
P-46	J-28I-Bunnell		29.82	0.17	0.00	1.35	2.83	2.83
P-47	J-32	J-29	29.36	1.49	0.00	1.33	2.75	2.75
P-48-XXCV	J-28	J-32						
P-607	J-553	J-1099	933.89	2.93	0.00	2.65	1.95	1.95
P-609	J-554	J-1097	899.43	6.38	0.00	3.67	4.41	4.41
P-610	J-556	J-557	552.19	1.76	0.00	1.57	0.74	0.74
P-612	J-557	MM-10	366.57	2.07	0.00	1.04	0.34	0.34
P-624	J-568	MM-15	853.49	1.78	0.00	2.42	1.65	1.65
P-625	J-570	J-568	893.61	1.40	0.00	2.53	1.79	1.79
P-993	J-893	J-932	31.07	2.47	0.00	1.41	3.05	3.05
P-1019	J-922	J-1143	-909.88	9.00	0.00	2.58	1.86	1.86
P-1026	J-920	J-1141	-60.04	0.35	0.00	0.38	0.09	0.09
P-1027	J-922	J-570	900.44	2.43	0.00	2.55	1.82	1.82
P-1028	J-930	J-1138	-64.93	0.20	0.00	0.41	0.10	0.10
P-1029	J-429	J-931	33.12	2.62	0.00	1.50	3.43	3.43
P-1030	J-931	J-893	32.32	3.74	0.00	1.47	3.28	3.28
P-1031	J-932	J-28	30.28	5.36	0.00	1.37	2.91	2.91
P-1232	J-1082	J-1121a	-607.72	1.01	0.00	0.97	0.22	0.22
P-1233	J-1082New Horse		607.38	0.58	0.00	1.72	0.88	0.88
P-1332	J-1097	J-556	927.64	3.05	0.00	3.79	4.67	4.67
P-1335	J-1099	J-554	933.55	1.04	0.00	3.81	4.73	4.73
P-1338	MM-10	J-559	-290.98	0.20	0.00	0.83	0.22	0.22
P-1339	J-559	J-1103	-290.98	1.03	0.00	0.83	0.22	0.22
P-1357	J-1103	J-1118	-292.01	0.61	0.00	0.83	0.23	0.23
P-1358	J-1117	MM-14	-293.37	0.63	0.00	0.83	0.23	0.23
P-1359	J-1118	J-1117	-292.80	0.35	0.00	0.83	0.23	0.23
P-1364	J-1121a	J-1121e	-608.40	1.10	0.00	0.97	0.22	0.22
P-1365	J-1121e	J-553	1120.50	0.07	0.00	1.79	0.67	0.67
P-1393	J-1137	J-429	-67.55	0.88	0.00	0.77	0.44	0.44
P-1394	J-1138	J-1137	-65.61	0.48	0.00	0.74	0.42	0.42
P-1400	J-1141	J-930	-61.18	0.16	0.00	0.39	0.09	0.09
P-1402	J-920	J-1143	85.21	0.02	0.00	0.54	0.17	0.17

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

P-22	P-27	P-30	P-45	P-530
P-535	P-568	P-967	P-1065	P-1092
P-1254	P-1304	P-1360	P-1434	

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC-ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	#PUMPS PARALLEL	#PUMPS SERIES	NPSH Avail. ft	Time hrs
Bunnell Cr	29.82	147.48	248.93	101.4	59.83	1.	0.0	2.2	**	**	180.7	20.0000
Canmer Pum	250.44	171.12	281.70	110.6	75.00	7.	0.3	16.0	**	**	204.2	20.0000
H.S. Pump	816.39	11.18	495.78	484.6	75.00	100.	3.8	129.4	**	**	44.4	20.0000
H.S. Pump	816.39	11.18	495.78	484.6	75.00	100.	3.8	228.4	**	**	44.4	20.0000
H.S. Pump	2448.69	11.08	495.78	484.7	75.00	300.	11.4	128.2	**	**	44.0	20.0000
Hiseville	193.73	52.93	195.88	143.0	80.00	7.	0.2	1.8	**	**	86.1	20.0000
Warning P2K107:Device Nelson Road is operating out of range.												
Nelson Roa	2.96	233.66	405.50	0.0	52.18	0.	0.0	0.2	**	**	266.9	20.0000
Wisdom Pum	107.37	79.38	263.62	184.2	75.00	5.	0.2	1.9	**	**	112.5	20.0000

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
O-Bunnell		0.00	935.93	687.00	248.93	107.87
New Horse		----	839.70	805.00	34.70	15.04
J-28		0.46(1.75)	834.65	687.00	147.65	63.98
J-29		0.91(1.75)	934.26	737.00	197.26	85.48
J-30		28.00	928.77	685.00	243.77	105.63
J-32		0.46(1.75)	935.75	687.00	248.75	107.79
J-429		2.84(1.75)	848.84	640.00	208.84	90.50
J-553		0.68(1.75)	842.32	740.00	102.32	44.34
J-554		1.37(1.75)	838.36	750.21	88.15	38.20
J-556		1.14(1.75)	828.92	676.00	152.92	66.27
J-557		2.39(1.75)	827.17	696.00	131.17	56.84
J-559		0.00	825.29	639.64	185.66	80.45
J-568		0.80(1.75)	833.91	630.00	203.91	88.36
J-570		1.93(1.75)	835.31	630.00	205.31	88.97
J-893		0.80(1.75)	842.48	650.91	191.57	83.01
J-920		1.37(1.75)	846.77	624.36	222.41	96.38
J-922		1.93(1.75)	837.75	628.00	209.75	90.89
J-930		1.02(1.75)	847.28	627.56	219.72	95.21
J-931		0.57(1.75)	846.22	690.00	156.22	67.69
J-932		0.80(1.75)	840.01	634.91	205.10	88.88
J-933		0.46(1.75)	932.04	799.00	133.04	57.65
J-1082		0.34(1.75)	840.28	744.72	95.56	41.41
J-1097		1.71(1.75)	831.97	687.70	144.27	62.52
J-1099		0.34(1.75)	839.39	758.89	80.51	34.89
J-1103		0.68(1.75)	826.33	635.08	191.24	82.87
J-1117		0.57(1.75)	827.28	621.35	205.93	89.24
J-1118		0.80(1.75)	826.93	626.18	200.75	86.99
J-1137		1.93(1.75)	847.96	636.19	211.76	91.76
J-1138		0.68(1.75)	847.48	635.99	211.49	91.65
J-1141		1.14(1.75)	847.12	645.25	201.87	87.48
J-1143		1.02(1.75)	846.75	624.06	222.69	96.50
J-1121a		0.68(1.75)	841.29	659.83	181.46	78.63
J-1121e		0.34(1.75)	842.39	741.93	100.46	43.53
MM-10		630.04(1.75)	825.10	640.00	185.10	80.21
MM-14		78.86(1.75)	827.91	636.39	191.53	83.00
MM-15		481.25(1.75)	832.13	630.00	202.13	87.59

Node at Horse Cave Tank

Suction Pressure at Pump Station

Discharge Pressure at Pump Discharge

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES	JUNCTION NUMBER	MINIMUM PRESSURES

	psi		psi
J-2	215.66	J-712	-3.64
J-1	215.64	I-H.S. Pump	4.80
O-H.S. Pump	214.84	I-H.S. Pump	4.84
O-H.S. Pump	214.84	I-H.S. Pump	4.84
O-H.S. Pump	214.84	I-H.S. Pump	4.84

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-11	6.51	P-586	0.00
P-34	6.51	P-1302	0.00
P-7	6.51	P-480	0.00
P-33	6.50	P-650	0.00
P-1229	4.95	P-854	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-1229	22.28	P-586	0.00
P-682	13.63	P-1302	0.00
P-11	8.57	P-627	0.00
P-34	8.57	P-1592	0.00
P-7	8.57	P-480	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-1229	22.28	P-586	0.00
P-682	13.63	P-1302	0.00
P-11	8.57	P-627	0.00
P-34	8.57	P-1592	0.00
P-7	8.57	P-480	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
Clearwell	4081.47	
Crailhope T	8.87	
Echo Tank	-69.72	
Hatcher Val	46.85	
Hiseville T	182.86	
Knob Lick T	103.95	
Monroe Tank	23.28	
New Horse C	-607.38	
Northtown T	21.84	
Toohey Ridg	58.24	

NET SYSTEM INFLOW = 4527.35
NET SYSTEM OUTFLOW = -677.10
NET SYSTEM DEMAND = 3850.29

T A N K S T A T U S R E P O R T (time = 20.0000 hours)

TANK NAME (*)	NET FLOW gpm	WATER ELEVATION ft	TANK DEPTH ft	TANK VOLUME gals	TANK VOLUME %	TANK STATUS	PROJECTED DEPTH ft

Crailhope T(2)	-8.87	957.66	5.66	14159.	56.6	DRAINING	5.45
Echo Tank(2)	69.72	1022.69	4.69	11724.	46.9	FILLING	6.36
Hatcher Val(2)	-46.85	1027.41	9.41	56438.	94.1	DRAINING	8.94
Hiseville T(2)	-182.86	867.58	7.58	189554.	75.8	DRAINING	7.14
Knob Lick T(2)	-103.95	911.84	0.84	12022.	8.0	DRAINING	0.40
Monroe Tank(2)	-23.28	868.27	3.27	136223.	54.5	DRAINING	3.24
New Horse C(2)	607.38	839.70	1.70	424105.	42.4	FILLING	1.84
Northtown T(2)	-21.84	940.39	5.39	20475.	53.9	DRAINING	5.04
Toohey Ridg(2)	-58.24	1035.53	7.53	188244.	75.3	DRAINING	7.39

* TANK TYPE: (1) - CONSTANT DIAMETER (2) - VARIABLE AREA

F L O W M E T E R R E P O R T (time = 20.0000 hours)

PIPE NUMBER	METERED FLOW gals
P-538	-2995.2
P-539	-2995.2

C H A N G E S F O R N E X T S I M U L A T I O N (time = 20.0000 hours)

UNIT COST OF POWER FOR THIS SIMULATION PERIOD = 0.100 $/kW-Hr

2 pumps on at 100% Speed

JUNCTION DEMANDS CHANGED - PLEASE SEE RESULTS TABLE

Time: 20.000

TIME FROM INITIATION OF EPS = 20.0000 HOURS (8.00PM, DAY: 1)

RESULTS OBTAINED AFTER 100 TRIALS: ACCURACY = 0.40791E-01

Warning P2K101: Maximum number of trials were executed!
Accuracy was NOT attained. TIME/CASE= 20.0000

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE CV -CHECK VALVE

PIPE NAME	NODE NUMBERS #1	#2	FLOWRATE gpm	HEAD LOSS ft	MINOR LOSS ft	LINE VELO. ft/s	HL+ML/ 1000 ft/f	HL/ 1000 ft/f
P-38	MM-14	MM-15	43.01	0.08	0.00	0.12	0.01	0.01
P-42	O-Bunnell	J-32	56.82	0.57	0.00	2.58	9.33	9.33
P-43	J-29	J-933	55.46	7.65	0.00	2.52	8.92	8.92
P-44	J-30	J-933	-55.00	11.41	0.00	2.50	8.78	8.78
P-46	J-28I-Bunnell		56.82	0.55	0.00	2.58	9.33	9.33
P-47	J-32	J-29	56.37	4.99	0.00	2.56	9.19	9.19
P-48-XXCV	J-28	J-32						
P-607	J-553	J-1099	1342.83	5.73	0.00	3.81	3.82	3.82
P-609	J-554	J-1097	1294.59	12.53	0.00	5.29	8.67	8.67
P-610	J-556	J-557	961.13	4.91	0.00	2.73	2.05	2.05
P-612	J-557	MM-10	781.82	8.42	0.00	2.22	1.40	1.40
P-624	J-568	MM-15	438.24	0.52	0.00	1.24	0.48	0.48
P-625	J-570	J-568	412.79	0.33	0.00	1.17	0.43	0.43
P-993	J-893	J-932	58.07	7.86	0.00	2.64	9.71	9.71
P-1019	J-922	J-1143	-429.06	2.24	0.00	1.22	0.46	0.46
P-1026	J-920	J-1141	141.92	1.70	0.00	0.91	0.43	0.43
P-1027	J-922	J-570	419.62	0.59	0.00	1.19	0.44	0.44
P-1028	J-930	J-1138	137.02	0.80	0.00	0.87	0.40	0.40
P-1029	J-429	J-931	60.12	7.90	0.00	2.73	10.36	10.36
P-1030	J-931	J-893	59.32	11.52	0.00	2.69	10.11	10.11
P-1031	J-932	J-28	57.28	17.46	0.00	2.60	9.47	9.47
P-1232	J-1082	J-1121a	950.88	2.31	0.00	1.52	0.50	0.50
P-1233	J-1082New Horse		-951.22	1.34	0.00	2.70	2.02	2.02
P-1332	J-1097	J-556	1336.58	5.99	0.00	5.46	9.19	9.19
P-1335	J-1099	J-554	1342.49	2.04	0.00	5.48	9.27	9.27
P-1338	MM-10	J-559	124.27	0.04	0.00	0.35	0.05	0.05
P-1339	J-559	J-1103	124.27	0.21	0.00	0.35	0.05	0.05
P-1357	J-1103	J-1118	123.24	0.12	0.00	0.35	0.05	0.05
P-1358	J-1117	MM-14	121.88	0.12	0.00	0.35	0.04	0.04
P-1359	J-1118	J-1117	122.45	0.07	0.00	0.35	0.05	0.05
P-1364	J-1121a	J-1121e	950.19	2.52	0.00	1.52	0.50	0.50
P-1365	J-1121e	J-553	1601.32	0.14	0.00	2.56	1.30	1.30
P-1393	J-1137	J-429	134.41	3.15	0.00	1.53	1.57	1.57
P-1394	J-1138	J-1137	136.34	1.84	0.00	1.55	1.61	1.61
P-1400	J-1141	J-930	140.78	0.76	0.00	0.90	0.42	0.42
P-1402	J-920	J-1143	-123.73	0.04	0.00	0.79	0.33	0.33

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

P-22	P-27	P-30	P-45	P-530
P-535	P-568	P-967	P-1065	P-1092
P-1254	P-1304	P-1360	P-1434	

P U M P/L O S S E L E M E N T R E S U L T S

NAME	FLOWRATE gpm	INLET HEAD ft	OUTLET HEAD ft	PUMP HEAD ft	EFFIC- ENCY %	USEFUL POWER Hp	INCREMTL COST $	TOTAL COST $	#PUMPS PARALLEL	#PUMPS SERIES	NPSH Avail. ft	Time hrs
Bunnell Cr	56.82	57.19	261.50	204.3	38.40	3.	0.2	12.7	2	**	90.3	20.0000
Canmer Pum	215.28	100.00	228.64	128.6	75.00	7.	0.3	15.2	**	**	133.1	20.0000
H.S. Pump	1125.99	11.72	363.08	351.4	75.00	100.	3.8	217.5	**	**	44.9	20.0000
H.S. Pump	1125.99	11.72	363.08	351.4	75.00	100.	3.8	217.5	**	**	44.9	20.0000
Warning P2K107:Device	Hatcher Val is operating out of range.											
Hatcher Va	62.35	121.51	357.61	0.0	12.32	4.	6439.7	34396.3	**	**	154.7	20.0000
Hiseville	184.28	40.92	191.21	150.3	80.00	7.	0.2	1.8	**	**	74.1	20.0000
Warning P2K107:Device	Nelson Road is operating out of range.											
Nelson Roa	2.96	164.32	336.17	0.0	52.18	0.	0.0	0.2	**	**	197.5	20.0000
Wisdom Pum	107.31	79.21	263.55	184.3	75.00	5.	0.2	1.8	**	**	112.3	20.0000

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

FOLLOWING ADDITIONAL PIPES ARE CLOSED :

N O D E R E S U L T S

NODE NAME	NODE TITLE	EXTERNAL DEMAND gpm	HYDRAULIC GRADE ft	NODE ELEVATION ft	PRESSURE HEAD ft	NODE PRESSURE psi
O-Bunnell		0.00	948.50	687.00	261.50	113.31
New Horse		----	840.32	805.00	35.32	15.31
J-28		0.46(1.75)	744.74	687.00	57.74	25.02
J-29		0.91(1.75)	942.93	737.00	205.93	89.24
J-30		55.00	923.87	685.00	238.87	103.51
J-32		0.46(1.75)	947.92	687.00	260.92	113.07
J-429		2.84(1.75)	789.15	640.00	149.15	64.63
J-553		0.68(1.75)	834.02	740.00	94.02	40.74
J-554		1.37(1.75)	826.25	750.21	76.04	32.95
J-556		1.14(1.75)	807.73	676.00	131.73	57.08
J-557		2.39(1.75)	802.82	696.00	106.82	46.29
J-559		0.00	794.36	639.64	154.72	67.05
J-568		0.80(1.75)	794.29	630.00	164.29	71.19
J-570		1.93(1.75)	794.62	630.00	164.62	71.34
J-893		0.80(1.75)	769.72	650.91	118.82	51.49
J-920		1.37(1.75)	797.41	624.36	173.06	74.99
J-922		1.93(1.75)	795.21	628.00	167.21	72.46
J-930		1.02(1.75)	794.95	627.56	167.39	72.53
J-931		0.57(1.75)	781.25	690.00	91.25	39.54
J-932		0.80(1.75)	761.86	634.91	126.96	55.01
J-933		0.46(1.75)	935.28	799.00	136.28	59.05
J-1082		0.34(1.75)	838.99	744.72	94.27	40.85
J-1097		1.71(1.75)	813.72	687.70	126.02	54.61
J-1099		0.34(1.75)	828.29	758.89	69.40	30.07
J-1103		0.68(1.75)	794.15	635.08	159.06	68.93
J-1117		0.57(1.75)	793.95	621.35	172.60	74.80
J-1118		0.80(1.75)	794.02	626.18	167.84	72.73
J-1137		1.93(1.75)	792.30	636.19	156.11	67.65
J-1138		0.68(1.75)	794.15	635.99	158.16	68.53
J-1141		1.14(1.75)	795.71	645.25	150.46	65.20
J-1143		1.02(1.75)	797.45	624.06	173.39	75.14
J-1121a		0.68(1.75)	836.68	659.83	176.85	76.63
J-1121e		0.34(1.75)	834.16	741.93	92.23	39.97
MM-10		630.04(1.75)	794.40	640.00	154.40	66.91
MM-14		78.86(1.75)	793.84	636.39	157.46	68.23
MM-15		481.25(1.75)	793.77	630.00	163.77	70.97

Node at Horse Cave Tank

Suction Pressure at Pump Station

Discharge Pressure at Pump Station

M A X I M U M A N D M I N I M U M V A L U E S

P R E S S U R E S

JUNCTION NUMBER	MAXIMUM PRESSURES psi	JUNCTION NUMBER	MINIMUM PRESSURES psi
J-529	173.24	J-712	-3.73
J-2	159.20	New Yogi Bea	-1.12
J-1	159.19	J-1055	-0.68
O-H.S. Pump	157.34	I-H.S. Pump	5.08
O-H.S. Pump	157.34	I-H.S. Pump	5.08

V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
P-1335	5.48	P-586	0.00
P-1332	5.46	P-480	0.00
P-609	5.29	P-650	0.00
P-1229	4.70	P-854	0.00
P-607	3.81	P-1317	0.00

H L + M L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL+ML/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL+ML/1000 (ft/ft)
P-1229	20.31	P-586	0.00
P-682	13.61	P-627	0.00
P-1029	10.36	P-1592	0.00
P-1030	10.11	P-480	0.00
P-993	9.71	P-650	0.00

H L / 1 0 0 0

PIPE NUMBER	MAXIMUM HL/1000 (ft/ft)	PIPE NUMBER	MINIMUM HL/1000 (ft/ft)
P-1229	20.31	P-586	0.00
P-682	13.61	P-627	0.00
P-1029	10.36	P-1592	0.00
P-1030	10.11	P-480	0.00
P-993	9.71	P-650	0.00

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM SUPPLY NODES
(-) OUTFLOWS FROM THE SYSTEM INTO SUPPLY NODES

NODE NAME	FLOWRATE gpm	NODE TITLE
Clearwell	2251.98	
Crailhope T	8.87	
Echo Tank	-69.66	
Hatcher Val	-15.89	
Hiseville T	291.08	
Knob Lick T	113.69	
Monroe Tank	266.75	
New Horse C	951.22	
Northtown T	21.84	
Toohey Ridg	58.24	

NET SYSTEM INFLOW = 3963.67
NET SYSTEM OUTFLOW = -85.55
NET SYSTEM DEMAND = 3877.29

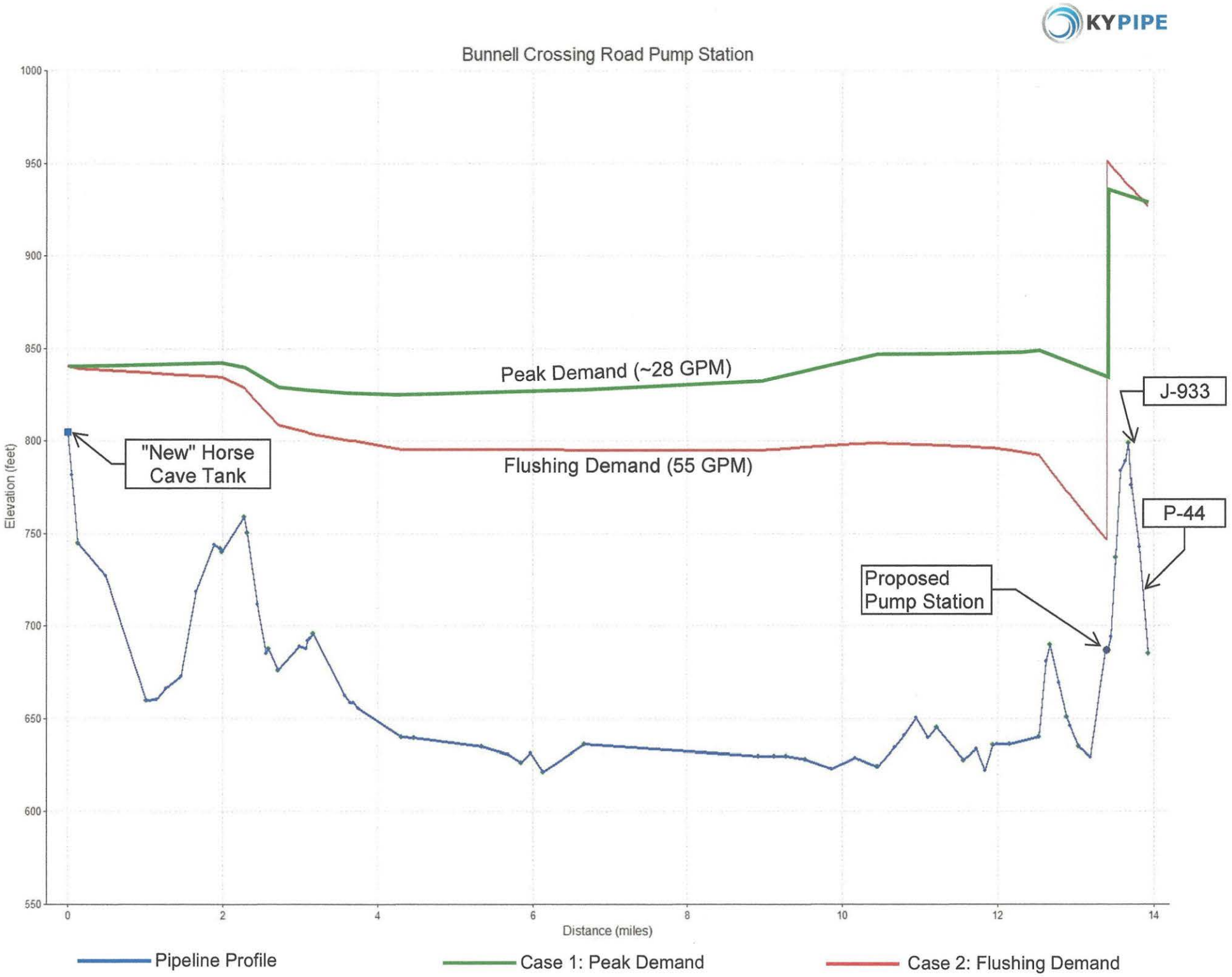
T A N K S T A T U S R E P O R T (time = 20.0000 hours)

TANK NAME (*)	NET FLOW gpm	WATER ELEVATION ft	TANK DEPTH ft	TANK VOLUME gals	TANK VOLUME %	TANK STATUS	PROJECTED DEPTH ft
Crailhope T(2)	-8.87	957.66	5.66	14159.	56.6	DRAINING	5.45
Echo Tank(2)	69.66	1022.69	4.69	11735.	46.9	FILLING	6.37
Hatcher Val(2)	15.89	1027.18	9.18	55105.	91.8	FILLING	9.34
Hiseville T(2)	-291.08	866.50	6.50	162551.	65.0	DRAINING	5.80
Knob Lick T(2)	-113.69	911.83	0.83	11814.	7.9	DRAINING	0.35
Monroe Tank(2)	-266.75	868.04	3.04	126836.	50.7	DRAINING	2.66
New Horse C(2)	-951.22	840.32	2.32	580379.	58.0	DRAINING	2.09
Northtown T(2)	-21.84	940.39	5.39	20476.	53.9	DRAINING	5.04
Toohey Ridg(2)	-58.24	1035.53	7.53	188246.	75.3	DRAINING	7.39

* TANK TYPE: (1) - CONSTANT DIAMETER (2) - VARIABLE AREA

F L O W M E T E R R E P O R T (time = 20.0000 hours)

PIPE NUMBER	METERED FLOW gals
P-538	-2995.2
P-539	-2995.2


KYPIPE
Bunnell Crossing Road Pump Station
Elevation (feet)
1000
950
900
850
800
750
700
650
600
550
0
2
4
6
8
10
12
14
Distance (miles)
Peak Demand (~28 GPM)
Flushing Demand (55 GPM)
"New" Horse Cave Tank
J-933
P-44
Proposed Pump Station
Pipeline Profile
Case 1: Peak Demand
Case 2: Flushing Demand

ATTACHMENT 2D

ENGINEERING PLANS
(FILED SEPARATELY)

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

TRACY KAY SANDERS	)	
	)	
COMPLAINANT	)	
	)	
v.	)	**CASE NO. 2019-00375**
	)	
GREEN RIVER VALLEY WATER DISTRICT	)	
	)	
DEFENDANT	)	

MOTION FOR DEVIATION FROM 807 KAR 5:001, SECTION 4(8)(d)

Pursuant to 807 KAR 5:001, Green River Valley Water District ("Green River District") moves for a deviation from 807 KAR 5:001, Section 4(8)(d) to permit the service of its Response to Commission Staff's First Request for Information upon Complainant without Attachment 2D. In support of its Motion, Green River District states:

1. On September 2, 2020 Commission Staff issued its First Request for Information to Green River District. Question 6 of this Request sought a copy of Green River District's application to the Kentucky Division of Water for approval of the construction and installation of a booster pumping station that would serve the Bunnell Crossing Road area.

2. At part of its response to Question 6, Green River District is submitting the engineering plans for the proposed booster station (Attachment 2D). These plans consist of five pages, each of which is 36 inches in length and 24 inches in width. Pursuant to the instructions set forth in Commission Staff's Request, these plans will be submitted electronically to the Commission.

3. As the use of electronic filing procedures has not been ordered for this proceeding and as Complainant did not indicate an electronic mail address on his complaint, 807 KAR 5:001, Section 4(8)(d) requires a paper copy of the engineering plans be served upon the Complainant.

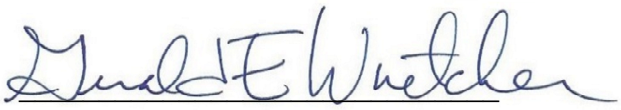
3. Providing Complainant with a paper copy of the engineering plans is unnecessary. These plans will be available to the Complainant through the Commission's website shortly after their filing and can be easily accessed and viewed by the Complainant. When serving a copy of its Response upon the Complainant, Green River District will provide directions as to the Complainant on how to access the engineering plans.

4. Printing and mailing a copy of these plans will result in unnecessary expense to Green River District.

WHEREFORE, Green River District requests that the Commission permit it to deviate from 807 KAR 5:001, Section 4(8)(d) and serve a copy of its Response upon Complainant without Attachment 2D.

Dated: September 15, 2020

Respectfully submitted,



Patrick A. Ross
hrh@scrtc.com
Hensley & Ross Attorneys
P.O. Box 350
Horse Cave, Kentucky 42749
Telephone: (270) 786-2155
Fax: (270) 786-2118

Gerald E. Wuetcher
gerald.wuetcher@skofirm.com
Stoll Keenon Ogden PLLC
300 West Vine St. Suite 2100
Lexington, Kentucky 40507-1801
Telephone: (859) 231-3000
Fax: (859) 259-3517

Counsel for Green River Valley Water District

CERTIFICATE OF SERVICE

In accordance with 807 KAR 5:001, Section 6, I certify that a true and accurate copy of this Motion was served by U.S. Mail, postage prepaid, on Tracy Kay Sanders, 1134 Bunnell Crossing Road, Munfordville, Kentucky 42765 on September 15, 2020.

Counsel for Green River Valley Water District