

## **WORK ITEM 716-1 – H.D.P.E. WATER SUPPLY PIPE AND APPURTENANCES**

### **DESCRIPTION**

The work shall include the furnishing and installation of all materials, labor and equipment necessary to complete the H.D.P.E. water supply piping where shown on the Plans. The work shall be completed by trenchless excavation/horizontal directional drilling per the Plans and these Specifications, including all verification of existing utilities, dewatering, excavation and backfill included in this section.

In these Specifications, references are made to the Standard Specifications for the American Society of Testing and Materials (ASTM), American Water Works Association (AWWA), and/or the American National Standards Institute (ANSI). Where such references occur, the standard in effect at the date of the bid opening will apply.

### **MATERIALS**

All materials shall conform to the applicable requirements of Sections 715 and 716 and as indicated below.

High Density Polyethylene (H.D.P.E.) Pipe: The H.D.P.E. water supply pipe shall be 8-inch (DIPS), DR 11 as shown on the plans.

Materials used for the manufacture of polyethylene pipe and fittings conform to AWWA C-906 and NSF Standard 61 and shall be PE3408 high density polyethylene for pressure pipe meeting cell classification PE345464C per ASTM D 3350; and, shall be listed in the name of the pipe and fitting Manufacturer in Plastics Pipe Institute (PPI) TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade HDB rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meets these requirements. Permanent identification of the pipe shall be provided by co-extruding color stripes into the pipe outside surface. The striping material shall be the same material as the pipe material except for color. Stripes printed on the pipe outside surface shall not be accepted. DIPS pipe shall have three equally spaced pairs of longitudinal color stripes. The stripe color shall be blue.

Polyethylene pipe shall be manufactured in accordance with ASTM F 714-97, Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, and shall be so marked. Each production lot of pipe shall be tested for (from material or pipe) melt index, density, % carbon, (from pipe) dimensions and ring tensile strength.

The Contractor shall submit Manufacturer's Certificate of Compliance certifying compliance with the referenced specifications and standards and certified copies of reports of factory tests specified in this section and required by the referenced standards.

Heat Fusion Joining: Joints between plain end pipes and fittings shall be made by butt fusion (ASTM D3261-03) using only procedures that are recommended by pipe and fitting manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed. Socket fusion shall not be used. Electrofusion joints will be allowed, as approved by the Engineer, in areas which are difficult to access.

H.D.P.E. Fittings: H.D.P.E. fittings, as required, shall conform to the same manufacture and material requirements as listed for the H.D.P.E. pipe. The electrofusion fittings and couplings shall meet the requirements of ASTM D3350-02 and ASTM F1055 and be of the same resin type as the pipe.

H.D.P.E. Mechanical Joint Adaptors with Kits: H.D.P.E. Mechanical Joint Adaptors with Kits shall be used to connect the H.D.P.E. water main river crossing pipe to D.I. fittings or D.I. pipe. Instead of mechanical joint adapters, the combination of a mechanical joint restrainer and pipe stiffener may be used. Stainless steel pipe stiffeners shall be used for insertion into the H.D.P.E. pipe for support at each mechanical joint. The stiffeners shall be constructed of 304 stainless steel and be 12-inches wide with a diameter sized appropriately for the respective water main river crossing pipe.

Tracer Wire: All HDPE pipe shall be installed with stainless steel tracer wire, Stranded SS/45 MIL HDPE, 30 Volt, meeting the following requirements:

Wire:

Material: 302 Stainless Steel Alloy, 49 strands, annealed.  
Rating: 30 Volts maximum. 1,700 lb. yield.  
Thickness: 0.125-inch overall diameter  
(Dimensionally equivalent to AWG8).

Insulating Jacket:

Material: High Molecular Weight, High Density Polyethylene (HMW-HDPE) to be repeated at a minimum interval of every two (2) linear feet.  
Thickness: 0.045-inch maximum (45 mil.)  
Rating: 30 Volts maximum.  
Label  
(Minimum required): "Pipe Tracer Wire, Stranded SS/45 MIL HMW-HDPE, 30 Volt, HDD Direct Burial Use Only".  
Color: Blue

The tracer wire for the water supply pipe shall be attached to the pipe and shall terminate at each valve box structure. The tracer wire shall be attached at the surface to the outside of each valve box to allow for reliable connection of the tracing equipment. Wire at each valve box structure shall be tag labeled identifying its purpose. Testing for conductivity shall be performed on each section of tracer wire, immediately following installation and prior to final project acceptance.

**CONSTRUCTION METHODS**

H.D.P.E. Pipe:

When planning the procedures for the directional drilled H.D.P.E. water supply pipe installation, the Contractor must comply with all permit and bonding requirements. The Contractor shall prepare and submit a Plan of Operation for the Engineer's approval. This plan should show the exact procedures the Contractor intends to use in accomplishing the work (including calibration of the transmitter/receiver, the horizontal and vertical tracking/plotting of the pilot bore alignment, and handling and disposal of drilling fluids), and shall show any special activities, and other features of the proposed work. He shall submit a listing of such subcontractors he intends to use, major directional drilling equipment to be used, and any special equipment, including barges, pontoons, etc., or other equipment.

The H.D.P.E. water supply piping in the locations shown on the Plans shall be installed using trenchless excavation/horizontal directional boring methods. Spot section open cut excavation for installation of fittings and short segments of water supply pipe will be allowed and shall conform to the H.D.P.E. pipe manufacturer's trench details and as directed by the Engineer.

All excavations and trenches shall be properly sloped or braced to furnish and provide proper and safe working conditions for the equipment and workmen in accordance with IOSHA requirements as set forth in Indiana Code IC-22-8-4, Section 238. The costs to comply with IOSHA shall be included in the prices for the installed water main facility.

The Contractor shall provide sheeting to protect adjacent structures when the work is close to existing structures or facilities.

When running sand is encountered, tight sheeting, well points, or both, shall be used to control the excavation.

It shall be the responsibility of the Contractor to provide proper materials, bracing and working conditions for and during construction.

Select excavated material shall be used for backfill. If the native material is not granular and is unsuitable for backfilling, Structure Backfill shall be installed around the pipe in the manner described above. Structure Backfill must be approved by the Engineer.

Contractor shall install and maintain filter fabric in any existing storm inlets prior to beginning any excavation (open-cut or spot). Fabric shall be removed at project closeout.

The Contractor shall submit details of equipment and written procedure with working drawings describing in detail the proposed boring method and the entire operation to be used. Completion and review of details and procedures by Engineer and Owner will be a condition of Notice to Proceed authorization.

Contractor shall verify the locations of all utilities and structures prior to any boring. Vacuum excavation or hand excavation shall be used to spot verify locations of existing utilities to minimize disturbance to surrounding facilities. These utilities and structures include:

1. Underground utilities such as, but not limited to:
  - a. Storm Drains
  - b. Electric Cables
  - c. Water Mains
  - d. Sewer Lines and Septic Systems
  - e. Gas Lines
  - f. Telephone Lines
  - g. Fiber Optic Lines
  - h. Cable Television Lines
  - i. Wells
  - j. Field Drain Tiles

2. Above-ground utilities and other obstructions such as, but not limited to:
  - a. Electric and Telephone Poles
  - b. Buildings
  - c. Trees
  - d. Existing Road Signs
  - e. Right-of-way Markers

Before installing any pipe, the pipe shall be inspected for defects. Damaged or unsound pipe shall immediately be removed from the site.

A minimum separation distance of 10-feet horizontally and 18-inches vertically shall be maintained between the proposed water supply pipe and any existing sanitary and storm sewers. If these separation distances cannot be maintained then the Contractor shall follow the requirements of 327 IAC 3-6-9.

The directional drilling system to be used shall have the following features:

1. The system shall be remotely steerable and permit electronic monitoring of bore/tunnel depth and location. The system shall be able to control the depth and direction of the pipes and must be accurate to a tolerance of  $\pm 6$  inches.
2. The Contractor shall track and plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30-feet over the course of the entire horizontal directionally drilled pipe installation. The Contractor shall, at all times, provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow pressure. The Contractor shall grant the Engineer access to all data and readouts pertaining to the position of the bore head and the fluid pressures and flows and shall provide the Engineer a copy of this data each day during the horizontal drilling operation.

The pipe installed by the horizontal directional drilling method shall be located in plan as shown in the drawings and shall be no shallower than as shown on the drawings unless otherwise approved. The minimum depth of cover shall be as shown on the plans and the maximum depth of cover shall be as shown on the plans, unless approved by the engineer to avoid a conflict with existing utilities.

The locating system shall, at a minimum, consist of an electronic transmitter (sonde) positioned at the drill head and a receiver which displays the signal strength. The transmitter shall also employ a pitch (inclination) and roll sensor.

3. The Contractor shall calibrate the transmitter and receiver system per the manufacturer's specifications for signal strength and verify depth accuracy with a tape measure. The Contractor shall also check other parameters such as pitch, roll, battery life and temperature according to the manufacturer's specifications. Calibration shall be conducted in an area which is clear of possible interference sources. The Contractor shall submit to the Engineer a copy of the calibration and field check records prior to beginning installation.

After calibration of the transmitter and receiver system, the Contractor shall walk the bore path to the extent allowable with the receiver "on" and the transmitter "off" in order to check for signal interference. The Contractor shall record the location and particulars of any unusual interference readings and take adequate measures to ensure a proper installation.

4. A swivel type apparatus shall be used to connect the water supply pipe to the drill pipe to prevent torsional stresses from occurring in the pipe during installation.
5. The system shall utilize a fluid cutting process, using liquid clay such as bentonite. This clay shall be totally inert and contain no risk to the environment. The Contractor shall submit to the Engineer a Drilling Fluid Plan which details types of drilling fluids, cleaning and recycling equipment, estimated drilling fluid flow rates, and procedures for minimizing drilling fluid escape. This Drilling Fluid Plan shall be submitted to the Engineer before starting the horizontal directional drilling installation process.
6. The liquid clay shall remain in the bore hole/tunnel to increase the stability of the bore hole/tunnel and to provide a lubricant to reduce frictional drag when the pipe is installed.
7. The H.D.P.E. Pipe shall be filled with a fluid during pullback to offset buoyancy.
8. Immediately after installation of the H.D.P.E. Pipe, the pipe shall be filled with clean water from the new well to offset buoyancy.
9. Drilling fluids shall not be discharged into sanitary sewers, storm sewers, or waterways.. Pits shall be constructed at the pipe entry and exit points to completely contain the drilling fluid and prevent its escape into waterways.
10. The spoils shall be recovered by use of a vacuum system mounted on a vehicle for removal of the spoils. Spoils are not to be discharged into sewers, storm drains, or waterways. The Contractor is responsible for disposal of all spoil material.
11. Equipment shall be fitted with a permanent alarm system capable of detecting an electrical current. The system will have an audible alarm to warn the operator when the drill head nears electrified cables within a safe operating distance. Refer to "Safety" for additional safety requirements.

## **EXPERIENCE**

1. The Contractor shall demonstrate experience and expertise in trenchless excavation methods by providing a list of four references for which similar work has been performed prior to commencing any work. These references shall include a name and telephone number for contact so Owner/Engineer may verify the claims.
2. The Contractor (Contractor, drilling sub-contractor and supervisory personnel) shall also provide documentation showing successful completion of at least:
  - 50,000 linear feet minimum of Horizontal Directional Drilled Pipe, of which a minimum of 20,000 linear feet of pipe shall be have an outside diameter of 6.0-inches or greater.
  - Minimum of three River/Stream Crossings with pipes having an outside diameter of 6.0-inches or greater with a minimum crossing length of 75-feet for each crossing.

3. Contractor shall be responsible for means and methods and shall utilize equipment sized adequately to install the proposed water main to the elevations shown on the plans.
4. All supervisory personnel shall be adequately trained and shall have at least four years experience in horizontal directional drilling. The Contractor shall also submit the names and resumes of all supervisory field personnel for review by the Engineer prior to commencing any work.
5. The Contractor shall submit a listing of such subcontractors he intends to use, major directional drilling equipment to be used, and any special equipment.
6. The Contractor's Bid shall include completion of the Experience, Equipment and Plan of Operation Form included with the Bid Forms.

### **SAFETY**

1. Mechanical, pneumatic or water-jetting methods shall not be acceptable due to the risk of surface subsidence and damage.
2. Upon completion of boring and pipe installation, the Contractor shall remove all spoils from all starting and termination pits. The pits shall be restored to their original condition.
3. Because directional boring may be performed while existing buried electrical cable is energized, the following minimum safety requirements shall be met:
  - a. All drilling equipment must have a permanent, inherent alarm system capable of detecting an electrical current. The ground system shall be equipped with an audible alarm to warn the operator when the drill head nears electrified cable within a safe operating distance.
  - b. All crews shall be provided with grounded safety mats, heavy gauge ground cables with connectors, hot boots and gloves.
  - c. All supervisory personnel shall be adequately trained and have experience in directional boring. See above.

### **TESTING**

Butt Fusion Testing: Butt fusion testing shall be conducted at least once every day that butt fusions are made. The first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely to ambient temperature, and then fusion test straps shall be cut out per ASTM D 2657. The test strap shall be 12-inch minimum or 30 times the wall thickness in length with the fusion in the center and 1-inch minimum or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

Pressure Testing: Pressure testing of the H.D.P.E. water supply pipe shall be conducted at 150 psi,  $\pm 5$  psi hydrostatic pressure for at least two hours according to ASTM F 2164 and Technical Note 802 – Leak Testing, July 2006, from Performance Pipe and per the manufacturer’s recommendations. A copy of Technical Note 802 may be obtained at [www.performancepipe.com](http://www.performancepipe.com). Pressure testing shall be hydrostatic only. Pneumatic pressure testing shall not be used.

Test Duration: The maximum test duration is eight (8) hours including time to pressurize the pipe, time for initial expansion, time for the test at test pressure, and time to depressurize the segment of pipe being tested. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow for it to relax for at least eight (8) hours before pressurizing the test section again. The hydrostatic test as described in Technical Note 802 is summarized as follows:

Pipe Segment Filling: Fill the test section completely with water from the lowest possible point. Ensure that there is no air trapped in the test section by utilizing vents to expel the air.

Initial Expansion: Gradually pressurize the test section to test pressure and maintain test pressure for three (3) hours. During the initial expansion phase polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. The water added during this phase will not be monitored.

Testing: Immediately following the initial expansion phase, monitor the amount of make-up water required to maintain test pressure (150 psi) for two (2) hours. The test pressure shall be measured at the lowest possible point in the section being tested. The amount of make-up water required shall not exceed the allowance shown in Table 2, Technical Note 802 which is summarized below:

8-inch H.D.P.E. Pressure Main Leakage Allowance = 1.0 gal/100 Ft. of Pipe

Lines or joints, which leak, shall be repaired and retested. All pipes, fittings and other materials found to be defective under test shall be removed and replaced by the Contractor at his own expense.

Depressurizing: At the conclusion of the test, slowly and carefully depressurize the test section by the controlled release of the test liquid.

The pump connections, fittings and all necessary labor and materials for conducting the tests, shall be furnished by the Contractor and included in the price for the appropriate item. The Contractor shall provide and pay for all water as required to conduct the hydrostatic testing.

The water supply pipe shall not have to be disinfected prior to placing in service since it will not be used to supply potable water.

All H.D.P.E. pipe pressure testing shall be witnessed and certified by a Professional Engineer, registered in the State of Indiana. The Contractor shall contact the Owner a minimum of 48-hours in advance of testing to allow a representative to witness the testing. The results of the H.D.P.E. Pipe Pressure Test shall be certified by a Professional Engineer, Registered in the State of Indiana who is not an employee of the Owner or Engineer. A copy of the test results shall be forwarded to both the Owner and the Engineer.

**WORK ITEM 716-2 – STEEL CASING PIPE - BORE AND JACK**

**DESCRIPTION**

The Contractor shall provide all materials, equipment and labor necessary to complete the 18- inch Steel Casing Pipe installation, jacked and bored under State Road 327 as shown on the Plans and as directed by the Engineer.

**MATERIALS**

All materials shall conform to the applicable requirements of Section 716.

**CONSTRUCTION REQUIREMENTS**

Construction shall conform to the applicable requirements of Section 716.

## **WORK ITEM 900-1 – VIDEO AND PHOTO RECORD**

### **DESCRIPTION**

The Contractor shall furnish all necessary equipment, labor and material required to videotape the project area and to complete a photo record of the project area to verify existing conditions prior to construction.

### **MATERIALS**

As required.

### **CONSTRUCTION REQUIREMENTS**

The Contractor will be required to submit a color video recording of the entire project area to clearly show all features located within and adjacent to the project site, prior to the start of construction. The video shall indicate the time and date of the recording.

Site photographs shall be provided as necessary to clearly show all existing features of the pre-project work site. Photographs shall be taken in sufficient lighting to provide high quality details. Each photo shall indicate the date it was taken and be provided in digital format.

Two digital copies (DVD's) of both the video and photographs shall be forwarded to the Engineer for review prior to beginning construction. All DVD's shall be labeled showing the Owner's name, project name and the name of the Contractor.

## **WORK ITEM E-1 – ELECTRICAL/MECHANICAL**

### **DESCRIPTION**

This work shall consist of furnishing materials, installation, and all necessary incidentals associated with the electrical power and control components of this work in accordance with this special provision and in reasonably close conformance with the lines, grades, and locations shown on the plans.

Also, the interconnecting electrical wiring, incoming power supply, and other features regularly and normally required as a part of the complete system shall be in accordance with the National Electrical Code and the National Electrical Safety Code. All work shall be done in accordance with site requirements, plans, manufacturer's recommendations.

### **1. BASIC ELECTRICAL REQUIREMENTS**

#### **GENERAL**

#### RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

#### DESCRIPTION OF WORK

The Basic Electrical Requirements apply to all electrical materials, equipment, installations, and services supplied under any portion of the work.

The Contractor shall coordinate the Basic Electrical Requirements as applicable to any equipment, installations, and services of an electrical nature.

It is the intention of this Division of the Specifications and the accompanying drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and successful operation all equipment, materials, devices and necessary appurtenances to provide a complete electrical system, together with such other miscellaneous installations and equipment hereinafter specified and/or shown on the plans. The work shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the plans, but which are necessary to make a complete working installation of all electrical systems shown on the plans or described herein. Equipment and devices furnished and installed under other Divisions of this specification (or by Owner) shall be connected under this Division. The drawings and specifications are complementary and what is called for in either is binding as if called for in both.

The contract drawings indicate the extent and the general location and arrangement of equipment, conduit and wiring. The contractor shall study plans and details and shall cooperate with all other trades to prevent conflict and interference as to space requirements. Fixtures, equipment and outlets shall be located to avoid interference with mechanical or structural features. Lighting fixtures shall be symmetrically located according to the room arrangement. Raceways, junction and outlet boxes, lighting fixtures, and all other electrical equipment shall be properly supported to comply with applicable codes and good work practice.

Electrical Contractor is responsible for installation of a complete and operating electrical system in accordance with the intent of the drawings and specifications.

The scale of drawings cannot show all necessary transitions, offsets, changes in direction, etc. It shall be the responsibility of the Electrical Contractor to provide all pull boxes, elbows, fittings, supports, etc. necessary to install his work to conform to structures, to preserve head room and to keep openings and passageways clear.

Electrical diagrams are schematic and diagrammatic only, not necessarily to scale, and do not necessarily show physical arrangement of equipment. Electrical diagrams and plans are complementary and what is shown on either is same as if shown on both.

The horsepower of motors and equipment wattages indicated on the plans are based on information made available to Engineer and field notes of existing installation, and are as accurate as practical. However, there may be discrepancies. All wiring, switches, circuit breakers, and magnetic motor starters shall be of sizes and capacities to suit the horsepower of the motors and equipment actually furnished and actually being connected. However, in no case shall wiring, switches, circuit breakers and magnetic motor starters be of smaller capacities or sizes than those indicated on the drawings or specified unless approved by the Engineer.

Any minor changes in the location of all equipment, switchboards, panelboards, starters, fixtures, conduits, outlets, etc. from those shown on the plans shall be made without extra charge if so directed by the Engineer or Owner before installation.

Minor changes in location shall be defined as within 10 feet in any direction, horizontally or vertically, from the location indicated on the drawings.

#### PERMITS AND FEES

This work shall include the procurement of and payment for all permits and fees for the performance of the electrical work.

#### COORDINATION OF ELECTRICAL WORK

Contract documents are diagrammatic in showing certain physical relationships which must be established; such establishment and the final physical relationship is the exclusive responsibility of the Contractor.

Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of structures, maximize overhead clearance.

Locate operating and control equipment and arrange entire electrical work with adequate access for operation and maintenance.

Advise other trades of openings required in their work, and scheduling cooperation required, for the subsequent move-in of large units of electrical work (equipment, conduits, pull boxes, etc.).

## COORDINATION OF OPTION, SUBSTITUTIONS, AND ARRANGEMENT

Where the contract documents permit the selection from several product options, and where it becomes necessary to authorize a substitution, do not proceed with purchasing until coordination of interface requirements has been checked and satisfactorily established.

The Contractor will not be paid for cutting, patching, retrofitting, and finishing required for relocation of work installed due to interference and improperly located equipment.

## QUALITY ASSURANCE

In case of difference between building codes, state laws and federal laws, local ordinances, industry standards and utility regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.

## NON-COMPLIANCE

Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state and federal laws, local ordinances, industry standards and utility regulations, he shall bear all costs in correcting all deficiencies.

Applicable codes and standards shall include all the state laws, local ordinances, utility company regulations and the applicable requirements of the following nationally accepted codes and standards. All of the following codes shall apply to the equipment, and equipment installation, where applicable. All equipment shall bear U.L. labels where labeled equipment is available.

## INDUSTRY STANDARDS, CODES AND SPECIFICATIONS

- |                 |   |
|-----------------|---|
| A. NEC          | National Electric Code (NFPA No. 70).                                   |
| B. UBC          | Uniform Building Code - International Conference of Building Officials. |
| C. ANSI C2      | National Electrical Safety Code.  |
| D. IEEE         | Institute of Electrical and Electronics Engineers.                      |
| E. ASTM         | American Society of Testing Materials.                                  |
| F. IPCEA        | Insulated Power Cable Engineers Association.                            |
| G. NEMA         | National Electrical Manufacturers Association.                          |
| H. NFPA         | National Fire Protection Association.                                   |
| I. UL           | Underwriters Laboratories.  |
| J. NECA         | Standard of Installation, National Electrical Contractor's Association. |
| K. NFPA No. 101 | Life Safety Code.   |

L. FM                      Factory Mutual

M. ADA                     Americans with Disabilities Act.

All electric materials shall be new, in original cartons, bundles, or shipping crates and shall have U.L. label whenever available.

Nothing in these drawings and specifications shall be construed to permit work not conforming with governing codes. Also, this shall not be construed as relieving the Contractor from complying with any requirements of the plans or specifications which may exceed requirements of the hereinbefore mentioned governing codes and rules and not contrary to same.

#### MANUFACTURERS

Firms regularly engaged in the manufacture of the equipment specified of the types and capacities required, whose products have been in satisfactory use in similar service for not less than 3 years, unless specified otherwise.

#### INSTALLERS

A firm with at least 3 years of successful installation experience on projects with electrical installation work similar to that required for the project, unless specified otherwise.

#### SUBMITTALS

General: Provide submittals of shop drawings and descriptive data for selected all electrical power, control, lighting, and similar items, and obtain Engineer's approval of same prior to proceeding with work.

Submittals shall comply with the following:

- A. Include complete catalog information such as construction, ratings, and insulating systems, as applicable.
- B. For any material specified to meet U.L. or trade standards, furnish manufacturer's or vendor's certification that material furnished for work does in fact equal or exceed Specifications.
- C. Shop drawings shall be submitted in complete groups of material (i.e., all lighting fixtures or all switchgear, etc.), and each item of material submitted shall have Contractor's stamp and be initialed by Contractor as verification that submittal has been reviewed in detail and is in fact Contractor's choice of materials. Bind catalog cuts, descriptive bulletins and drawings 11" x 17" or smaller in sets with covers showing titles. Contractor shall verify dimensions of equipment and be satisfied as to code compliance for fit prior to submitting shop drawings for approval. Departure from above procedure will result in resubmittal and delays. Include all information required by Specifications.

## O&M MANUALS

Submit three sets of Operation and Maintenance Manuals. Refer to General Conditions.

## WARRANTIES

All new equipment shall have a warranty in accordance with General Conditions of the project.

## 2. IDENTIFICATION AND SIGNAGE

### GENERAL

#### INDUSTRY STANDARDS

Current editions of publications of the following institutes, are referred to in this section.

American National Standards Institutes, ANSI.

### PRODUCTS

Nameplates shall be of white engraved plastic laminate. Letters shall be black and a minimum of 3/16" high.

Wire/cable tags shall be self-adhesive wrap-around vinyl cloth; Brady or equal.

### EXECUTION

#### NAMEPLATES

Provide engraved laminate nameplates on all of the following devices listing the equipment name, equipment controlled or served and the circuit number.

- A. Panelboards.
- B. Dry-Type Transformers.
- C. Enclosed Circuit Breaker
- D. Circuit breakers.

On the inside of each wiring device box indicate the panelboard and circuit number of the circuit serving the device by using a cable tag.

In pull boxes, and within switchboards, panelboards, motor starters, switches, etc. and at the equipment served by the circuit or feeder, on each cable of panelboard feeder circuits, and on each cable of all motor circuits, provide a cable tag identifying circuit number and phase.

All Instrument and Control wires and cables shall be similarly tagged as noted above within the pump control panel, pull boxes, and terminal boxes.

Instrument tags shall be stainless steel with identification punched into the tag. Tag shall be secured with stainless steel tie wraps or stainless steel chain.

### **3. RACEWAYS AND CONDUIT**

#### **GENERAL**

##### DESCRIPTION OF WORK

The work required under this section includes the provision, fabrication, and installation of all raceways and conduit required for this Work.

This section covers all conduit to be used on the various portions of the project and the Contractor shall meet the requirements of these Specifications wherever applicable.

The types of electrical raceways include the following:

- A. Galvanized rigid steel conduit.
- B. Flexible metal liquid-tight conduit.
- C. Aluminum rigid conduit.
- D. Rigid nonmetallic PVC conduit.

##### QUALITY ASSURANCE

**Manufacturers:** Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service, and whose products meet all requirements specified herein.

**Installer:** Qualified with successful installation experience on projects with electrical raceway work similar to that required for this project.

An experienced journeyman shall be in responsible charge of all raceway and conduit work.

**NEMA Compliance:** Comply with applicable requirements of NEMA standards pertaining to raceways.  
**UL Compliance and Labeling:** Comply with provisions of UL safety standards pertaining to electrical raceway systems: and provide products and components which have been UL-listed and labeled.

**NEC Compliance:** Comply with requirements as applicable to construction and installation of raceway systems.

##### SUBMITTALS

Shop drawing submittals for raceways are not required.

##### PRODUCT DELIVERY, STORAGE AND HANDLING

Provide end-cap thread protectors on exposed threads of threaded metal conduit.

Handle conduit and tubing carefully to prevent bending and end-damage and to avoid scoring finish.

Store conduit and tubing inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, watertight wrapping.

## **PRODUCTS**

### **GENERAL**

For each electrical raceway system provide a complete assembly of conduit or tubing with all required fittings; including, but not necessarily limited to, connectors, nipples, couplings, elbows, expansion fittings, pull boxes and other components and accessories as needed to form a complete system.

Provide conduit, tubing, and raceway accessories including straps, hangers, angles, expansion fittings as required for a complete system.

### **GALVANIZED RIGID STEEL CONDUIT**

Galvanized rigid metal conduit shall be mild steel, hot-dip galvanized conduit complying with ANSI C80.1 and Fed. Spec. WW-C-581 and shall be U.L. listed.

Elbows, bends, and similar offsets shall be made of full weight material complying with the above and shall be coated and threaded the same as conduit.

Threads for conduit, couplings, and fittings shall be full depth and clean cut.

Conduit shall be 3/4" trade size or larger or as indicated on the drawings or as required for the application if not indicated, and shall be manufactured by National Electrical Products Company, Youngstown Steel and Tube Company, Republic Steel, Allied Steel Tube and Conduit Company, or equal.

Rigid metal conduit fittings shall comply with Fed. Spec. FS W-F-408.

All couplings and fittings shall use threaded connections. Do not use any non-threaded fittings or connections.

### **LIQUID-TIGHT FLEXIBLE METAL CONDUIT**

Liquid-tight flexible metal conduit shall comply with Fed. Spec. WW-C-566 and shall be minimum 1/2" trade size, UL listed, standard weight, flexible, galvanized zinc-coated and PVC jacketed steel conduit.

Fittings shall be designed for use with liquid-tight flexible metal conduit and shall maintain electrical continuity throughout fittings and conduit. Fittings shall comply with Fed. Spec. W-F-406, Type 1, Class1, Style A.

### **RIGID ALUMINUM CONDUIT**

Rigid aluminum conduit shall be 6063 alloy, T41 temper, complying with ANSI C80.5 and Fed. Spec. WW-C-540 and shall be UL 6 listed.

Elbows, bends, and similar offsets shall be made of full weight material complying with the above and shall be coated and threaded the same as conduit.

Threads for conduit, couplings, and fittings shall be full depth and clean cut.

Conduit shall be ¾" trade size or larger or as indicated on the drawings or as required for the application if not indicated, and shall be manufactured by VAW, or equal.

Rigid aluminum conduit fittings shall comply with Fed. Spec. FS W-F-408.

All couplings and fittings shall use threaded connections. Do not use any non-threaded fittings or connections.

#### RIGID NONMETALLIC CONDUIT

Electrical Plastic Conduit: NEMA Stds. Pub. No. TC2, Type 3, Schedule 40, for direct burial and normal aboveground duty, Schedule 80 aboveground for the first 8' above finished grade, manufactured from ASTM D1784 PVC in compliance with NEMA TC-2. PVC conduit shall be UL listed. Joints shall be solvent cement types.

Provide PVC elbows, bends, fittings, and adapters as required for a complete installation. PVC conduit and tubing fittings shall comply with NEMA Stds. Pub. No TC3, match to conduit/tubing type and material. Provide solvent cement as recommended by the conduit manufacturer.

Minimum size of underground and underpavement conduits shall be 1-1/4".

#### EXECUTION

##### INSTALLATION - GENERAL

Install raceway products as indicated on the drawings and as required, in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve intended function.

Unless indicated otherwise on the drawings; install conduit exposed in mechanical and electrical rooms and tight to structure and walls.

Conduit field joints shall be cut square and reamed smooth. Threads shall be cleanly cut and joints drawn up tight. No running threads will be permitted.

Offsets and bends shall be made carefully, without reducing cross sectional area, and shall not be less than the radius of standard elbows.

Conduits shall be supported from the structural system; not from ceiling, ductwork, or piping systems. Provide additional support at junction and pull boxes.

All spare conduits shall have a No. 12 pull wire installed and available at each end for future conductor installation.

Wherever possible, install horizontal raceway runs above water and steam piping.

All conduit runs shall be grounded in an effective and approved manner at point of origin and shall maintain a continuous ground throughout all runs, cabinets, pull boxes, and fittings from point of service to all outlets.

All runs shall be completed and cleaned and free from foreign matter inside before the conductors are drawn in. During the installation, conduit ends are to be plugged or capped to prevent the entrance of foreign materials.

Conduit supports shall be spaced in accordance with the National Electrical Code.

Conduit fittings made for the conduit type shall be used as required to keep conduits close to the building surface.

Install raceways that stub up through concrete surfaces at such depth that the exposed raceway is vertical and no curved section of the elbow is visible.

All penetrations through masonry or concrete surfaces shall be made with galvanized rigid conduit, coated with corrosion resistant material.

Coordinate with other work as necessary to interface installation of electrical raceways and components with other work.

Level and square raceway runs, and install at proper elevations/heights.

Conduit fittings for exterior installation shall be hot dipped galvanized gray iron or copper free aluminum with aluminum enamel; these may be used interchangeably.

Exterior installed conduit – Wall or structure mounted conduit shall be supported with clamp back style conduit supports with spacers; material shall be malleable iron with hot dipped galvanized finish. Anchors shall be stainless steel expansion style bolts and hardware.

Exterior installed conduit – Hand rail/equipment mounted conduit shall be supported with a combination of stainless steel unistrut (and stainless steel hardware) and hot dipped galvanized conduit clamps.

Surface mounted device boxes shall be cast metal FS/FD style.

#### RACEWAY USAGE

Utilize galvanized steel conduit or rigid aluminum conduit in exterior environments, locations exposed to moisture, and non-air conditioned spaces. Do not mix conduit types.

Provide flexible metal liquid-tight steel conduit and fittings for engine-generator final connections, dry-type transformer final connections, and for other electrical equipment connections subject to movement and vibrations. Do not use flexible conduit where a rigid conduit elbow should be used.

Provide support and straps for flexible conduits. Unsupported free spans are not acceptable.

Provide nonmetallic schedule 40 PVC conduit underground and under slabs on-grade; all conduits turning up from below grade shall have galvanized rigid steel elbows.

#### SEALS AROUND RACEWAYS

Fire Rated Construction: All penetrations through fire rated construction shall be sealed to maintain fire rating of construction penetrated.

#### MOISTURE AND HAZARDOUS GASES SEALS

Provide seals against water entry at all entries. Provide conduit seals at boundary of hazardous area or before equipment entries. Used only bolted, break-apart, reusable conduit seals.

In cored openings in manholes or concrete structures, use multi-link bolted seals to seal the opening.

#### SEISMIC REQUIREMENTS

Raceway installation for the work shall meet all applicable code seismic requirements.

### **4. WIRES AND CONNECTORS**

#### **GENERAL**

#### DESCRIPTION OF WORK

Extent of electrical wire and cable work is indicated by the project drawings.

Types of wire, cable and connectors specified in this section include the following:

- A. 600-volt insulated Copper conductors.
- B. Fixture wires.
- C. Tap-type connectors.
- D. Mechanical and compression connectors.
- E. Twist-on insulated metal spring connectors.

Signal, instrumentation, and control type wire and cable products are not part of this Section.

Applications of electrical wire, cable, and connectors required for project are as follows:

- A. For power distribution circuitry.
- B. For branch-circuit appliances and equipment.
- C. For control circuits, except analog and instrument cables.

## QUALITY ASSURANCE

**Manufacturers:** Firms regularly engaged in manufacture of electrical wire and cable products of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than three (3) years.

**Installer's Qualifications:** Firm with at least three (3) years of successful installation experience with projects utilizing electrical wiring and cabling work similar to those required for project.

**NEC Compliance:** Comply with NEC requirements as applicable to construction, installation; and color coding of electrical wires and cable.

**UL Compliance:** Comply with applicable requirements of UL Std. 83, "Thermoplastic-Insulated Wires and Cables", and Std 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors," except where manufacturer's torque-tightening requirements are more stringent.

**UL Labels:** Provide wiring/cabling and connector products that are UL listed and labeled.

**NEMA/ICEA Compliance:** Comply with NEMA/ICEA Std Pub/No.'s WC 5, "Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy," and WC-30, "Color Coding of Wires and Cables," pertaining to electrical-power-type wires and cables.

**IEEE Compliance:** Comply with applicable requirements of Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to wiring systems.

**ASTM Compliance:** Comply with applicable requirements of ASTM B1, 2, 3, 8 and D-753. Provide copper conductors with conductivity of not less than 98% at 20 Deg.C. (68 Deg. F.).

## STANDARDS

All materials shall be new, manufactured in accordance with latest edition of UL, NEMA, ANSI, and IPCEA.

All cables furnished shall be of same type and by same manufacturer. All accessories of a particular type shall be by the same manufacturer.

## SUBMITTALS

Not required.

## DELIVERY, STORAGE, AND HANDLING

Deliver wire and cable properly packaged in factory-fabricated type containers, or wound on NEMA-specified type non-returnable wire and cable reels.

Store wire and cable in clean, dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

Handle wire and cable carefully to avoid abrading, puncturing, or tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

## MANUFACTURERS

Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

- A. Wire and Cable:
  - 1. American Insulated Wire Corp.
  - 2. Brand-Rex Div; Pyle National Co.
  - 3. Cerro Wire and Cable Co.
  - 4. Hitemp Wires, Inc.
  - 5. Phelps Dodge Cable and Wire Co.
  - 6. Pirelli Cable Corp.
  - 7. Rome Cable Corp.
  - 8. Southwire Company.
  
- B. Connectors:
  - 1. AMP, Inc.
  - 2. Burndy Corporation
  - 3. Brand-Rex Div., Pyle National Co.
  - 4. General Electric Co.
  - 5. 3M Company
  - 6. O-Z/Gedney Co.
  - 7. Square D Company
  - 8. Thomas and Betts Corp.

## PRODUCTS

### WIRES, CABLES AND CONNECTORS

General: Provide electrical wires, cables and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation, and for application indicated.

Except as otherwise indicated, provide copper conductors with conductivity of not less than 98% at 20 Deg. C (68 Deg. F).

General Purpose Wires: Provide factory-fabricated wire of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project requirements, NEC and NEMA standards. Select from the following UL types, those wires with construction features which fulfill project requirements. Conductors shall be annealed copper.

Type THWN-THHN: For dry and wet locations; max dry location operating temperature 90 Deg. C. Insulation shall be flame-retardant, moisture-resistant and heat-resistant thermoplastic; outer covering shall be nylon jacket.

Apply conductors at 75 deg. C. ampere rating for circuits greater than 100 amperes. Use 60 deg. C. ampere rating for circuits 100A or less.

## CONNECTORS

General: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, material, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements, NEC and NEMA standards. Ensure connector materials mate and match and are compatible with conductor materials and cables. Select from the following types:

- A. Type: Insulated mechanical-bolted parallel or compression type for conductors #8 AWG and larger; twist-on insulated metal spring connectors for #12 and #10 awg miscellaneous branch circuit wiring, including equipment ground conductors.
- B. Material: Copper (for Cu to Cu connection).
- C. Insulation: All connectors shall be fully insulated to match insulation type and rating of conductors being spliced.

## EXECUTION

### INSTALLATION OF WIRES AND CABLES

Install electrical cables, wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL, and NECA's "Standard of Installation," and in accordance with recognized industry practices.

Coordinate wire/cable installation with electrical raceway and equipment installation work, as necessary.

Pull conductors together where more than one is being installed in a raceway.

Use pulling compound or lubricant, where necessary. Compound must not deteriorate conductor or insulation. Use of soap is not permitted as a pulling lubricant.

Use pulling means, including fish tape, cable, rope and basket-weave wire/cable grips that will not damage cables or raceway.

Keep conductor splices to a minimum.

Install splices and tapes that possess equivalent-or-better mechanical strength, electrical ampacity, and insulation ratings than conductor being spliced.

Use heat-shrink or cold-shrink splice kits for feeder circuit splices.

Use splice and tap connectors that are compatible with conductor material.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A.

Use twist-on insulated metal spring connectors for branch circuit wiring, including equipment ground conductors.

#### FIELD QUALITY CONTROL

Prior to energizing circuitry, check installed service and feeder wires and cables with megohm meter to determine insulation resistance levels, to ensure insulation integrity.

Prior to energizing, test wires and cables for electrical continuity and for short-circuit. Test branch circuit wiring with ohmmeter.

Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, replace faulty conductors and retest to demonstrate compliance.

Ensure correct rotation of all motors.

Ensure correct sequence of phases at all switchgear and panelboards. Phase-sequence testing shall be performed in the presence of the Owner and Engineer, on both high-voltage and low-voltage systems, on both existing and new equipment. Ensure all phases of all circuits are identified. Ensure proper rotation of all motors. Ensure phase sequence of tie circuit(s) and both sides of secondary unit substation are exactly the same (as applicable). Provide A-B-C phase arrangement, left-to-right, top-to-bottom.

### 5. WIRING DEVICES

#### GENERAL

#### DESCRIPTION OF WORK

The extent of wiring device work is indicated by drawings. Wiring devices are defined as single discrete units of electrical distribution systems which are intended to carry but not utilize electric energy.

Types of electrical wiring devices in this section include the following:

- A. Receptacles and GFCI type receptacles.
- B. Lighting toggle switches.
- C. Cover plates.

#### QUALITY ASSURANCE

NEC Compliance: Comply with NEC as applicable to installation and wiring devices.

UL Compliance: Comply with applicable requirements of UL 20, "General-Use Snap Switches"; 486A "Wire Connectors and Soldering Lugs for Use with Copper Conductors"; 498, "Electrical Attachment Plugs and Receptacles"; and 943, "Ground Fault Circuit Interrupters" pertaining to installation of wiring devices. Provide wiring devices which are UL-listed and labeled.

NEMA Compliance: Comply with applicable portions of NEMA Stds Pub/ No. WD 1, "General-Purpose Wiring Devices", WD 2, "Semiconductor Dimmers for Incandescent Lamps", and WD 5, "Specific-Purpose Wiring Devices".

## MANUFACTURERS

Subject to compliance with requirements, manufacturers offering wiring devices which may be incorporated in the work include, but are not limited to, the following:

- A. Harvey Hubbell Inc.
- B. Arrow-Hart.
- C. Dimmer switches: Lutron, 'Nova T' Series (White).
- D. Pass & Seymour.
- E. Leviton.
- F. Eagle.

## PRODUCTS

### FABRICATED WIRING DEVICES

General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated and which comply with NEMA Stds. Pub No. WD 1.

Device and Coverplates Colors: All coverplates shall be stainless steel.

### RECEPTACLES

Heavy-Duty Duplex: Provide heavy-duty, Hubbell #5362 (or equal) receptacles, 2-pole, 3-wire grounding, 20-amperes, 125 volts, with metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated; side screw wiring terminals.

Ground-Fault Interrupters: Provide "feed-through" type ground-fault circuit interrupters, with heavy-duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL-rated Class A, Group 1, rated 20-amperes, 120 volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 milliamperes ground-fault trip level; equip with NEMA 5-20R configuration; side screw wiring terminals.

Class 1 Division 2 Groups B,C,D: Provide heavy duty classified receptacles (with appropriate conduit seals) where classified areas appear on the drawing. In addition, provide (1) matching plug for each receptacle.

All receptacles shall be installed with the ground in the DOWN position.

## SWITCHES

Toggle: Provide heavy-duty flush single-pole toggle switches, 20-amperes, 125-277 volts AC, white color for normal circuits, quiet type, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, silver/cadmium alloy contacts and side and back wired terminals.

and 4-way AC switches, 20 amperes, 125-277 volts, with mounting yoke insulated from mechanism, equipped with plaster ears, insulated type switch handles, side-wired screw terminals, with break-off tab features, which allows wiring with separate or common feed.

## WIRING DEVICE ACCESSORIES

Coverplates: Provide coverplates for single and combination wiring devices, of types, sizes, and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates. Provide plates possessing the following additional construction features:

Material and finish: Stainless steel.

Outdoor area (weatherproof): Polycarbonate, stainless steel mounting screws, in-use type.

Surface mounted device boxes: Cast device covers.

## EXECUTION

### INSTALLATION OF WIRING DEVICES

Install wiring devices as indicated, in accordance with manufacturer's written instruction, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

Install wiring devices only in electrical boxes, which are clean; free from excess building material, dirt, and debris.

Install wiring devices after wiring pull-in work is completed.

Install coverplates after painting work is completed.

Replace any and all coverplates or devices damaged prior to final acceptance of work by the Owner with new units.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A. Use properly scaled torque indicating hand tool.

Surface mounted device boxes shall be cast copper free aluminum/aluminum enamel boxes.

#### PROTECTION OF WALL PLATES AND RECEPTACLES

At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

#### GROUNDING

Provide equipment grounding conductor and connection for wiring devices, unless otherwise indicated. Tighten connection to comply with tightening torques specified in US Std 486A to assure permanent and effective grounds. Grounding continuity shall be maintained between devices and metallic raceway system.

#### TESTING

Prior to energizing circuitry, test wiring devices for electrical continuity and short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements, by use of a Woodhead or equal continuity testing device.

#### IDENTIFICATION

Mark the panelboard name and circuit # to which the device is connected, on each circuit wire, using vinyl/cloth wire tags.

### 6. GROUNDING SYSTEM

#### GENERAL

#### DESCRIPTION OF WORK

Extent of electrical grounding and bonding work is indicated by drawings as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

Types of electrical grounding and bonding work in this section includes the following:

- A. Solidly grounded.
- B. Dry-type transformers shall be separately derived systems.
- C. Ground electrode system for new service.
- D. Bonding and ground rods for lightning protection of radio telemetry antenna mast.

Refer to other sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

## MANUFACTURERS

Subject to compliance with requirements, provide grounding and bonding products of one of the following (for each type of product):

- A. Burndy Corporation.
- B. Cadweld Div.; Erico Products Inc.
- C. Crouse-Hinds Div.; Cooper Industries.
- D. Ideal Industries, Inc.
- E. Joslyn Corporation.
- F. Okonite Company.
- G. OZ Gedney Div.; General Signal Corp.
- H. Thomas and Betts Corp.

## PRODUCTS

### GROUNDING AND BONDING

General: Except as otherwise indicated, provide electrical grounding and bonding systems; with assembly of materials, including, but not limited to, wires, connectors, solderless lug terminals, grounding electrodes bonding jumper braid, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products which comply with NEC, UL, NEMA, IEEE requirements, and with established industry standards for those applications indicated.

Conductors: Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match building wiring materials and are sized according to NEC.

Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service indicated.

Field Welding: Comply with AWS Code for procedures, appearance, and quality of welds; and for methods used in correcting welding work. Provide exothermic type or equal welded connections where grounding conductors connect to underground grounding electrodes and underground or underslab or encased metal structural components.

## **EXECUTION**

### **INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS**

General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that installations comply with requirements.

Coordinate with other work as necessary to interface installation of electrical grounding and bonding system.

Weld grounding conductors to underground grounding electrodes.

For this project, ground emergency electrical system neutral to utility system neutral at grounding electrode system neutral bonding point. Provide a solid neutral at the automatic transfer switch such that the generator does not comprise a separately derived system. Do not ground the neutral at the generator.

Connect together by equipment ground conductors and bonding, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, equipment frames, structural steel, reinforcing steel of generator pad, and major piping.

Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug.

All feeder, branch circuits, and control circuits shall have a green insulated equipment ground conductor. (Ground conductors may not be indicated on plans, but shall be provided).

Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to ensure permanent and effective grounding.

Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises. Solidly ground drain wires from TVSS devices.

Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

Provide ground conductor and bonding to ground rod(s), structural steel, or rebar, equipment mounting racks, and major metal mechanical piping. Provide ground rod and #6 ground wire for each pole mounted lighting fixture.

### **FIELD QUALITY CONTROL:**

Use ohmmeter and test for continuity of all ground conductors, all metallic raceways and enclosures, metallic building structure, and metallic piping, and ground rod system.

Test resistance of ground rod system for NEC and industry compliance.

## 7. DRY-TYPE TRANSFORMERS

### GENERAL

#### INDUSTRY STANDARDS

Equipment specified herein shall be furnished and installed complete by the Contractor.

The equipment specified herein shall meet the applicable of the following agencies and associations:

- A. Underwriters Laboratories U.L.
- B. National Fire Protection Association, NFPA.
- C. National Electrical Manufactiures Association.
- D. American National Standards Institute, ANSI.
- E. Factory Mutual.

#### SUBMITTALS

Shop drawings shall be submitted showing KVA, temperature rating, voltage rating, dimensional and other data showing compliance with the electrical and physical requirements of the project.

#### MANUFACTURERS

Provide one of the following:

- A. Eaton/Cutler-Hammer
- B. Square-D Company
- C. Siemens
- D. General Electric

### PRODUCTS

#### TYPE AND MOUNTING

All units shall be metal enclosed ventilated dry type for wall or floor mounting as indicated on the plans, or as dictated by physical size.

KVA, voltage and phase ratings shall be as shown on the drawings.

Floor mounted transformers shall be mounted on wire reinforced 3000 psi concrete pads.

## ENCLOSURES

Transformer enclosures shall be non-ventilated type for outdoor applications constructed from minimum 16 gauge steel and shall be designed in such a manner to prevent accidental access to electrically energized parts.

Conduit knockouts shall be provided in-line with the terminals and be of sufficient size and number to accommodate the necessary cables and conduit.

## CORE AND COIL

Core and coil shall be of the highest quality materials to minimize no-load losses and exciting current, and shall be mechanically braced to withstand short circuit stresses of 25 times normal load current for two seconds.

Coils shall be copper. All busbar shall be copper. All current carrying components shall be copper.

Core and coil assembly shall be internally isolated and shall be subjected to a double dip and bake process.

Coils shall be continuous from start to finish with no splices being allowed. Coils shall have a final wrap of insulating material designed to prevent injury to the magnet wire. Units having visible magnet wire are not acceptable.

Core and coil unit shall be completely isolated from the enclosure by means of vibration absorbing mounts.

Core and coil unit shall be adequately grounded to the enclosure by means of a flexible grounding strap.

Provide neutral ground strap and grounding to ground electrode system.

Terminals for line, load and ground connections shall be supplied. Terminals shall be located in an area of the unit where the temperature does not exceed 40 degrees C. All terminals, lugs, and connectors shall be copper.

## INSULATION AND TEMPERATURE RISE

Insulation and transformer core and coil shall be designed for a maximum 115 degrees C temperature rise above an ambient of 30 degrees C at rated full load; capable of operating at an overload for 150 degrees C rise.

## TAPS

Units thru 25 KVA shall have two 5% full capacity taps below normal rated primary voltage.

Units 30 KVA and larger shall have two 2-1/2% full capacity above and four 2-1/2% full capacity below normal primary voltage.

## SOUND LEVELS

Sound levels shall not exceed NEMA Standard.

Unless noted otherwise, sound levels shall not exceed 45 db on units thru 150 KVA, 50 db on units from 151 KVA thru 300 KVA and 55 db on units larger than 300 KVA.

## EFFICIENCY

Units shall have a 96% minimum efficiency at 75% load.

## CASE TEMPERATURE

The maximum case temperature at the warmest spot shall not exceed 35 degrees C above a 40 degrees C ambient, regardless of insulation system used.

## EXECUTION

### INSTALLATION

Transformers shall be installed where shown on the drawings. Units shall be set so as to allow easy access to at least three sides of the unit.

Ensure all units have adequate air space for self-cooling.

All hardware and accessories shall be furnished and installed by the Contractor.

Prior to energizing and during start-up, perform electrical tests to provide correct voltages and phase rotation.

## 8. PANELBOARDS

### GENERAL

#### DESCRIPTION OF WORK

Extent of panelboard, and enclosure work is indicated by drawings and schedules.

#### QUALITY ASSURANCE

NEC Compliance: Comply with NEC as applicable to installation of panelboards, cabinets, and cutout boxes, including NEC Article 384.

UL Compliance: Comply with applicable requirements of Std No. 67, "Electric Panelboards", and Std No.'s 50, 869, 486A, and 1053 pertaining to panelboards, accessories and enclosures. Provide units which are UL-listed and labeled.

NEMA Compliance: Comply with NEMA Stds. Pub/No, 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", Pub/No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less." Comply with NEMA Pub/No. PB 1.2, "Application Guide for Ground-fault Protective Devices for Equipment", where applicable.

## SUBMITTALS

Product Data: Submit manufacturer's data on panelboards.

## MANUFACTURERS

Subject to compliance with requirements, manufacturers offering electrical panelboard products which may be incorporated in the work include the following:

- A. Eaton/Cutler-Hammer
- B. Square D Company
- C. Siemens
- D. General Electric

## PRODUCTS

### PANELBOARDS

General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, except copper busbars, copper neutral bar, copper ground bar, and copper cable lugs shall be provided.; design and construct in accordance with published product information; equip with proper number of unit branch devices as required for complete installation. Refer to panelboard schedules or one-line on the drawings.

NEMA Compliance: Comply with NEMA Stds. Pub/No, 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)", Pub/No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less." Comply with NEMA Pub/No. PB 1.2, "Application Guide for Ground-fault Protective Devices for Equipment", where applicable.

Panelboards: Provide dead-front safety type lighting and appliance branch circuit panelboards as indicated, with branch devices in quantities, ratings, types and arrangement shown; with copper anti-burn solderless pressure type lug connectors approved for copper conductors; equip with copper bus bars, full-sized copper neutral bar insulated from ground, copper ground bar, and bolt-in type molded case circuit-breakers, with toggle handles that indicate when tripped. Where multiple pole breakers are indicated, provide with common trip so that all poles trip simultaneously. Provide suitable copper lugs on neutral bus for each outgoing circuit required; provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.

Provide short circuit rating not less than 10,000 AIC if not indicated.

Circuit breakers shall be thermal magnetic type unless noted otherwise. Voltage and poles shall be as indicated on the drawings.

Panelboard Enclosures: Provide NEMA 4X sheet steel cabinet type enclosures, in sizes required and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Design enclosures for recessed or surface mounting, as applicable. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed.

## **EXECUTION**

### **INSTALLATION OF PANELBOARDS**

General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards.

and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

Coordinate installation of panelboards and enclosures with wire and raceway installation work. Coordinate exact locations with other trades to ensure no space conflicts and no transgressions of dedicated panelboard space by piping and ductwork.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A. Where manufacturer's torque requirements are more stringent, manufacturer's requirements shall be followed.

Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure. All panelboards shall use unistrut type channels for mounting to walls.

Provide properly wired electrical connection within enclosures. Wiring must be neatly routed.

Fill out panelboard's circuit directory card upon completion of installation work. Directory cards shall be typed.

Adjust and set adjustable circuit breaker trip and time delay settings where applicable.

### **GROUNDING**

Provide equipment grounding connection for panelboards as indicated. All panelboard feeders and branch circuits shall have green insulated equipment ground conductors. Tighten connections to comply with tightening torques specified in UL Stds. 486A to assure permanent and effective grounds.

## FIELD QUALITY CONTROL

Prior to energization of circuitry, check tightness of all accessible connections for compliance with manufacturer's tightening torque specifications.

Prior to energizing panelboards, check panelboard busbar and feeder phase-to-phase and phase-to-ground insulation resistance levels to ensure no ground faults and no short circuits.

Prior to energization, check branch circuit panelboards for electrical continuity of circuits, and check for short-circuits and ground faults.

Subsequent to wire and cable hook-ups, energize panelboards and demonstrate compliance with requirements. Where necessary, correct malfunctions and replace faulty components in field, and then retest to demonstrate compliance.

Provide wire tags to identify all circuits.

Check for proper phase arrangement and rotation; A-B-C left -to-right and top-to-bottom.

## 9. LIGHTING

### GENERAL

#### RELATED DOCUMENTS

Basic Electrical Materials and Methods sections and drawings apply to work specified in this section.

#### SUMMARY

Extent of lighting fixture work is indicated by drawings and schedules.

#### SUBMITTALS

Product Data: Submit manufacturer's product data and installation instructions on each type lighting fixture.

#### QUALITY ASSURANCE

Codes and Standards:

Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 225, 250, 410, and 501 as applicable to installation and construction of building lighting fixtures.

NEMA Compliance: Comply with applicable requirements of NEMA Stds. Pub/No. LE 2 pertaining to lighting equipment.

UL compliance: Comply with requirements of UL standards, including Stds. 486A and B, pertaining to exterior lighting fixtures. Provide lighting fixtures and components which are UL-listed and labeled.

## DELIVERY, STORAGE AND HANDLING

Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from construction debris and physical damage.

Store lighting fixtures in original wrappings in a clean dry space. Protect from weather, dirt, fumes, water, construction debris and damage.

Handle lighting fixtures carefully to prevent damage, breaking, and scoring. Do not install damaged fixtures or components; remove units from site and replace with new.

## SEQUENCING AND SCHEDULING

Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting fixtures with other work.

Sequence lighting installation with other work to reduce possibility of damage and soiling of fixtures during remainder of construction period.

## MAINTENANCE

Maintenance Data: Submit maintenance data and parts list for each lighting fixture and accessory; including "trouble-shooting" maintenance guide. Include that data, product data, and shop drawings in a maintenance manual.

Extra Stock: Furnish stock or replacement lamps amounting to 10 percent (but not less than one lamp in each case) of each type and size lamp used in each type fixture. Deliver replacement stock as directed to Owner's storage space.

## MANUFACTURERS

Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are listed on the fixture schedule.

## PRODUCTS

### LIGHTING FIXTURES

General: provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, poles, energy efficient ballasts, starters, lamps and wiring.

Wiring: Provide electrical wiring within fixtures which is suitable for connection to branch circuit wiring as follows:

- A. NEC Type AF for 120-volts, minimum no. 18 AWG.; NEC Type SF-2 for 208-volts, minimum No. 18 AWG.

High-Intensity-Discharge Lamp Ballasts: Provide HID lamp ballasts, of ratings, types and makes as recommended by lamp manufacturer, which properly mates and matches lamps to electrical supply by providing appropriate voltages and impedances for which lamps are designed. Design ballasts to operate lamp within the lamp's power trapezoid requirements. Ballasts shall be high power factor type and primary shall be fused.

Lamps: Provide clear metal halide in wattage indicated.  
Fusing: Provide Primary Fusing in all phase conductors.

#### PHOTOCELL CONTROLLERS

2000 watt, 120 VAC rated, conduit pedestal mounted, used to control an individual circuit or a lighting contactor; Tork Model #2101 or approved equal.

#### HAND-OFF-AUTO CONTROLS

Provide hand-off-auto selector switch. In hand position, fixtures shall be energized. In auto position, fixtures shall be controlled by photocell.

#### EXECUTION

#### EXAMINATION

Examine areas and conditions under which lighting fixtures are to be installed, and substrate which will support lighting fixtures. Notify Contractor in writing of conditions detrimental to proper completion of the Work. Do not proceed with the Work until satisfactory conditions have been corrected in a manner acceptable to Installer.

#### INSTALLATION OF LIGHTING FIXTURES

Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry requirements.

Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B, and the National Electrical Code.

Fasten electrical lighting fixtures and brackets securely to structural supports, and ensure that installed fixtures are plumb and level.

Construct reinforced concrete bases flush with grade, with conduits, anchor bolts and ground wire. Refer to detail on drawings for additional information. Provide six foot minimum ground rod located six foot distant from pole, 24" below finished grade to top of ground rod; provide #6 ground wire.

Install poles on bases and adjust to provide plumb installation.

#### GROUNDING

Provide equipment grounding connections for lighting fixtures. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

#### FIELD QUALITY CONTROL

At the Date of Substantial Completion, replace lamps in lighting fixtures which are observed to be noticeably dimmed as judged by the Engineer.

#### ADJUSTING AND CLEANING

Aim adjustable lighting fixtures and lamps in night test of system.

Clean lighting fixtures of dirt and debris upon completion of installation.

Protect installed fixtures from damage during construction period.

## DEMONSTRATION

Upon completion of installation of lighting fixtures, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate compliance with requirements. Where possible correct any malfunctions at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

### **Mechanical Requirements**

#### **DESCRIPTION**

This work shall consist of furnishing materials, installation, and all necessary incidentals associated with the HVAC equipment as indicated on the plans. Contractor shall provide and install a complete and working single package HVAC system as described on the plans. Contractor shall install according to all manufacturer's recommendations and requirements as described in the documentation of their system. Mechanical work shall comply with all drawing requirements and general provisions of the Contract.

## **WORK ITEM W-1 - PUMP WELL HOUSE**

### **DESCRIPTION**

The work shall include the furnishing of all materials, labor and equipment necessary to complete the construction of a Pump Well House for the new water well and pump as shown on the Plans. Any references made to Specifications, or other published standards, shall be to the standards in effect at the date of Bid.

### **Concrete**

All concrete used in the work develop a minimum compressive strength of 4,000 pounds per square inch in 28 days in accordance with ASTM C39.

### **Cement**

All cement used in concrete shall be air-entraining Portland Cement, conforming to ASTM C150, Type IA or IIIA.

### **Proportions and Consistency**

All concrete shall be proportioned by the water-cement ratio, except for small batches when permission is granted to deviate from this method. The water-cement ratio shall be interpreted as the ratio of the total quantity of water, including surface water contained in the aggregate, expressed in U.S. gallons, per pound of cement.

|                                  |  |
|----------------------------------|--|
| Water-<br>Cement<br><u>Ratio</u> | 28-Day<br>Compressive<br><u>Strength (PSI)</u> |
| 0.45                             | 4,000  |

The amount of entrained air in the concrete shall be greater than 4% and less than 7%.

All concrete placed in the work shall show slumps within the limits of 2" and 4". In all cases, the slump shall be the minimum consistent with good workmanship.

### **Mixing of Concrete**

All concrete incorporated in the work shall be transit-mixed in accordance with ASTM C94 for ready-mixed concrete. Small batches of concrete may be job-mixed by the Contractor when approved by the Engineer.

Concrete which for any reasons is poorly mixed and is not of uniform consistency, will be rejected. Re-tempering and remixing will not be permitted.

When placed, concrete shall have a temperature of not less than 60°F, nor more than 90°F.

## **Forms**

The Contractor shall provide forms with smooth surfaces of ample strength and rigidly braced to prevent deviations from the correct lines. Forms shall be substantially watertight and securely anchored against flotation. All exposed corners shall be formed with 1" chamfer strips, unless otherwise directed. Forms shall remain in place until the concrete is adequately set and capable of bearing, without damage, any load which may be imposed.

## **Placing of Concrete**

Forms shall be cleaned and treated to prevent adherence of mortar to the forms. All debris shall be completely removed from between the forms. Concrete shall not be placed under water, on muddy, frozen, or insufficiently compacted soil. The concrete shall be deposited in the forms in a manner which will prevent segregation. The method of placing concrete in the forms shall be subject to the approval of the Engineer. Concrete shall not be permitted to drop freely more than 4 feet. Concrete shall be hand-spaced or vibrated with approved mechanical vibrators for a period of time sufficient to make a dense mass but not so long that segregation occurs.

## **Placing Concrete in Cold Weather**

When the air temperature is below 45°F, the Contractor shall use special means in mixing and placing concrete to prevent its freezing in compliance with ACI 306 and as herein specified. Water and aggregates shall be heated to a temperature of not less than 70°F, nor more than 150°F, by means of steam or by heat, prior to being placed in the mixer, provided uniform results are obtained. Salt, antifreeze solution, or other chemicals shall not be used.

## **Placing Concrete in Hot Weather**

When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified. Cool ingredients before mixing to maintain concrete temperatures at time of placement below 90°F. Mixing water may be chilled or chopped ice may be used to control the concrete temperature providing the water equivalent of the ice is considered for the calculation of the total amount of mixing water. Cover reinforcing steel with water soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete. Do not use retarding admixtures unless otherwise accepted in mix design.

## **Concrete Curing and Protection**

**General:** Protect freshly placed concrete from premature drying and excessive cold or hot temperature for a period of time necessary for hydration of cement and proper hardening.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
2. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

**Curing Methods:** Perform curing of concrete by moist curing, by moisture-retaining cover curing, membrane curing and by combinations thereof, as herein specified.

1. Provide moisture curing as follows:
  - a. Keep concrete surface continuously wet by covering with water.
  - b. Continuous water-fog spray.
  - c. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges with 4" lap over adjacent absorptive covers.
2. Provide moisture-cover curing as follows:
  - a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Provide membrane curing to slabs as follows:
  - a. Apply membrane-forming curing compound to concrete surfaces as soon as final finishing operations are complete (Within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
  - b. Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring, painting and other coatings and finish materials unless acceptable to the Engineer.

### **Finishing of Concrete**

Any defective work discovered after the forms have been removed shall be corrected immediately. All surfaces shall be reasonably free from "honey-combing", bulging, aggregate pockets, and excessive depressions or projections. If any defects cannot be repaired satisfactorily in the opinion of the Engineer, the entire defective section shall be removed and replaced by the Contractor at his expense.

Immediately after the forms have been removed, all minor depressions resulting from the removal of metal ties, or from other causes, shall be carefully pointed with mortar consisting of one (1) part cement and three (3) parts sand. The surface film of all such filled areas shall be carefully removed before setting occurs.

All exposed concrete surface except floors, landings, stairs, entrance slabs and walks, shall be given a rubbed finish. Fins and other projections shall be carefully removed, offsets leveled and damaged places repaired. The surfaces shall then be rubbed with a carborundum brick and water, without the addition of cement, mortar or grout. The finished surface shall be true to line, level and contour, and shall be free of form marks or other blemishes.

Concrete floors, landing and stair treads shall receive a steel trowel finish, unless otherwise directed by the Engineer.

Entrance slabs and walks shall receive a wood float finish.

Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete the work.

### **Reinforcing Steel**

Metal reinforcement shall conform to the applicable specifications of the American Society for Testing Materials, as follows:

| <u>Standard Specifications for:</u>                          | <u>Serial Designation</u> |
|--|---------------------------|
| Deformed Steel Bars for Concrete Reinforcement               | A615 Grade 60             |
| Welded Steel Wire Fabric for Concrete Reinforcement          | A185                      |
| Steel Wire for Concrete Reinforcement                        | A82                       |
| Welded deformed Steel Bar or Mats for Concrete Reinforcement | A184                      |

All reinforcing bars, unless otherwise specified, shall be deformed in accordance with ASTM A615.

### **Placing Reinforcing Steel**

All reinforcement shall be accurately placed in accordance with the Plans or as specified, and shall be adequately secured in position by concrete or metal chairs and spacers and by wire tags. Adjoining bars at splices shall overlap the length as shown on the Plans. All bent bars shall be accurately bent to the required shape before being placed in the forms.

### **Ordering Reinforcement**

Before ordering reinforcement which is to be bent, the Contractor shall submit to the Engineer, diagrams and lists showing the number, size, length and arrangement of the reinforcement he proposes to finish and place. The Contractor shall furnish a sufficient number of such diagrams and lists to permit three (3) copies to be retained by the Engineer. At least two weeks shall be allowed for the Engineer to check said lists and diagrams and these may be changed or revised to meet the approval of the Engineer.

Reinforcement, if shop bent, shall be tied in bundles and shall be identified with a metal tag on which shall be plainly stenciled or stamped the designation of the bars shown on the reinforcement drawings as approved by the Engineer.

### **MASONRY (General)**

#### **Compliance with Standard and Industry Specifications**

For all conflicts between the referenced specifications and the project specifications, the project specifications shall govern.

The Contractor, if requested, shall furnish an affidavit from the manufacturer, certifying that the materials or products delivered to the job meet the requirements specified. However, such certification shall not relieve the Contractor from the responsibility of complying with any added requirements specified herein.

### **Precautions and General Requirements**

Cold Weather Protective Methods: No masonry work shall be permitted in cold weather when the temperature is below 32°F on a rising thermometer or below 40°F on a falling thermometer unless adequate protection against freezing is provided as follows:

1) Below 40°F, but above 32°F

Heat mortar mixing water, but not above 160°F. Mortar when placed shall be between 70°F and 100°F. Plastic sheets or tarpaulins shall be placed over newly laid walls.

2) Below 32°F, but above 0°F

In addition to preceding requirements, sand shall be heated but not scorched. The working area shall be protected. When the temperature falls below 20°F, all concrete masonry units shall be heated to at least 50°F at the job site.

3) Below 0°F

Construction shall be stopped unless the enclosure is complete and tight. Observe all preceding requirements.

4) Masonry shall be protected against freezing for at least 48 hours.

5) No masonry shall be laid with or on frozen materials.

6) No antifreeze ingredient shall be used in the mortar.

Protect facing material against staining, and keep tops of walls covered with non-staining waterproof coverings when work is not in progress. When work is resumed, top surface of work shall be cleaned of all loose mortar and in drying weather, thoroughly wet except for concrete masonry units.

Before closing up any pipe, duct or similar inaccessible spaces or shafts with masonry, remove all rubbish and sweep out the area to be enclosed.

Provide level and solid bearing in masonry walls directly under bond beams and lintels.

The open space at expansion joints shall be kept free of mortar by using a continuous wood or metal strip temporarily set on the wall.

Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry and wet it lightly so as to obtain the best possible bond with the new work. Remove all loose brick and mortar. If it is necessary to “stop-off” of horizontal run of masonry, this shall be done by racking back one-half (1/2) unit length in each course. Tothing will not be permitted.

Consult other trades and make provisions that will permit the installation of their work in a manner to avoid cutting and patching. Build in work specified under other Sections, as necessary, and as the work progresses. Set steel lintels in beds of mortar. Fill spaces around jambs and heads of metal door bucks and frames solidly with mortar. Build in anchors and clips for windows.

### **Building in Work**

Build in all anchors, flashings, sleeves, frames, structural steel, loose lintels and miscellaneous iron and all other items required to be built into masonry during the course of the work.

Contractor shall fully familiarize himself with the Mechanical and Electrical Drawings and Specifications, in order that there may be no misunderstanding as to what items are to be installed by other Contractors and what items he shall install.

### **Cutting and Patching**

The Contractor shall be responsible for all cutting and patching of masonry work, including any cutting and patching required for the work of the mechanical, electrical and other trades. Actual cutting may be left to each trade with material and equipment to install, but such cutting shall be done under the supervision of the General Contractor.

Patching shall be done by the Contractor, and unless otherwise directed, be done at the conclusion of the general work. Patching shall be done in such a manner that the patching will be indistinguishable from surrounding or adjoining work.

### **Material Handling and Storage**

- 1) Store any masonry material on the job so as to prevent the inclusion of any foreign materials in the work and any damage from weather and ground.
- 2) In cold weather all masonry units and mortar materials shall be thoroughly covered with tarpaulins or felt paper. Masonry units shall be stored on a high, dry location on platforms of sufficient thickness and height to prevent absorption of moisture from the ground. Masonry units and mortar materials shall never be permitted to become covered with ice and snow.
- 3) Manufactured materials, such as cement and lime, shall be delivered and stored in original packages plainly marked with the brand and manufacturer's name. Material in broken containers or in packages showing water marks or other evidence of damage will be wholly rejected.

### **Accessories**

Anchors and ties shall be of zinc-coated steel. Except for steel wire, zinc-coating shall conform to ASTM Specifications A-153. Steel wire shall be zinc-coated in accordance with ASTM Specification A-116 for Class 2 coating. The extent and location of anchors and ties shall be as indicated on the drawings and as hereinafter specified under the laying requirements for the various items of masonry.

### **Joint Reinforcement**

Steel reinforcement for use in horizontal bed joints of concrete masonry units and other locations as hereinafter specified shall be prefabricated type formed of zinc-coated cold drawn steel wire conforming to ASTM Specification A1064/A1064M. Side wires shall be formed of 3/16" gauge wire to be

deformed, cross rods shall be 9 gauge or larger, smooth or deformed wire, butt welded to side wires in the same place at contact points and spaced not more than 16 inches apart. Provide special formed pieces at corners and intersections of walls or partitions. Reinforcing shall be of proper widths for the partitions and wall thickness shown. Reinforcing shall be "Block-Lok and Econo-Lok" as manufactured by A-A Wire Products or "Dur-O-Wall and Continuous Rectangular Ties" as manufactured by Dur-O-Wall Manufacturing Company, or approved equal.

Reinforcement for lintels and other reinforcement not specified otherwise, shall conform to ASTM Specification A-615.

### **Expansion or Control Joint Filler Strips**

Strips shall be of natural or synthetic rubber, wide flange type as manufactured by Dur-O-Wall Manufacturing Company, or approved equal; resistant to oils and solvents and meet the flexure test being exposed to a temperature of minus 40°F, as required by ASTM Specification D-736.

### **Pointing and Cleaning Masonry**

Point all holes in exposed masonry. Cut out defective joints and repoint them with mortar. All exposed masonry shall be cleaned thoroughly.

Concrete masonry units shall have all loose mortar cleaned off and all stains removed.

## **CONCRETE MASONRY**

### **Materials**

Concrete masonry units shall be hollow load bearing crushed stone, aggregate units conforming to ASTM Specification C-90, Grade "N-I".

The moisture content of all masonry concrete units at the time of delivery shall not exceed 25% of the total absorption. The maximum linear drying shrinkage of concrete masonry units shall not exceed 0.040 percent as tested by the procedure described in ASTM Specification C-426.

The unit manufacturer shall certify that the units delivered to the job meet the requirements specified herein and shall submit tests to the Engineer from each lot furnished. The reports shall give compressive strength in pounds per square inch; water absorption in pounds per cubic foot; moisture content in percent of total absorption; and the linear drying shrinkage in percent of total gauge length.

Selection of test specimens will be made by the Engineer from units delivered to the job site in accordance with ASTM C-140.

Units shall have face dimensions of 15-5/8" x 7-5/8". Corner units shall have square external corners. Provide jamb units at doors and windows, bond beam units and other special units as necessary for the conditions shown. The texture of units shall match the approved samples for the type of construction and locations designated. Units shall not contain iron spots or other substances that will stain plaster or paint.

Include all special shapes for jambs, bond beams, lintels and other items required for a complete job.

## **Workmanship**

Lay units plumb and true to line and grade with level, accurately spaced courses; in running bond unless otherwise indicated on Drawings or in Schedules. Keep corners plumb and true; chases and raked joints free of mortar and debris. Do not dampen units prior to laying.

Use and place mortar within 2 hours after mixing. Mortar that has stiffened may be re-tempered with the minimum of water necessary to obtain desired workability and proper water retention. (See ASTM C-270) Discard any mortar that has not been used in 2-1/2 hours.

Where electric conduit, outlet and switch boxes occur, grind and cut units before building in services. Coordinate with Electrical Work. Use power saw for cutting units exposed in finished work.

Reinforce all concrete masonry walls as follows:

Walls: The top course of all walls, the first two (2) courses above and below all openings (extend not less than 18 inches beyond each edge of openings), and in addition – every other course (32" o/c).

All joists and beams shall bear on concrete filled bond beams or solid units to a minimum depth of 8 inches; or a combination of both as detailed. In no case shall structural members bear directly on hollow masonry units unless the cores are filled.

At all windows and door openings: Fill cores of units with 3,000 psi concrete for three (3) courses below bearing of lintels and a distance of at least 16 inches each side of opening. Provide two (2) #4 rebars in each of two (2) cores.

Where any concentrated load occurs: Fill cores of units with 3,000 psi concrete from bearing area to foundation and a distance of not less than 8 inches each side of bearing area.

Bond each course at corners in a masonry bond and at intersections with metal ties, anchors, or joint reinforcement spaced vertically not exceeding 16 inches.

All walls shall be topped off with a bond beam. Cast-in-place lintels and bond beams are formed in place with special shaped units and reinforced with not less than two (2) #4 deformed bars. Run bars continuously in bond beams. Fill bond beams and lintels with 3,000 psi concrete. Lintels shall have a minimum of 8 inches bearing each end. Provide temporary support under lintels as necessary.

## **MORTAR**

### **Mortar Materials**

Portland Cement shall conform to ASTM Specifications C-205. Type IS grey in color.

Masonry Cement shall conform to ASTM Specification C-91, Type II. Cement shall be grey except where other color is specified hereinafter. Universal-Atlas Masonry Cement is acceptable.

Non-Staining Portland Cement shall conform to the requirements specified for Type I Cement in ASTM Specification C-150 and shall not contain more than 0.03 percent of water soluble alkali and shall not stain other materials and surfaces with which it is in contact. Cement shall be grey except for locations where white is specified hereinafter.

Hydrated Lime shall be Type S conforming to ASTM Specification C-207. Quick-lime shall conform to ASTM Specification C-5; it shall be grey except for locations where white is specified hereinafter.

Lime Putty shall be a stiff mixture of lime and water. Keep putty moist until used. Putty made from quicklime shall be slaked and allowed to soak at least 24 hours before using. Putty made from Type S hydrated lime may be used immediately after mixing.

Sand shall conform to ASTM Specification C-144 except that sand for mortar in ¼ inch wide joints shall pass a No. 16 sieve.

Mixing Water shall be clean and free from oil and acids, alkali or organic matter.

Mortar for all unit masonry not specified otherwise shall be mixed in the proportions of 1 part Portland or Portland Blast Furnace Slag Cement, 1/2 to 1-1/4 parts hydrated lime or lime putty and 4-1/2 to 6 parts of sand by volume. At the option of the Contractor, mortar may be mixed in the proportions of 1 part masonry cement and 2-1/4 to 3 parts of sand by volume. (ASTM C-270 – Type N – 750 PSI).

### **Mixing Mortar**

Mix all cementitious materials and sand in a mechanical batch mixer for a minimum of 5 minutes. Adjust the consistency of the mortar to the satisfaction of the mason, but add only as much water as is compatible with convenience in using the mortar. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, retemper the mortar immediately by adding water, and remix the mortar. All mortar shall be used within 2 hours of the initial mixing. It shall not be used after it has begun to set.

Measuring of cement, lime and sand quantities shall be by means of an approved measuring container such as a cubic foot box, not by shovelful.

Once a mix has been established, it shall not be changed throughout the job except by approval of the Engineer.

### **BLOCK VENTS**

Block vents shall be factory painted cast aluminum frame 16" wide x 8" high (nominal) with aluminum mesh screen on interior, 20 ga. damper on interior with exterior screw operator and continuous top and bottom drip.

Block vents shall be built into wall by mason.

### **HOLLOW METAL DOORS AND FRAMES**

#### **Materials**

Except as otherwise specified herein, or specifically approved by the Engineer, all hollow metal doors and frames shall be products of a name-brand door manufacturer with a minimum of 10 years of door manufacturing experience.

Shop drawings for metal frames shall be submitted to Engineer for approval and shall indicate:

1. Elevations of each door type.
2. Details of each frame type (doors, sidelines, transoms and windows).
3. Location in the building for each item.
4. Conditions at openings with various wall thicknesses and materials.
5. Typical and special details of construction.
6. Methods of assembling sections.
7. Location and installation requirements for hardware.
8. Materials and finishes.
9. Size, shape and thickness of materials.

Metal for frames shall be cold-rolled or galvanized steel sheets with clean smooth surfaces. Steel frames for exterior doors shall be 14 gauge and shall be galvanized.

Provide concealed metal reinforcements for hardware as required. The gauges of metal for reinforcement shall be no lighter than those required by Commercial Standard CS 242-62.

The finished work shall be strong and rigid, neat in appearance and free from defects. Fabricated molded members straight and true with corner joints well formed, in true alignment. Where practical, conceal fastenings. Where exterior frames are set in masonry, provide a caulking groove, 1/4" wide by 5/8" deep, with a closed back, to receive the caulking compound.

Welded type frames shall be mitered or butted and continuously arc-welded for full depth and width of frame and trim. All contact edges shall be closed tight and all welds on exposed surfaces dressed smooth and flush.

Frames shall be prepared at the factory for the installation of hardware. Welding of hinges to frames will not be permitted. Frames shall be mortised, reinforced, drilled and tapped to templates to receive all mortised hardware; frames to receive surface applied hardware shall be provided with reinforcing plates only. For steel frames set in masonry, provide masonry wire tee anchors.

Shop Painting: Apply a primed finish to all ferrous metal surfaces. Clean and chemically treat metal surfaces to assure maximum paint adherence; follow with a dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces. Finished surfaces shall be smooth and free from irregularities and rough spots.

Each coat of paint shall be separately baked or oven dried in accordance with manufacturer's recommendations.

Weatherstrip Frames: All exterior frames shall be provided with a flexible seal interlocked into the jambs and head by a tab and slot connection installed in factory; or provide neoprene weatherstripping as selected by the Engineer. Material shall be plastic and impervious to fatigue and withstand extreme temperatures.

Door Sizes and Clearances: Doors shall be of type, sizes and design indicated; 1-3/4" thick, unless designated otherwise. The clearances for doors shall be 1/8" at jambs and heads and 5/8" at bottom, unless indicated or specified otherwise.

Construct doors of two outer steel sheets not lighter than 18 gauge and with edges, finished flush. Seams or joints will not be permitted on door faces. Top, sides and bottom of door shall be welded flush with all welds ground smooth. The outer face sheets shall be reinforced with all welds ground smooth. The outer face sheets shall be reinforced with either 22 gauge interlocking vertical channels or z-shaped

members spaced not more than 8-1/2" apart, and spot welded to outer sheets; or with 24 gauge horizontal U-shaped sections spaced in parallel rows not over 8-1/2" on center and welded in alternating sequence to the inside face of each outer sheet so that a horizontal stiffening occurs approximately 17" on each face sheet. Provide approved sound absorbing material on inside of door to eliminate the metallic sound. Exterior doors must be fully insulated with rockwool.

Louvers, if indicated for doors shall be stationary, siteproof type with the size indicated on the drawings, with watertight shutters.

Louvers shall be steel Barber-Coleman, 1/2" thick, "Gov. Site-Tite" with non-die formed fins. Size shall be as indicated on the drawings. All such grilles shall be primed with gray or beige primer.

### **Workmanship**

Set frames in position; plumb, align and brace securely under permanent anchors are set. Anchor bolt of frames to floors with expansion bolts or with power fasteners. Where frames require ceiling struts or other structural overhead bracing, they shall be anchored securely to ceilings or structural framing above, as indicated or specified.

The finished work shall be rigid, neat in appearance and free from defects. Form molded members straight and true with joints coped or mitered, well formed and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so they are invisible after finishing.

### **FINISH DOOR HARDWARE**

#### **Materials**

Selection of the appropriate lockset shall be coordinated within the facility operators.

All finish hardware shall be in accordance with the applicable Indiana Building Codes.

#### **HARDWARE**

##### **Hardware Set – Exterior Door**

All finish hardware shall be furnished and installed by the Contractor. All doors shall be furnished with closers, hook to hold in open position and dead bolt locks. The deadbolt lock shall allow for a core provided by the Owner. The Owner currently uses locks supplied by "Best".

#### **Shop Drawings**

Submit to Engineer for approval, Shop Drawings showing typical construction of all items. The Drawings shall show the conditions at doors with various wall thickness and materials and a schedule listing the location in the building for each item.

**NOTE:** All frames abutting masonry shall be completely filled with mortar.

#### **Workmanship**

After installation, demonstrate to the Engineer that all components are in proper working order.

## **ROOFING**

Roofing components shall be as shown on the Plans.

### **General**

## **PAINTING**

### **Scope**

Work under this heading includes the painting and finishing work in accordance with the Plans and Specifications substantially as follows:

1. Painting of all new wood work.
2. Painting of all exposed steel items on exterior of building.
3. Painting of all exposed to view in interior of building, steel items such as metal door frames, metal doors, steel beams, columns, angles, headers, etc.
4. Painting of all exposed concrete block on interior of building.
5. Painting of all piping, valves, fittings, including all above the floor parts of the pump not having a factory applied finish.
6. Painting of items installed by Electrical Contractor and exposed to view such as: conduit and fittings and panelboards, etc. having only factory applied prime coat.

### **General Notes:**

1. Include all field painting necessary to complete work shown and specified.
2. Prime coats specified herein will not be required on items delivered with prime or shop coats already applied.
3. Field painting will not be required on items specified to be completely furnished at factory or on structural or miscellaneous steel items that will not be exposed to view in the completed structure.

### **Priming and Back-Priming**

Prime and back-prime all surfaces of millwork indicated to be varnished, also back-prime all unexposed faces of all millwork indicated, scheduled or specified to be stained. Parts inaccessible after assembly shall be primed or back-primed before assembly. Shellac all knots, streaks, etc., before priming. Do all priming and back-priming with approved primers. Priming colors as Engineer directs. Materials delivered at job without priming, back-priming and/or shop coats are not acceptable and will be rejected. Keep in contact with job; cooperate with Carpentry and Millwork Contractor.

### **Cleaning**

1. The Contractor shall be responsible for marring, spotting and/or staining of floors or other work and shall either entirely remove said stains, etc., or replace damaged materials with approved materials and make good any damage to other work in connection with said removal and replacement at this expense without extra cost to Owner.

### **Preparation**

1. Wood – Sandpaper to smooth and even surface and then dust off. After priming or stain coat has been applied, thoroughly fill nail and other holes and cracks; use plastic wood filler for stained work and putty for painted work.
2. Steel and Iron – Remove grease, rust scale and dust and touch up any chipped or abraided placed on items that have been shop coated.
3. Galvanized Metal – Thoroughly clean with gasoline and coat as specified.
4. Concrete Block – Remove all foreign material and wipe clean.
5. General – Before painting, remove hardware, accessories, plates, lighting fixtures and similar items or provide ample protection of such items. Upon completion of each space, replace above items. Remove doors if necessary to paint bottom edge. Use only skilled mechanics for removing and connecting above items.

### **Colors**

The Owner or Engineer will select all colors.

### **Paint Material**

All materials used under this heading shall be as manufactured by the O'Brien Paint Company, Glidden Company, Sherwin-Williams, Benjamin Moore, Pittsburgh Paint, Pratt & Lambert, National Chemical Manufacturing Company, or an approved equal.

All paint shall be ready-mixed and delivered to the site in manufacturer's sealed containers. Each container shall be labeled by the manufacturer. Labels shall give manufacturer's name, type of paint, color of paint and instructions for reducing. Thinning shall be done only in accordance with directions of manufacturer. Job mixing or job tinting may be done when approved by the Engineer.

All mixing required shall be done on premises and materials shall be thoroughly stirred. No materials shall be reduced or changed in any way, except as specified.

### **Schedule of Paint**

The kind and number of coats required on the various surfaces shall be as follows:

1. Exterior Exposed Steel  
First Coat – Approved rust inhibitive paint  
Second Coat – Approved Alkyd Semi Gloss Enamel  
Third Coat – Approved Alkyd Semi Gloss Enamel

Use this finish on all new exposed steel work such as pipe railings, exposed surfaces of steel angle lintels, hollow metal doors and frame.

### **Backfilling of Structures**

Prior to any backfilling around poured-in-place structures, adequate provisions shall be made to prevent any displacement of the walls, footings, or other elements of the structures, and the Engineer shall inspect the structure and approve the placing of the backfill. All footings, foundations, below ground drainage systems, all concrete and masonry walls, all waterproofing, damp-proofing, or surface treatment of the walls shall be complete. The backfill shall not be placed for one (1) week against poured walls, or at such lesser or longer time as directed by the Engineer in writing.

Unstable materials such as frozen earth, clay lumps, and other materials which will not compact properly, and foreign material such as wood, rock, broken masonry, brick, old concrete, metal, stones, etc. shall not be used in the backfill, or for fill around the site.

Backfilling around foundations, footings and pipes shall be done with acceptable granular material, and in eight (8) inch layers, each compacted to a 95% maximum density by approved tamping or vibrating equipment prior to the placing of the following layer of material.

During backfilling operations the material shall not be dropped on the pipe or on or against the structure walls, and during the compacting process the Contractor shall be careful that the new work is not displaced during the operation.

The Contractor shall remove all excess or surplus material from the site after completion of the project.

### **Compaction and Tests**

Compaction to 95% maximum density is a requirement for all backfill in excavations which will support floor slabs, foundations, footings, etc., and in trenches which will support pavements, slabs, foundations, etc. the 95% maximum density shall be determined by ASTM D698 of the latest issue, based on the moisture-density of soils, Method C, using a 5.5 pound rammer and a 12-inch drop.

An approved testing laboratory shall make the density-compaction tests with results sent directly to the Engineer.

Two tests will be required for each structure and two tests will be required for every 400 feet of trench, unless otherwise ordered by the Engineer.

## **WORK ITEM W-2 – INTAKE STRUCTURE AND CATWALK**

### **DESCRIPTION**

The Contractor shall furnish all necessary equipment, labor and materials to construct the Intake Structure with catwalk as shown on the project drawings. The work shall include the concrete foundation slab, catwalk with support, metal frame and screen, piping, valves, fittings, piping screen, appurtenances and all other work required to complete the work as shown on the project plans.

### **MATERIALS**

All materials shall conform to current codes.

Refer to Plans and Work Item W-1 Pump Well House for concrete and cement reinforcing steel requirements. Refer to Plans for structural steel requirements.

### **CONSTRUCTION REQUIREMENTS**

All equipment, construction methods and materials shall conform to the current and applicable provisions of local, State and National Codes, and as detailed in the design drawings.

***APPENDIX A***  
***ORTMAN DRILLING***  
***TEST BORING AND SIEVE ANALYSIS REPORT***



**RTMAN**  
**Drilling & Water Services**  
Research - Design - Construction - Maintenance  
241 N. 300 W. • Kokomo, IN 46901 • 765-459-4125 FAX 765-459-8750

June 20, 2014

PB13066

Dennis Zebell, PE  
Lawson-Fisher Associates  
525 West Washington Avenue  
South Bend, IN 46601

**Re:** DNR - Fawn River Fish Hatchery  
Test Boring and Sieve Analysis

Dennis,

**Ortman Drilling & Water Services** is pleased to provide you with this report on the recently completed test boring and sieve analysis from Fawn River Hatchery.

The attached well log shows formation available from 60-99 feet below grade. This material is coarse, with some fines, but sufficient for construction of a well with the following basic design:

|                               |  |
|-------------------------------|--|
| Total depth                   | 97'  |
| Total screen length           | 20'  |
| Well & screen diameter        | 12"  |
| Well screen slot size         | 0.080" (80 thousandths) assuming wire wound stainless steel screen |
| Potential production capacity | 650gpm (assuming approx. 50% plugging of screen by fines)          |

Based on the construction of the existing well on the west side of SR327 the 100year flood elevation will need to be considered for final elevation and design of the well head.

Pump system design will require a flow test on a completed test well. Test well may be constructed to permanent well specifications but based on the existing well and the formation, the design flow rate for bidding purposes may be based on 650gpm at a pumping level of 77' with design head calculated by Lawson Fisher at the well head for total head determination. Some variation in these numbers should be expected but this may serve as the basis for initial bid.

Sieve analysis and well log should be included with bid materials.

Location of the permanent well should be within approximately 5-10' of the test boring so that sieve analysis and depth estimates can be used in the bidding process. To move further from this test boring would require a second test boring to evaluate potential formation changes.

If you have any questions or need additional information, please call anytime.

Sincerely,

**Ortman Drilling & Water Services**

**Phil Bonneau, L.P.G.**  
Hydrogeologist

**RECEIVED**

JUN 26 2014

**LAWSON - FISHER ASSOCIATES, P.A.**

PB13066



**RECORD OF WATER WELL**  
State Form 35680 (R5/9-04)

Driller—Mail complete record in 30 days to:  
**INDIANA DEPT. OF NATURAL RESOURCES**  
Division of Water  
402 W. Washington St., Rm. W254  
Indianapolis, IN 46204-2641  
(877) 928-3736 toll-free or (317) 232-4160

County Permit Number   
DNR Variance Number

Fill in completely

Include if applicable

| WELL IDENTIFICATION   |  |  |  |   |   |  |   |  |  |  |  |
|---|--|--|--|---|---|--|---|--|--|--|--|
| County where drilled<br><b>Stauben</b>  |  | Civil township name<br><b>Millgrove</b>  |  | Township number (N-S)<br><b>38n</b>   |   | Range number (E-W)<br><b>12e</b>   |   | Section<br><b>20</b>                                       |  |  |  |
| Drilling direction to the well location (including origin, street & road names, intersecting roads, and compass directions) Show well address and subdivision in box at lower right.<br><b>Approx 1181 ft. south of co. rd 700 n. on east side of St.Rd. 327. ( about 60 ft. south of drive and 75 ft. east of st.rd. 327)</b>  |  |  |  |   |   | UTM Northing<br><b>4622578</b>   |   | UTM Easting<br><b>652070</b>                               |  |  |  |
|   |  |  |  |   |   | Datum <input checked="" type="checkbox"/> NAD 27 <input type="checkbox"/> NAD 83 |   | GPS used   |  |  |  |
|   |  |  |  |   |   | Subdivision name & lot number (if applicable)                                    |   |  |  |  |  |
| If drilled for water supply, this well is: <input type="checkbox"/> first well on property <input type="checkbox"/> Replacement well <input type="checkbox"/> Additional well on property <input type="checkbox"/> Dry hole   |  |  |  |   |   |  |   |  |  |  |  |
| OWNER CONTRACTOR  |  |  |  |   |   |  |   |  |  |  |  |
| Owner-Fawn River  |  |  |  |   |   |  |   |  |  |  |  |
| Building contractor-name  |  |  | Address (number and street, city, state, ZIP code)   |   |   |  | Telephone Number                        |  |  |  |  |
| Drilling contractor-name<br><b>Ortman Drilling</b>  |  |  | Address (number and street, city, state, ZIP code)<br><b>241 N. 300 W. Kokomo, Indiana 46901</b> |   |   |  | Telephone number<br><b>765-459-4125</b> |  |  |  |  |
| Equipment operator-name<br><b>Clint Barker-Rick Ortman-Brad Hodges</b>  |  |  | License number<br><b>1964-330</b>  |   | Date of well completion<br><b>6/11/2014</b> |  |   |  |  |  |  |
| CONSTRUCTION DETAILS  |  |  |  |   |   |  |   |  |  |  |  |
| Use of well<br><input type="checkbox"/> Home<br><input type="checkbox"/> Public supply<br><input type="checkbox"/> Industrial / commercial<br><input checked="" type="checkbox"/> Livestock<br><input type="checkbox"/> Irrigation<br><input type="checkbox"/> Monitoring / environ.<br><input checked="" type="checkbox"/> Test boring<br><input type="checkbox"/> other |  | Drilling method<br><input checked="" type="checkbox"/> Rotary<br><input type="checkbox"/> Reverse rotary<br><input type="checkbox"/> Cable tool<br><input type="checkbox"/> Jet<br>Bucket / bore Auger (including HAS)<br><input type="checkbox"/> Direct push<br>Other: |  | Type of pump<br>Submersible<br><input type="checkbox"/> Shallow-well jet<br><input checked="" type="checkbox"/> Deep-well jet<br><input type="checkbox"/> No pump installed<br>Other: |   | Pump depth setting (feet)  |   | FORMATIONS: Type of material                               |  | From (feet) To (feet)                        |  |
| Total depth of well (feet) <b>122</b>   |  | Borehole diameter (in.) $\phi$ 1/4   |  | Gravel pack inserted Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>  |   | fine to coarse sand and gravel and cobbles                                       |   | 0  |  | 49   |  |
| Casing length (feet) <b>n/a</b>   |  | Casing diameter (in.) <b>n/a</b>   |  | Casing material <b>pvc</b>  |   | gray clay  |   | 49   |  | 60   |  |
| Screen length (feet) <b>n/a</b>   |  | Screen diameter (in.) <b>n/a</b>   |  | Screen material <b>PVC</b>  |   | fine to coarse sand and gravel and cobbles                                       |   | 60   |  | 99   |  |
| Screen slot size <b>n/a</b>   |  | Water quality (clear, odor, etc.) <b>n/a</b>   |  | no screen   |   | brown clay   |   | 99   |  | 122  |  |
| Test method<br><input type="checkbox"/> Air<br><input checked="" type="checkbox"/> Bailing  |  | Static level below surface<br><b>n/a</b>   |  | Gallons per min. <b>n/a</b>   |   | Hours tested <b>n/a</b>  |   | Drawdown (change in level)<br><b>feet</b>                  |  | used 9 bags drilling mud and 2000 gal. water |  |
| GROUTING  |  |  |  |   |   |  |   |  |  |  |  |
| Grout material  |  | Grout depth from to  |  | Material <b>Ben SEAL</b>  |   | Depth filled from to   |   |  |  |  |  |
| Installation method   |  | No. of bags used   |  | Installation method   |   | quantity   |   |  |  |  |  |
|   |  |  |  | Pumped with tremie  |   | 11   |   | Additional space for well log and comments on reverse side |  |  |  |
| I hereby swear or affirm, under the penalties for perjury, that the information submitted herewith is, to the best of my knowledge and belief, true, accurate, and complete.  |  |  |  | Signature of drilling contractor or authorized representative<br><b>bobroberts</b>  |   |  |   | MUST BE SIGNED OR STAMPED                                  |  | Date<br><b>6/13/2014</b>                     |  |

Ortman Drilling & Water Services  
 241 North 300 West  
 Kokomo, Indiana 46901  
 (765) 459-4125

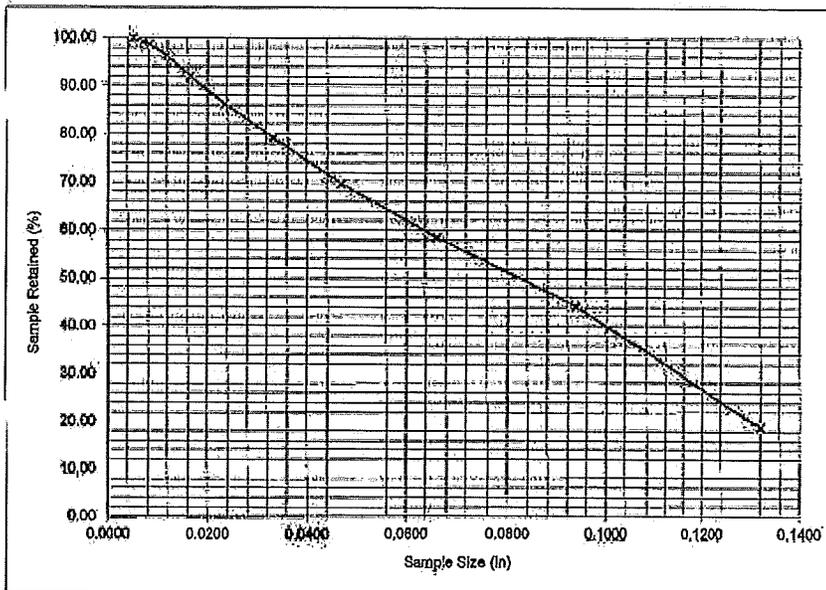


Well: FALLEN  
 Location: Fawn River Fish Hatchery  
 Date sieved: 01/17/2014  
 By: TBR

Sieved Interval (feet): 60-67

| Sieve No.<br>(U.S.A.S.E.) | Mesh Size<br>(inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|---------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                         | 0.1875                | 40.0                                 |                                  |                                   |
| 6                         | 0.1320                | 190.0                                | 18.89                            | 18.89                             |
| 8                         | 0.0937                | 254.0                                | 25.25                            | 44.14                             |
| 12                        | 0.0681                | 145.0                                | 14.41                            | 58.55                             |
| 18                        | 0.0468                | 112.0                                | 11.13                            | 69.68                             |
| 20                        | 0.0331                | 97.0                                 | 9.64                             | 79.32                             |
| 30                        | 0.0234                | 70.0                                 | 6.96                             | 86.28                             |
| 40                        | 0.0165                | 58.0                                 | 5.77                             | 92.05                             |
| 50                        | 0.0117                | 43.0                                 | 4.27                             | 96.32                             |
| 70                        | 0.0083                | 24.0                                 | 2.39                             | 98.71                             |
| 80                        | 0.007                 | 4.0                                  | 0.40                             | 99.11                             |
| <80                       | 0.0050                | 8.0                                  | 0.89                             | 100.00                            |

Total Sample Processed (grams) 1008



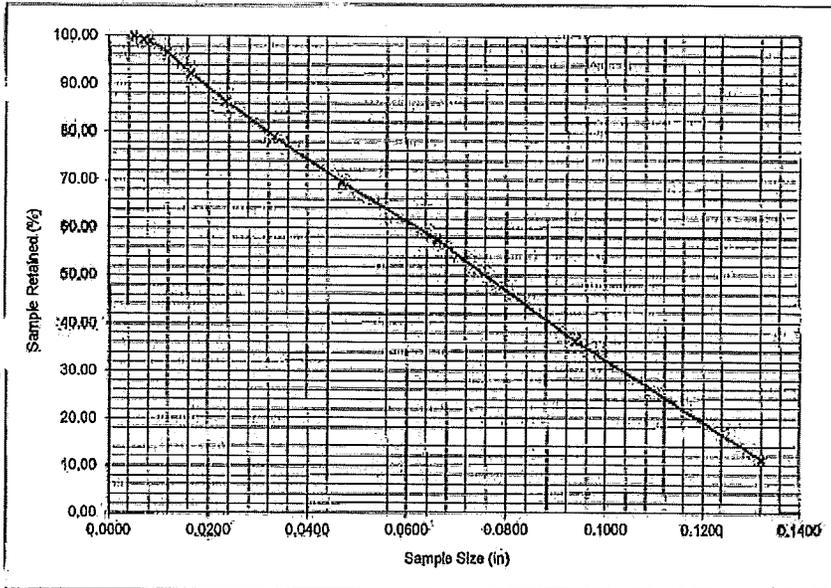
Ortman Drilling & Water Services  
 241 North 300 West  
 Kokomo, Indiana 46901  
 (765) 459-4125



Well: P013004  
 Location: Fawn River Fish Hatchery  
 Date sieved: 6/17/2014  
 By: TSP

Sieved Interval (feet): 87-72

| Sieve No.<br>(U.S.A.S.E.)      | Mesh Size<br>(inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|--------------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                              | 0.1875                | 43.0                                 |                                  |                                   |
| 8                              | 0.1320                | 116.0                                | 11.28                            | 11.28                             |
| 16                             | 0.0937                | 250.0                                | 24.90                            | 36.18                             |
| 30                             | 0.0661                | 220.0                                | 21.40                            | 57.58                             |
| 40                             | 0.0469                | 123.0                                | 11.96                            | 69.53                             |
| 60                             | 0.0331                | 97.0                                 | 9.44                             | 78.99                             |
| 80                             | 0.0234                | 76.0                                 | 7.39                             | 86.38                             |
| 100                            | 0.0165                | 60.0                                 | 5.84                             | 92.22                             |
| 150                            | 0.0117                | 45.0                                 | 4.38                             | 96.60                             |
| 200                            | 0.0083                | 25.0                                 | 2.43                             | 99.03                             |
| 300                            | 0.007                 | 3.0                                  | 0.29                             | 99.32                             |
| 400                            | 0.0050                | 7.0                                  | 0.68                             | 100.00                            |
| Total Sample Processed (grams) |                       | 1028                                 |                                  |                                   |



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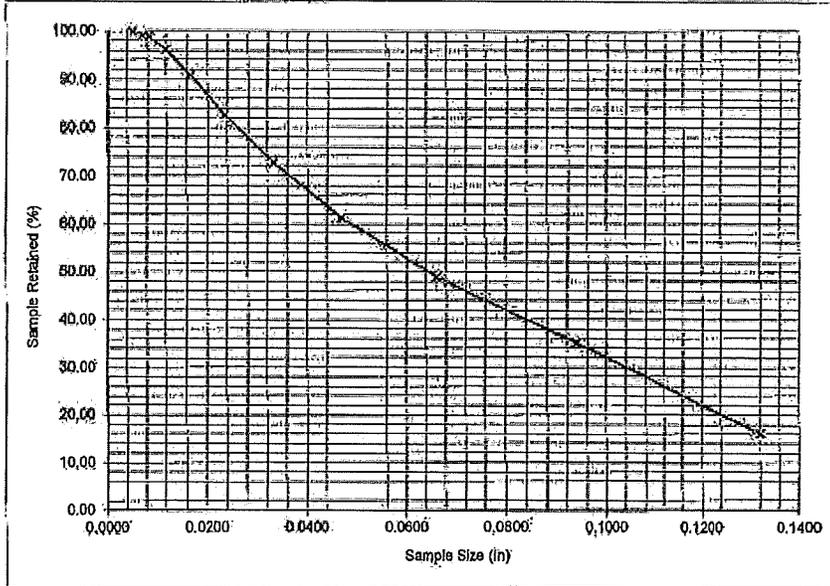


Well: PB13088  
 Location: Fawn River Fish Hatchery  
 Date sieved: 6/17/2014  
 By: TSB

Sieved Interval (feet): 72-77

| Sieve No.<br>(U.S.A.S.E.) | Mesh Size<br>(Inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|---------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                         | 0.1875                | 93.0                                 |                                  |                                   |
| 6                         | 0.1320                | 184.0                                | 18.11                            | 18.11                             |
| 8                         | 0.0937                | 194.0                                | 19.06                            | 35.17                             |
| 12                        | 0.0661                | 140.0                                | 13.75                            | 48.92                             |
| 16                        | 0.0489                | 128.0                                | 12.38                            | 61.30                             |
| 20                        | 0.0334                | 117.0                                | 11.49                            | 72.79                             |
| 30                        | 0.0234                | 101.0                                | 9.92                             | 82.71                             |
| 40                        | 0.0165                | 84.0                                 | 8.25                             | 90.96                             |
| 60                        | 0.0117                | 54.0                                 | 5.30                             | 96.27                             |
| 70                        | 0.0083                | 27.0                                 | 2.65                             | 98.92                             |
| 80                        | 0.007                 | 3.0                                  | 0.29                             | 99.21                             |
| <80                       | 0.0050                | 8.0                                  | 0.78                             | 100.00                            |

Total Sample Processed (grams) 1018



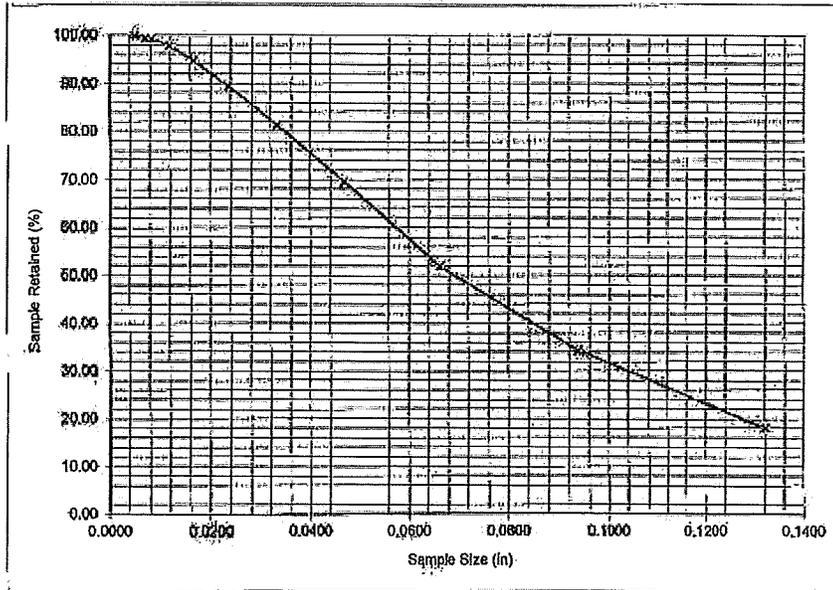
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 241 North 300 West  
 Kokomo, Indiana 46901  
 (765) 459-4125



Well: P&1306a  
 Location: Fawn River Fish Hatchery  
 Date sieved: 5/11/2014  
 By: TEP

Sieved Interval (feet): 77-82

| Sieve No.<br>(U.S.A.S.E.)      | Mesh Size<br>(inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|--------------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 2                              | 0.1670                | 273.0                                |                                  |                                   |
| 4                              | 0.1320                | 140.0                                | 18.09                            | 18.09                             |
| 6                              | 0.0937                | 126.0                                | 16.28                            | 34.37                             |
| 12                             | 0.0661                | 138.0                                | 17.57                            | 51.94                             |
| 16                             | 0.0489                | 137.0                                | 17.70                            | 69.64                             |
| 20                             | 0.0331                | 80.0                                 | 11.63                            | 81.27                             |
| 30                             | 0.0234                | 83.0                                 | 8.14                             | 89.41                             |
| 40                             | 0.0165                | 41.0                                 | 5.30                             | 94.70                             |
| 50                             | 0.0117                | 24.0                                 | 3.10                             | 97.80                             |
| 70                             | 0.0083                | 11.0                                 | 1.42                             | 99.22                             |
| 80                             | 0.007                 | 1.0                                  | 0.13                             | 99.35                             |
| 100                            | 0.0050                | 0.0                                  | 0.85                             | 100.00                            |
| Total Sample Processed (grams) |                       | 774                                  |                                  |                                   |



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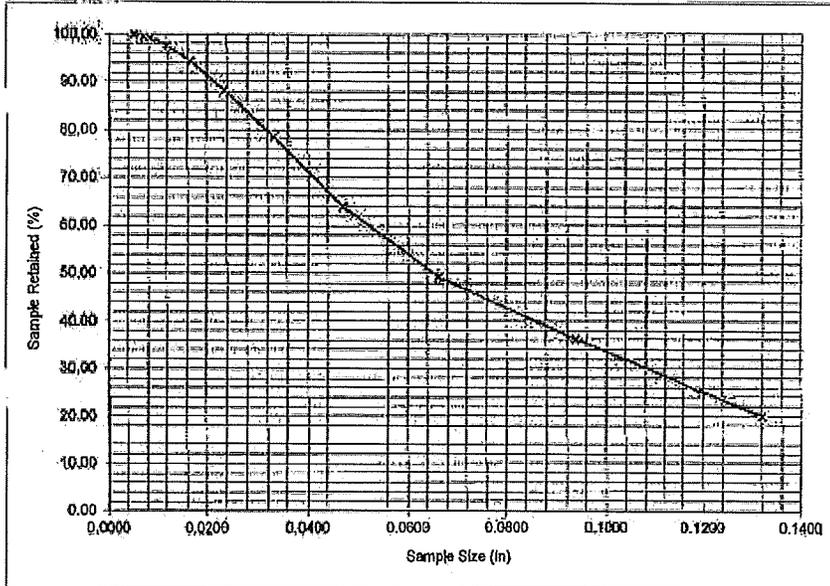
Well:  
 Location:  
 Date sieved:  
 By:

PS13066  
 Fawn River Fish Hatchery  
 6/17/2014  
 188-

Sieved Interval (feet): 82-87

| Sieve No.<br>(U.S.A.S.E.) | Mesh Size<br>(Inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|---------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                         | 0.1070                | 130.0                                |                                  |                                   |
| 6                         | 0.1320                | 190.0                                | 19.98                            | 19.98                             |
| 8                         | 0.0937                | 155.0                                | 16.30                            | 36.28                             |
| 12                        | 0.0681                | 124.0                                | 13.04                            | 49.32                             |
| 16                        | 0.0469                | 140.0                                | 14.72                            | 64.04                             |
| 20                        | 0.0331                | 138.0                                | 14.51                            | 78.55                             |
| 30                        | 0.0234                | 93.0                                 | 9.78                             | 88.33                             |
| 40                        | 0.0165                | 58.0                                 | 6.10                             | 94.43                             |
| 50                        | 0.0117                | 31.0                                 | 3.26                             | 97.69                             |
| 70                        | 0.0083                | 15.0                                 | 1.58                             | 99.26                             |
| 80                        | 0.007                 | 2.0                                  | 0.21                             | 99.47                             |
| <80                       | 0.0050                | 5.0                                  | 0.53                             | 100.00                            |

Total Sample Processed (grams) 881



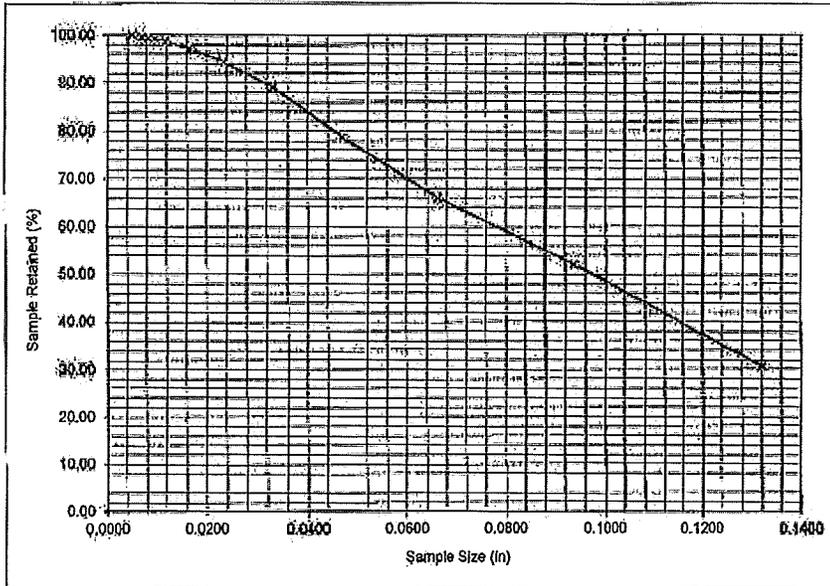
Ortman Drilling & Water Services  
 241 North 300 West  
 Kokomo, Indiana 46901  
 (765) 459-4125



Well: PBI3086  
 Location: Fawn River Fish Hatchery  
 Date sieved: 4/17/03  
 By: TBP

Sieved Interval (feet): 87-82

| Sieve No.<br>(U.S.A.S.E.)      | Mesh Size<br>(Inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|--------------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                              | 0.4250                | 291.0                                |                                  |                                   |
| 6                              | 0.1320                | 247.0                                | 30.68                            | 30.68                             |
| 8                              | 0.0937                | 172.0                                | 21.37                            | 52.05                             |
| 12                             | 0.0661                | 113.0                                | 14.04                            | 66.09                             |
| 16                             | 0.0476                | 102.0                                | 12.67                            | 78.76                             |
| 20                             | 0.0331                | 63.0                                 | 10.31                            | 89.07                             |
| 30                             | 0.0234                | 43.0                                 | 5.34                             | 94.41                             |
| 40                             | 0.0165                | 22.0                                 | 2.73                             | 97.14                             |
| 50                             | 0.0117                | 12.0                                 | 1.49                             | 98.63                             |
| 70                             | 0.0083                | 6.0                                  | 0.76                             | 99.39                             |
| 80                             | 0.007                 | 1.0                                  | 0.12                             | 99.50                             |
| <80                            | 0.0050                | 4.0                                  | 0.50                             | 100.00                            |
| Total Sample Processed (grams) |                       | 306                                  |                                  |                                   |



Ortman Drilling & Water Services  
 241 North 300 West  
 Kokomo, Indiana 46901  
 (765) 459-4125

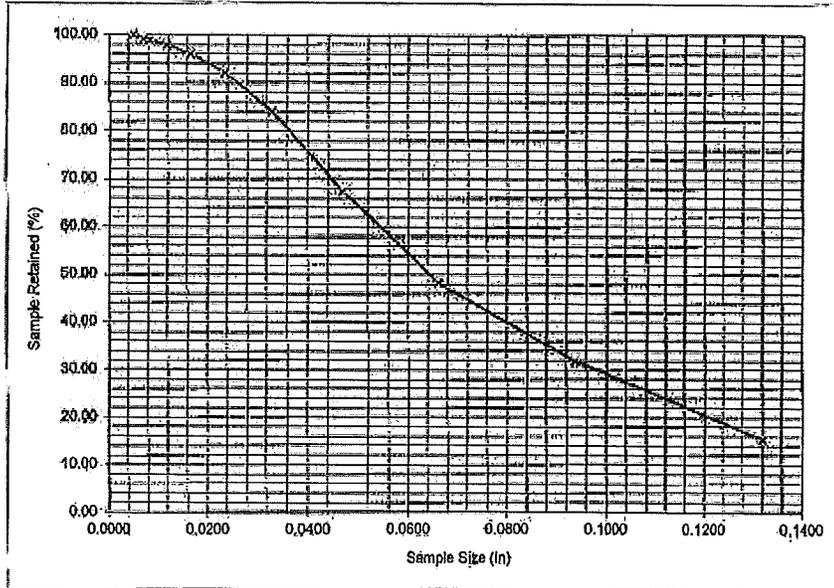


Well: 251398  
 Location: Fawn River Fish Hatchery  
 Date sieved: 6/7/2014  
 By: TSB

Sieved Interval (feet): 92-99

| Sieve No.<br>(U.S.A.S.E.) | Mesh Size<br>(Inches) | Sample Retained<br>(grams per sieve) | Sample Retained<br>(% per sieve) | Sample Retained<br>(cumulative %) |
|---------------------------|-----------------------|--------------------------------------|----------------------------------|-----------------------------------|
| 4                         | 0.4870                | 389.0                                |                                  |                                   |
| 6                         | 0.2500                | 122.0                                | 15.40                            | 15.40                             |
| 8                         | 0.0937                | 130.0                                | 16.41                            | 31.82                             |
| 12                        | 0.0861                | 130.0                                | 16.41                            | 48.23                             |
| 16                        | 0.0469                | 152.0                                | 19.19                            | 67.42                             |
| 20                        | 0.0331                | 131.0                                | 16.54                            | 83.99                             |
| 30                        | 0.0284                | 65.0                                 | 8.21                             | 92.17                             |
| 40                        | 0.0165                | 30.0                                 | 3.79                             | 95.96                             |
| 50                        | 0.0117                | 15.0                                 | 1.89                             | 97.85                             |
| 70                        | 0.0083                | 8.0                                  | 1.01                             | 98.86                             |
| 80                        | 0.007                 | 2.0                                  | 0.25                             | 99.12                             |
| 100                       | 0.0050                | 7.0                                  | 0.88                             | 100.00                            |

Total Sample Processed (grams): 792



***APPENDIX B***  
***PROJECT PLANS***