

# CITY OF SOUTH HAVEN

## STANDARD SPECIFICATIONS

### PART B

## PUMP STATIONS

June 2006

Project No. N262

# **CCJM**

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**PART A**

**Division 0: Not used**

**Division 1: General Requirements**

- 01010 Summary of Work
- 01012 Staking and Inspection Services
- 01013 Protection, Restoration and Notification
- 01060 Regulatory Requirements
- 01090 References
- 01200 Project Meetings
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- 01310 Construction Progress Schedules
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- 01630 Substitutions and Product Options
- 01700 Contract Closeout
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**Division 2: Sitework**

- 02100 Site Preparation
- 02222 Excavating, Backfilling, and Compacting for Utilities
- 02272 Soil Erosion and Sedimentation Control
- 02665 Water Distribution System
- 02723 Forcemain
- 02731 Sanitary Sewer System

**PART B**

**Division 3: Concrete**

- 03300 Cast-in-Place Concrete
- 03600 Grout

**Division 4 through Division 10: Not used**

**Division 11: Equipment**

- 11252 Wastewater Pump Station
- 11253 Chemical Feed System

**Division 12 through Division 15: Not used**

**Division 16: Electrical**

- 16101 Pump Station Electrical Work
- 16900 Controls and Instrumentation

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. The work includes all cast-in-place concrete.

**1.02 SUBMITTALS**

- A. Proposed mix design prepared by an approved independent testing firm for each class of concrete. Select proportions according to ACI 301-72, Section 3.8, Method 1 or Method 2. Approval of mix is required prior to placement of concrete.
- B. Shop drawings showing fabrication dimensions and locations for placing the reinforcing steel and accessories. Details of reinforcement and accessories shall be in accordance with ACI 315.
- C. Certifications for the following:
  - 1. Cement.
  - 2. Aggregates.
  - 3. Admixtures.
  - 4. Reinforcement: Mill test report.

**1.03 REFERENCES**

- A. ACI 318, Building Code Requirements for Reinforced Concrete.
- B. ACI 301, Specifications for Structural Concrete for Buildings.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Concrete:
  - 1. Cement: ASTM C150 or ASTM C595 (maximum fly ash content shall be 20% by weight). All cement used in exposed concrete shall be of the same brand from the same mill.
  - 2. Coarse aggregate: ASTM C33.
  - 3. Fine aggregate: ASTM C33.
  - 4. Mixing water: Clean, fresh, and potable.
  - 5. Admixtures:
    - a. Air-entraining: ASTM C260.
    - b. Water-reducing, retarding, and accelerating: ASTM C494. Calcium chloride will not be permitted as an admixture.
    - c. Pozzolanic admixtures: ASTM C618, Type F, loss on ignition limited to 4%.
- B. Reinforcement:
  - 1. Bars: Deformed, ASTM A615 (S1), Grade 60.
  - 2. Welded wire fabric: ASTM A185.
- C. Accessories:

1. Tie wire: 16 gage annealed.
  2. Chairs, bar supports, bolsters, spacers: CRSI, Class C for structural slabs, Class A, for slabs-on-grade.
  3. Form ties: Commercially manufactured, water seal form ties with minimum 1 inch diameter steel or neoprene collar at mid-point for walls subject to hydrostatic pressure.
- D. Premolded Joint Filler:
1. Exterior: ASTM D1751, non-extruding, bituminous.
  2. Interior: ASTM D1752, non-extruding, non-bituminous.
- E. Latex Bonding Agent: W.R. Meadows "Intralok", L&M Construction Chemicals "Everbond", Sonneborn "Sonocrete", or equal.
- F. Epoxy Bonding Agent: L&M Construction Chemicals "Permunitite", Sonneborn "Sonobond", Toch "Epotox 350", or equal.
- G. Vapor Barrier: 6 mil clear polyethylene film, below grade application.
- H. "Dry Shake" for Non-Slip Finish: Aluminum oxide type: L&M Construction Chemicals "Grip It", Toch "Toxgrip", Sonneborn "FricTex", or equal.
- I. Curing Compound, if used: ASTM C309.
- J. Floor Sealer/Compound: ASTM C309, Federal Specification TT-C- 800A: W.R. Meadows "CR-26-GSA", L&M Construction Chemicals "Surfaseal", Toch "Sealkure", or equal.
- K. Joint Sealant: Semi-rigid, non-tracking type: W.R. Meadows "Sealtight Gardox", or equal.
- L. Wall Finish: Thoro "ThoroSeal" applied according to manufacturer's instructions may be substituted for a grout cleaned finish specified in 3.01. J.4.

## **2.02 PROPORTIONING CONCRETE**

- A. Proportions and materials: See Schedule A.
- B. Admixtures: Approval of ENGINEER required. Use in accordance with the manufacturer's instructions.
- C. If the CONTRACTOR intends to place concrete by pumping, the mix design shall be prepared in accordance with these specifications and the recommendations of ACI 304.

## **2.03 FABRICATING REINFORCEMENT**

- A. Fabricate in accordance with approved shop drawings and ACI 315.
- B. Reinforcing splices: Class C unless otherwise shown.

## **PART 3 - EXECUTION**

### 3.01 PLACEMENT

#### A. Formwork:

1. Formwork design is the responsibility of the CONTRACTOR.
2. Earth cut forms are prohibited.
3. Place chamfer strips in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such exposed surfaces and the edges of formed joints will not require beveling.
4. Provide temporary openings at the base of forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
5. Construct form ties so that the ends or end fasteners can be removed without causing spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, terminate the embedded portion of the ties not less than 2 diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4 inch. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.
6. At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than 1 inch. Prevent offsets or loss of mortar at the construction joint and maintain a true surface.
7. Formwork tolerances: See Schedule B.
8. Clean form surfaces and embedded materials of accumulated mortar or grout from previous concreting and of other foreign material before placing concrete.
9. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded items.
10. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.
11. Do not allow excess release agent material to stand in puddles in the forms. Do not allow release agent to come in contact with hardened concrete against which fresh concrete is to be placed.
12. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.
13. Inform ENGINEER when formwork is complete and has been cleaned, to allow for inspection. Obtain approval prior to placing concrete.

#### B. Placement of Reinforcement:

1. Place reinforcement as indicated on approved shop drawings and to the following tolerances:
  - a. Clear distance to formed surfaces:  $\pm 1/4$  inch.
  - b. Minimum spacing between bars:  $-1/4$  inch.
  - c. Top bars in slabs and beams:
    - 1) Members 8 inches deep or less:  $\pm 1/4$  inch.
    - 2) Members more than 8 inches but not over 2 feet deep:  $\pm 1/2$  inch.
    - 3) Members more than 2 feet deep:  $\pm 1$  inch.

- d. Crosswise of members: spaced evenly within 2 inches.
  - e. Lengthwise of members:  $\pm 2$  inches.
  2. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars must be approved.
  3. Minimum concrete protective covering for reinforcement:
    - a. Concrete deposited against the ground: 3 inches.
    - b. Formed surfaces exposed to weather or in contact with the ground: 2 inches for reinforcing bars #6 or larger; 1-1/2 inches for reinforcing bars less than #6.
    - c. Interior surfaces: 1-1/2 inches for beams, girders, and columns; 3/4 inch for slabs, walls and joists with #11 bars or smaller, and 1-1/2 inches with #14 and #18 bars.
  4. Reinforcement, at the time concrete is placed, shall be free of mud, oil or other materials that may adversely affect or reduce the bond.
  5. Unless permitted by the ENGINEER, do not bend reinforcement after it is in hardened concrete.
  6. Where indicated on the drawings, weld reinforcing in accordance with applicable requirements of AWS D12.1. No welding is permitted without specific approval of the ENGINEER. No welding of crossing bars (tack welding) is permitted.
- C. Construction Joints:
1. Place formed construction joints in floor slabs and walls as shown on drawings or at maximum 20 foot intervals. Secure to resist movement during concrete placement.
  2. All reinforcement shall be continued across joints. Keys shall be provided. Longitudinal keys at least 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings.
  3. Thoroughly clean and remove all laitance from joints prior to placing adjoining concrete.
  4. When joining new concrete to previously existing concrete, obtain bond by one of the following methods:
    - a. The use of an approved bonding agent. Use epoxy bonding agent in joints exposed to moisture or below grade. Use latex bonding agent in other applications.
    - b. Roughening the surface of the concrete in an approved manner which will expose the aggregate and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.
- D. Expansion/Isolation Joints:
1. Reinforcement or other embedded metal items bonded to the concrete not to extend continuously through any expansion joint. Exception is dowels in floors bonded on only one side of joints.
  2. Use premolded expansion joint filler where shown.
- E. Embedded Items:
1. Provide formed openings where pipes, conduits, sleeves, and other work will pass through concrete members.
  2. Accurately locate and set in place items which are to be cast directly into concrete.
  3. Co-ordinate work of other sections and co-operate with trade involved in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.

4. Install all concrete accessories in accordance with drawings and manufacturer's recommendations; straight, level, and plumb. Secure items to avoid displacement during concrete placement.
  5. Fill voids in sleeves, inserts, and anchor slots temporarily with a removable material to prevent entry of concrete.
  6. No aluminum items shall be embedded in concrete, unless specifically indicated on the drawings.
- F. Concrete Production:
1. General:
    - a. All concrete shall be ready-mixed and shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete", ASTM C94. Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.
    - b. Mix concrete only in quantities for immediate use. Batch-to-discharge time shall not exceed 60 minutes. Concrete which has set shall not be retempered, but shall be discarded.
    - c. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. An addition of water above that permitted by the limitation on water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain the proper water-cement ratio. Such addition shall be accomplished only upon authorization of the ENGINEER.
  2. Cold weather: Cold weather concreting shall follow the recommendations of ACI 306, except as otherwise directed by the ENGINEER.
  3. Hot weather: Hot weather concreting shall follow the recommendations of ACI 605, except as otherwise directed by the ENGINEER.
- G. Placing Concrete - General:
1. Preparation:
    - a. Remove hardened concrete and foreign materials from the inner surfaces of the conveying equipment.
    - b. Formwork shall have been completed; snow, ice and water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors, and other embedded items shall have been positioned; and the entire preparation shall have been approved.
    - c. Do not be place concrete on frozen ground.
  2. Conveying:
    - a. Convey concrete from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and will maintain the quality of the concrete.
  3. Depositing:
    - a. General: Deposit concrete continuously or in layers of such thickness, maximum 2 feet, that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. No interruption shall exceed 45 minutes.

- b. Segregation: Do not subject concrete to any procedure which will cause segregation. Maximum vertical drop is 4 feet.
- c. Consolidation: Consolidate concrete by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Keep a spare vibrator on the job site during all concrete placing operations.
- 4. Protection:
  - a. Unless adequate protection is provided and approved do not place concrete during rain, sleet, or snow.
  - b. Do not allow rainwater to increase the mixing water nor to damage the surface finish.
- 5. Bonding:
  - a. When joining new concrete to previously existing concrete, prepare the surface of joints in accordance with one of the methods specified in Section 3.01, C.4.
  - b. Immediately prior to placing of fresh concrete, dampen, but do not saturate, the hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below.
  - c. The hardened concrete of joints in exposed work; joints in the middle of beams, girders, joists, and slabs; and joints in work designed to contain liquids shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
  - d. Joints receiving a bonding agent shall have been prepared and agent applied in accordance with the manufacturer's recommendations prior to placing of fresh concrete.
- H. Removal of Formwork:
  - 1. Do not remove forms, shores and bracing until concrete has gained sufficient strength to carry its own weight, and construction and design load which are liable to be imposed upon it. Verify strength of concrete by compressive test results.
  - 2. Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.
- I. Repair of Surface Defects:
  - 1. Repair surface defects, including tie holes, immediately after form removal.
- J. Finishing of Formed Surfaces:
  - 1. For all unexposed concrete, provide a rough form finish.
  - 2. For all exposed concrete, provide a smooth form finish.
  - 3. Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces.
  - 4. For all concrete which is to be coated or painted, provide a grout cleaned finish on a smooth form finish.
- K. Placing and Finishing Concrete-Slabs:
  - 1. Preparation of subgrade for slabs on ground:

- a. The subgrade shall be well drained and of uniform load bearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade.
- b. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing, raise and maintain the temperature above 50 degrees F long enough to remove all frost from the subgrade.
- c. The subgrade shall be moist at the time of concreting. If necessary, dampen with water in advance of concreting but do not allow free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.
2. Edge forms and screeds:
  - a. Set edge forms and intermediate screed strips accurately to produce the designated elevations and contours of the finished surface.
3. Placement:
  - a. Carefully coordinated mixing and placing with finishing. Do not place concrete on the subgrade or forms more rapidly than it can be spread, straight edged, and darried or bull floated. These operations must be performed before bleeding water has an opportunity to collect on the surface.
4. Jointing:
  - a. Locate and detail joints as indicated. If saw-cut joints are required or permitted, cutting shall be timed properly with the set of the concrete. Begin cutting as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and complete before shrinkage stresses become sufficient to produce cracking.
5. Consolidation:
  - a. Thoroughly consolidate concrete. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.
6. Finishes:
  - a. When type of finish is not specified otherwise, provide the following:
    - 1) Floated finish: For surfaces intended to receive roofing, waterproofing membranes, or sand bed terazzo. Finish to Class B tolerance.
    - 2) Troweled finish: For floors intended as walking surfaces or for reception of floor coverings. Finish to Class A tolerance.
    - 3) Broom or belt finish: For sidewalks and garage floors and ramps. Finish to Class A tolerance.
    - 4) Nonslip finish: For exterior platforms, steps, and landings; and for exterior and interior pedestrian ramps. Finish to Class A tolerance.
  - b. Finishing tolerances:
    - 1) Finishes with Class A tolerances shall be true planes within 1/8 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
    - 2) Finishes with Class B tolerance shall be true planes within 1/4 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
- L. Curing and Protection:
  1. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury and maintain with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.

2. For interior slabs which will not be covered, topped, or painted, apply a combination floor sealer/curing compound (ASTM C309, Fed. Spec. TT-C-800A) in accordance with manufacturer's recommendations.

### **3.02 FIELD QUALITY CONTROL**

- A. Field inspection and testing is to be performed by a firm appointed and paid for by the OWNER. When additional testing of materials or concrete is necessary because of their failure by test or inspection to meet specification requirements, the cost of the additional testing shall be paid for by the CONTRACTOR. Additional testing for early form removal shall also be paid for by the CONTRACTOR.
- B. Provide access to all portions of the work and any necessary assistance in obtaining and handling samples at the project or other material sources. Three concrete test cylinders will be taken for every 50 cubic yards, or fraction thereof, for each class of concrete placed in any one day. One additional cylinder will be taken during cold weather concreting and be cured on the project site under the same conditions as the concrete it represents. One slump test will be taken for each set of cylinders taken.

### **3.03 SCHEDULES**

- A. Specification Requirements for Concrete.
- B. Tolerances for Formed Surfaces.

<b>SCHEDULE A</b>							
<b>SPECIFICATION REQUIREMENTS FOR CONCRETE</b>							
<u>PERMISSIBLE USE CATEGORY</u>	<u>CEMENT TYPE</u>	<u>MINIMUM CEMENT CONTENT/TD3</u>	<u>MAXIMUM COARSE AGGREGATE</u>	<u>WATER/CEMENT RATIO*</u>	<u>MINIMUM ENTRAINED AIR CONTENT</u>	<u>MAX. SLUMP</u>	<u>COMPRESSIVE STRENGTH<sup>fc</sup></u>
<b>Interior Floors:</b>							
a. Residential	I, IP	5-1/2 sacks	MDOT-6A	5.5 gal/sack	-	4"	3500 psi
b. Industrial (garage)	I, IP, IA, IP-A	5-1/2 sacks	MDOT-6A	5.5 gal/sack	5-7%	3"	4000 psi
c. Industrial and Commercial	I, IP, IA, IP-A	5-1/2 sacks	MDOT-6A	5.5 gal/sack	2-3%	3"	4000 psi
<b>Exterior-Slab on Grade:</b>							
a. Sidewalks, Conc. Paving, etc.	I, IP, IA, IP-A	5-1/2 sacks	MDOT-6AA	5.0 gal/sack	5-7%	3"	3500 psi
<b>Interior:</b>							
a. Liquid Containing Structures	I, IP, IA, IP-A	6 sacks	MDOT-6AA	5.5 gal/sack	5-7%	4"	3500 psi
b. Conc. exposed to raw sewage or aggressive solutions	IP, II, V, IP-A IIA, VA	6 sacks	MDOT-6AA	5.0 gal/sack	5-7%	4"	3500 psi
c. Beams, Columns, Walls, etc.	I, IP	5-1/2 sacks	MDOT-6A	6.0 gal/sack	--	4"	3500 psi
<b>Exterior: **</b>							
a. Liquid Containing Structures	I, IP, IA, IP-A	6 sacks	MDOT-6AA	5.5 gal/sack	5-7%	4"	4000 psi
b. Conc. exposed to raw sewage or aggressive solutions	IP, II, V, IP-A IIA, VA	6 sacks	MDOT-6AA	5.0 gal/sack	5-7%	4"	4000 psi
c. Beams, Columns, Walls, etc.	I, IP, IA, IP-A	5-1/2 sacks	MDOT-6A	5.5 gal/sack	5-7%	4"	3500 psi
d. Architectural Conc.	I, IP, IA, IP-A	5-1/2 sacks	***	5.5 gal/sack	5-7%	4"	3500 psi
<b>Footings</b>							
I, IP	I, IP	5-1/2 sacks	MDOT-6A	6.0 gal/sack	--	3"	3500 psi
* Water Cement Ratio: 5.0 gal/sack = 0.44 lbs/lbs., 5.5 gal/sack = 0.48 lbs/lbs., 6.0 gal/sack = 0.53 lbs/lbs.							
** Exterior exposure on any side.							
*** Maximum Coarse Aggregate size shall be compatible with the form liner and placing methods to be used by the CONTRACTOR.							

**SCHEDULE B: TOLERANCES FOR FORMED SURFACES**

1. Variation from plumb:
  - A. In the lines and surfaces of columns, piers, walls, and in arrises:

In any 10 foot of length .....	1/4 inch
Maximum for the entire length .....	1 inch
  - B. For exposed corner columns, control joint grooves, and other conspicuous lines:

In any 20 foot length .....	1/4 inch
Maximum for the entire length .....	1/2 inch
  
2. Variation from the level or from the grades specified in the contract documents:
  - A. In slab soffits, ceilings, beam soffits and in arrises, measured before removal of supporting shores

In any 10 foot of length .....	1/4 inch
In any bay or in any 20 foot length .....	3/8 inch
Maximum for the entire length .....	3/4 inch
  - B. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:

In any bay or in any 20 foot length .....	1/4 inch
Maximum for the entire length .....	1/2 inch
  
3. Variation of the liner building lines from established position in plan and related position of columns, walls, and partitions:

In any bay .....	1/2 inch
In any 20 foot of length .....	1/2 inch
Maximum for the entire length .....	1 inch
  
4. Variation in the sizes and location of sleeves, floor openings, and wall openings .....  $\pm$  1/4 inch
  
5. Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls:

Minus .....	1/4 inch
Plus .....	1/2 inch
  
6. Footings\*
  - A. Variations in dimensions in plan:

Minus .....	1/2 inch
Plus .....	2 inches
  - B. Misplacement or eccentricity:

2 percent of the footing width in the direction of misplacement but not more than .....	2 inches
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  - C. Thickness:

Decrease in specified thickness .....	5 percent
Increase in specified thickness .....	No limit
  
7. Variation in steps:
  - A. In a flight of stairs:

Rise .....	$\pm$ 1/8 inch
Tread .....	$\pm$ 1/4 inch
  - B. In consecutive steps:

Rise .....	$\pm$ 1/16 inch
Tread .....	$\pm$ 1/8 inch

\* Tolerances apply to concrete dimensions only, not to positions of vertical reinforcing steel, dowels, or embedded items.

\*\*\* END OF SECTION \*\*\*

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. The work includes the use of non-shrink grout for:
  - 1. Abandonment of pipes and existing pump chamber.
  - 2. Installation of base plates, bearing plates, drilled-in anchor bolts, drilled-in reinforcing dowels, railing posts, or where called for on the plans.
- B. All grout shall be cementitious grout unless noted. Epoxy grout shall be used only where specifically called for on the plans.

**1.02 SUBMITTALS**

- A. Submit product data describing the grout, including recommended mixing and placing instructions.
- B. Prior to grouting submit plan for grouting existing pump chamber and access tubes for review and approval.

**PART 2 - PRODUCTS**

**2.01 MATERIALS**

- A. Cementitious Grout - Acceptable Products Include:

<u>Trade Name</u>	<u>Manufacturer</u>
Crystex	L&M Construction Chemicals Inc.
Embeco 636	Master Builders
Ferrolith G-NC	Sonneborn Building Products
Five-Star Grout	U.S. Grout Corporation
Masterflow 713	Master Builders
Sauereisen F-100	Sauereisen Cements Company
SonogROUT	Sonneborn Building Products
Upcon Multi Purpose Grout (262)	Bostik, Upco Division

- B. Epoxy Grout - Acceptable Products Include:

<u>Trade Name</u>	<u>Manufacturer</u>
Concresive 1463	Adhesive Engineering Company
Upcon Epoxy Grout	Bostik, Upco Division
647 R Repair Grout	Ceilmote
Epoxy Grout 1-270	Permagile-Salmon Ltd.

- C. Flowable mix shall develop a minimum compressive stress of 6000 psi in 28 days for cementitious grout and 10,000 psi in 28 days for epoxy grout.

**PART 3 - EXECUTION**

**3.01 PLACEMENT**

- A. Grout shall be mixed and placed per manufacturer's recommendations.
- B. All voids within area to be grouted must be filled.
- C. Strike-off grout cleanly and neatly. Rectify all defects.

\*\*\* END OF SECTION \*\*\*

**PART 1 - GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section includes all submersible wastewater pump stations and appurtenances, as specified herein, and as necessary for the proper and complete performance of the work.

**1.02 SUBMITTALS**

- A. Submit shop drawings and manufacturer's data including pump, motor, seals, guide rails, discharge connection, valves, and access doors including dimensions and locations.
- B. Include five (5) copies of the installation instructions with the delivery of the equipment.
- C. Provide five (5) copies of the operation and maintenance manuals, each containing "as-built" data on pump station equipment, instructions on operation and maintenance, list of parts and sources from which they may be obtained, and a list of recommended spare parts maintained on site.
- D. Pump Curves:
  - 1. Furnish performance curves and tables showing flow in gallons per minute, total dynamic head in feet, efficiency in percent and brake horsepower with shop drawings.
  - 2. Furnish factory test data for each pump showing flow in gallons per minute, total dynamic head in feet, efficiency in percent and brake horsepower at design operating points before pump shipment.

**1.03 DELIVERY, STORAGE AND HANDLING**

- A. Protect all equipment during delivery and during storage on site. Store equipment on suitable blocking to maintain parts clear of the ground and cover to insure drainage of all rainwater.

**PART 2 - PRODUCTS**

**2.01 PUMP CHAMBER**

- A. Construction:
  - 1. Reinforced concrete pipe wall sections: ASTM C76, Class III Wall "B" with ASTM C443 rubber gasket joints.
  - 2. Base and top slabs: Cast-in-place concrete Class A or precast conforming to ASTM C478.
  - 3. Seal joint between lowest section and base with waterproof joint sealant.
- B. Paint (Concrete):
  - 1. Exterior below grade with 2 coats of self-priming coal tar waterproofing at 7.0 mils per coat.
  - 2. Prepare surface using wire brush.

**2.02 VALVE CHAMBER**

- A. Same construction and painting as pump chamber.

**2.03 DESIGN CONDITIONS**

- A. Two pumps required (one backup).
- B. Operating conditions:
  - 1. Based on design flows and total head conditions with one pump operating.
  - 2. Minimum design flow rate for each submersible pump is 80 gpm.
  - 3. Maximum design flow rate for each grinder pump is 50 gpm.
  - 4. Minimum velocity in discharge piping is 2 fps.
  - 5. Maximum velocity in discharge piping is 6 fps.
- C. Speed:
  - 1. Submersible pumps – 1700 RPM maximum.
  - 2. Grinder pumps – 3450 RPM maximum.
- D. Horsepower: Based on operating conditions.
- E. Efficiency: 50 % minimum for submersible pumps.

**2.04 PUMP CONSTRUCTION - SUBMERSIBLE PUMPS**

- A. Corrosion resistant.
- B. Stainless steel fasteners and lifting bail.
- C. Seals: Double mechanical, running in oil, corrosion resistant, Viton O-rings.
- D. Impeller: N-Pump design, non-clog, self-cleaning, capable of passing 3-inch spherical solids, cast iron or bronze.
- E. Guide bracket: Non-sparking with corrosion resistant surfaces.
- F. Pump discharge: Automatically sealed to discharge connection when pump is lowered into place. Pump flange shall have non-sparking contact surfaces. Minimum suction and discharge openings of the pumps shall be 4 inches.
- G. Mix-Flush System: Automatically flushes pump sump during initial operation of the pump.
- H. Motors: 240 or 480 volt, 3 phase, 60 Hertz, capable of driving pump over full range of pump characteristic curve without exceeding 85% of motor horsepower rating based on a 1.0 service factor.
  - 1. UL or FM listed for NEC classified Class 1, Division 1, Group D hazardous locations.
  - 2. Housing: Air or oil filled watertight casing.

3. Insulation: Class F.
  4. Shaft: Stainless steel.
  5. Capable of running totally, partially or nonsubmerged.
  6. Provide seal leakage water sensor probe to indicate water in seal chamber.
  7. Thermal sensors in motor windings shall deactivate starter when temperature exceeds safe level.
  8. Motor electric service cable: Sufficient length to reach control panel without splices. Wiring in the pumping chamber shall permit total submergence without affecting operation. Stainless steel cable sheathing.
  9. Motor starting requirements not to exceed NEMA Code G.
- I. Manufacturer: Flygt, Type NP.

## **2.05 PUMP CONSTRUCTION - GRINDER PUMPS**

- A. Centrifugal.
- B. Pump impeller and grinder unit: Attached to a common motor and pump shaft.
- C. Pump and motor shaft: Stainless steel.
- D. Impeller: Grey cast iron.
- E. Grinder:
1. Located on suction side of pump impeller.
  2. Discharging directly into impeller inlet.
  3. Cutters: Stainless steel.
  4. Capable of reducing domestic wastewater solids to sizes less than 1 inch in diameter.
- F. Pump and motor housing: Grey iron castings.
- G. Fasteners: Stainless steel.
- H. Motors:
1. UL listed.
  2. Mounted in sealed submersible housing filled with oil.
  3. Bearing: O-ring sealed, removable cap permitting external adjustment.
  4. Capable of operating totally or partially submerged.
  5. Provide seal leakage water sensor probe.
- I. Manufacturer: Flygt.

## **2.06 PUMP ACCESSORIES**

- A. Guide rails: 316 stainless steel with enough intermediate supports to provide sufficient stiffness to allow the pump to be pulled out without binding.

- B. Discharge connection: Cast iron, bolted to the floor.
- C. Lift chain: Stainless steel, with lifting capacity of twice pump weight minimum.
- D. Anchor bolts: Stainless steel.

**2.07 PIPING - SUBMERSIBLE PUMPS**

- A. Wastewater influent, forcemain to cleanout structure and pump station piping: Ductile iron ANSI A21.50 or A21.51, class 53.
  - 1. Lining: Fusion-bonded epoxy coating.
  - 2. Outside Coating: Asphaltic.
  - 3. Joints:
    - a. Flanged, ANSI A21.10 and A21.15 with gasket.
    - b. Between chambers: Mechanical, ANSI A21.11 with retainer glands.
    - c. Site piping: Mechanical, ANSI A21.11.

**2.08 PIPING - GRINDER PUMPS**

- A. Pipe material:
  - 1. Wetwell: PVC - Schedule 80.
  - 2. Valve chamber:
    - a. PVC - Schedule 80.
    - b. HDPE - SDR 11.

**2.09 VALVES**

- A. Eccentric plug: Rated 150 psi.
  - 1. Lever operated, with position indicator.
  - 2. Permanently lubricated.
  - 3. Eccentric seating: drip-tight shut-off.
  - 4. Port area: 80% of pipe size, minimum.
  - 5. Body: Cast iron or semi steel with Class 125 flanged end connections.
  - 6. Bushings: Stainless steel.
  - 7. Seating surface: 90% nickel, 300 Series stainless steel or bronze, mechanically retained, or brazed to body and machined or ground.
  - 8. Rotating element seating surface: Neoprene capacity stuffing box and spring loaded or adjustable bolted gland packing follower.
  - 9. Manufacturers:
    - a. DeZurik.
    - b. Homestead.
    - c. Or equal.
- B. Check:
  - 1. Full opening, iron body, bronze mounted swing checks with outside lever and weights or spring loaded.

2. Provide on each discharge line.

## **2.10 ACCESS DOORS**

### **A. General:**

1. Provide aluminum access doors with drainage frame, fall prevention device and designed for pedestrian traffic.
2. Design loading: Live load of 300 psf with a maximum deflection of 1/150th of the span.
3. Doors:
  - a. Single or double leaf.
  - b. 1/4-inch thick aluminum diamond plate cover.
4. Hardware: Corrosion resistant materials.
5. Frame: Extruded aluminum channel frame with 1-1/2 inch NPT drain coupling in frame.
6. Gasket: A continuous EPDM gasket shall be mechanically attached to the channel frame to create a barrier around perimeter of the cover to reduce amount of debris that can enter the channel.
7. Fall prevention: Hinged fiberglass grating that covers hatch opening. Design live load shall be 300 psf minimum.
8. Hinges: Forged brass with stainless steel pins, or all stainless steel.
9. Door and grating: Holding arm shall engage and automatically lock the door or grating when it is open 90 degrees. Provide a vinyl grip handle to release for closing.
10. Locking device: Flush, spring loaded and capable of unlocking from interior.
11. Coat frame with bituminous coating where it will come in contact with concrete.

### **B. Manufacturers and models:**

1. Flygt, Series FTP.
2. Bilco Company, Series J-AL & JD-AL.
3. Or equal.

## **2.11 ELECTRICAL AND INSTRUMENTATION**

- A. Refer to Section 16101, Pump Station Electrical Work.
- B. Refer to Section 16900, Controls and Instrumentation.

## **2.12 PRESSURE GAUGES**

- A. Location on pump discharge pipes: In valve chamber upstream from check valve.
- B. 4-1/2-inch, black phenolic pressure gauge case, silicon filled, bottom connection, 0-60 psi calibrated range.
- C. Manufacturer:
  1. Ashcroft Model No. 1279.
  2. Approved equal.

**2.13 ISOLATION DIAPHRAGMS**

- A. General: Provide isolation diaphragms for each gauge mounted on tanks or pipes carrying waste water, solvents, acids, or caustics.
- B. Design: Clean-out type without disturbing diaphragm. Complete with filling and flushing connections.
- C. Process Connections: 1/2-inch NPT or 150# flanged connection.
- D. Flushing Connection: 1/4-inch NPT.
- E. Pressure Device Connection: 1/2-inch NPT.
- F. Material: Stainless steel body and diaphragm or other material which is compatible with fluid to be handled.
- G. Isolation diaphragm and pressure gauges shall be supplied as a single unit filled and tested as per design requirement.

**2.14 GASKETS**

- A. Neoprene flange gasket, 105°F, 200 psig, Garlock or approved equal.

**2.15 PAINTING**

- A. Piping and supports (non-submerged): 1 coat epoxy primer, 2 coats polyamide cured epoxy gloss enamel.
- B. Piping (submerged): Coal tar epoxy, 2 coats, 8 mils per coat.
- C. Surface preparation:
  - 1. Wire brush: Remove all rust and loose scale.

**2.16 MISCELLANEOUS METALS**

- A. Construction: All hangers, supports, brackets, anchors, bolts, etc. in wet well shall be 316 L SS.
- B. Painting:
  - 1. Ferrous metal (ungalvanized) exterior:
    - a. 1 coat rust inhibitive primer, 1.5 mils.
      - 1) Durako No. 692.
      - 2) Tnemec No. 99.
      - 3) Or equal.
    - b. 2 coats exterior alkyd glass enamel, 2 mils per coat.

2. Ferrous metal interior:
  - a. 2 coat epoxy primer, 2 mils.
  - b. Durako "Durepon."
  - c. Tnemec "Tneme-Tufcoat."
  - d. Or equal.

### **2.17 SUMP PUMP**

- A. General:
  1. Capacity: Minimum 14 gpm at 15 feet TDH.
  2. Quantity: One unit.
  3. Power: Thermally protected 120 volt, single phase, 60 Hertz with minimum 18-foot power cord.
  4. Dimensions: Allow for placement into 12-inch diameter sumps.
  5. Miscellaneous: Allow for submersed operation.
- B. Manufacturer:
  1. Little Giant Pump Company.
  2. Or equal.

### **2.18 SPARE PARTS**

- A. Furnish the following spare parts for each pump station:
  1. One (1) impeller
  2. Three (3) sets of station keys
  3. One (1) set of mechanical seals for each pump
  4. One (1) set of pump discharge seal gaskets
  5. One (1) pump impeller wrench
- B. Package each spare part and clearly label.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's recommendations, shop drawings, and contact drawings.
- B. Replacement pump station: Maintain operation of existing station or provide bypass pumping.
- C. Access doors: Connect drainage coupling to Schedule 80 PVC pipe and route pipe outlet to a location 12-inches away from chamber and 5-feet below grade.

### **3.02 FACTORY TESTING**

- A. Test each pump before shipment. Furnish performance data for each pump based on test results at design operating conditions.

### **3.03 FIELD QUALITY CONTROL**

- A. Testing and Inspection:
  - 1. Supervision by OWNER
  - 2. Complete before connecting to active system.
  - 3. After cleaning notify and arrange with OWNER for inspection and test.
  - 4. Provide equipment and assistance.
  
- B. Station performance test:
  - 1. Notification 48 hours prior to conducting.
  - 2. Supervision by factory trained representative for instrumentation and controls.
  - 3. Attendance by CITY, OWNER, ENGINEER and CONTRACTOR.
  - 4. Measure flow, wet well level, discharge pressure and electric power draw during test.
  - 5. Inspect components operating satisfactorily.
  - 6. Correct and repair all faulty operating components and repeat test until acceptable.
  
- C. Pressure:
  - 1. Air or air-water methods of applying pressure prohibited.
  - 2. Range: 100 to 110 psi at lowest elevation.
  - 3. Duration: 1 hour and until completion of inspection.
  - 4. Procedure: Fill system slowly, expel air through air release valve connection at high points and apply pressure. Install air release valve after test.
  - 5. Examine line and appurtenances for leaks and movement.
  - 6. Repair defects, visible leaks and repeat test until acceptable.

### **3.04 START-UP**

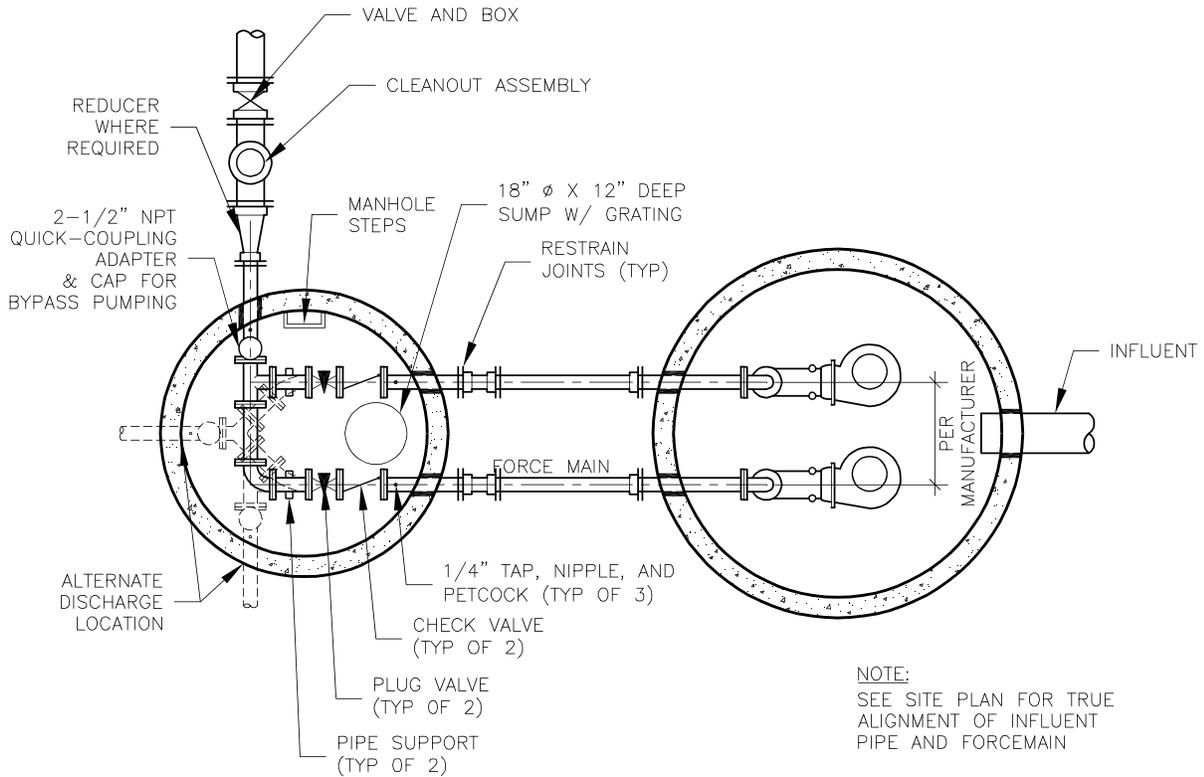
- A. Arrange and pay for the service of the manufacturer's representative to be on site for checking the installation, start-up and training for a minimum of two (2) days, and shall include all expenses.

### **3.05 OPERATOR TRAINING**

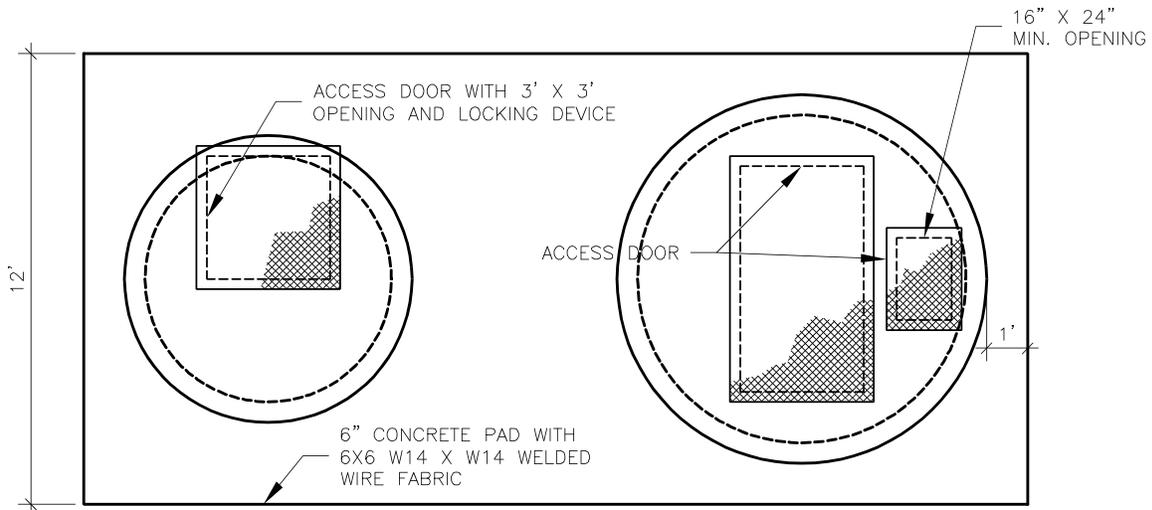
- A. Schedule 1/2 day of training after station performance test. Notification shall be at least 72 hours prior to conducting. Supervision shall be by factory trained representative.

### **3.06 SCHEDULES**

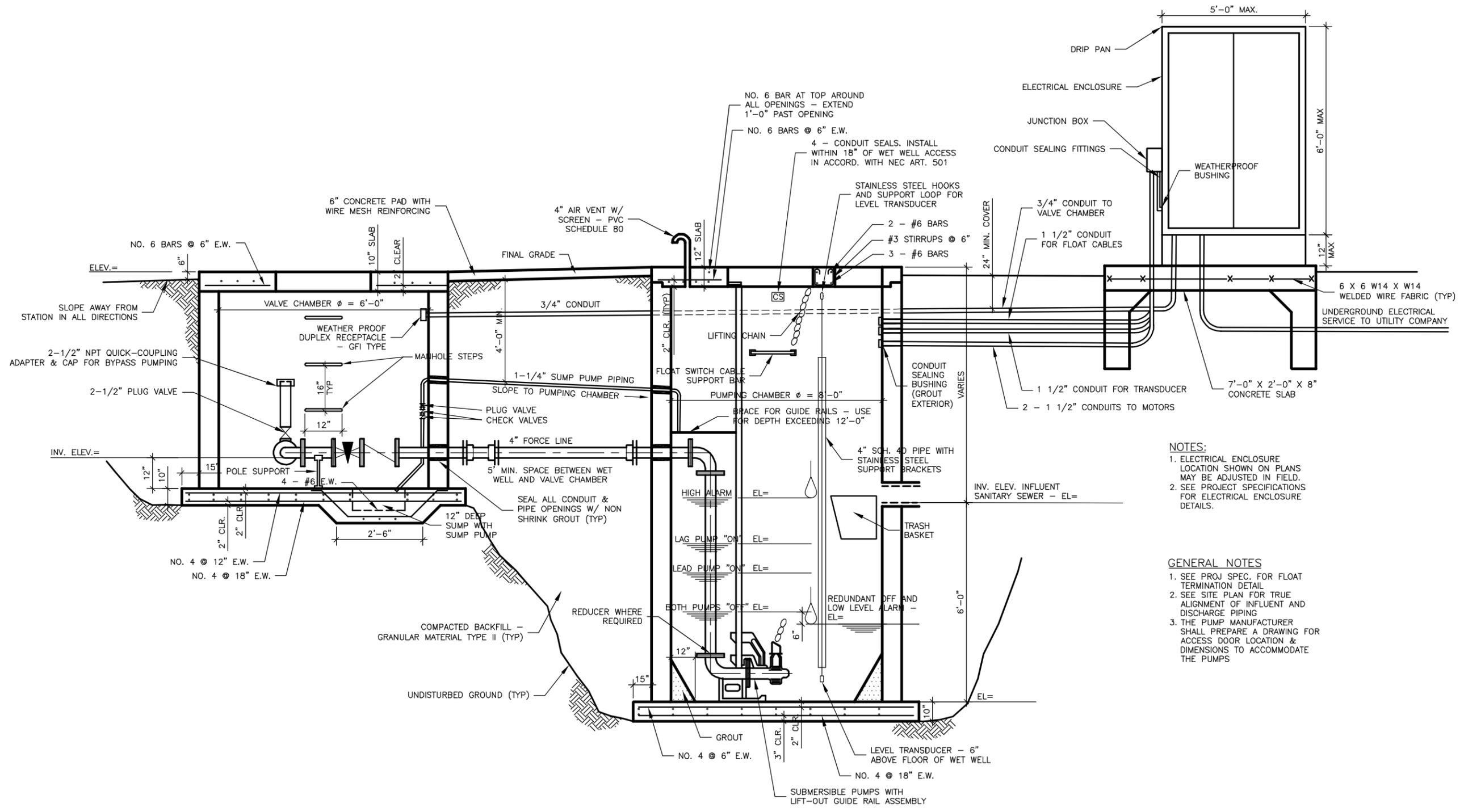
- A. Submersible Pump Station Details:
  - 1. Lift Station Plan.
  - 2. Lift Station Cross Section.



**TYPICAL LIFT-STATION PLAN**  
**TOP REMOVED FOR CLARITY**  
 NO SCALE



**TYPICAL LIFT-STATION PLAN**  
 NO SCALE



**NOTES:**  
1. ELECTRICAL ENCLOSURE LOCATION SHOWN ON PLANS MAY BE ADJUSTED IN FIELD.  
2. SEE PROJECT SPECIFICATIONS FOR ELECTRICAL ENCLOSURE DETAILS.

**GENERAL NOTES**  
1. SEE PROJ. SPEC. FOR FLOAT TERMINATION DETAIL  
2. SEE SITE PLAN FOR TRUE ALIGNMENT OF INFLUENT AND DISCHARGE PIPING  
3. THE PUMP MANUFACTURER SHALL PREPARE A DRAWING FOR ACCESS DOOR LOCATION & DIMENSIONS TO ACCOMMODATE THE PUMPS

**TYPICAL LIFT-STATION CROSS-SECTION**  
NO SCALE

\*\*\*END OF SECTION\*\*\*

**PART 1 - GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section includes all labor and materials required to install a chemical feed system at each lift station when required by the CITY. The Work at each lift station must meet the following requirements:
1. Install enclosure for equipment on top of concrete slab as shown on Drawing in Schedule A. Enclosure must be Rubbermaid Model 3746: 4'-8" wide, 2'-8" deep and 6'-6" high.
  2. Install 3/4-inch treated exterior plywood on floor. Install treated exterior 2x4s on edge around inside perimeter of enclosure for spill containment. Fasten plywood to 2x4s with stainless steel wood screws (recessed). Caulk interior joints to make watertight.
  3. Anchor enclosure to concrete slab with 4 stainless steel anchors through 2x4 frame.
  4. Secure enclosure walls to 2x4 frame with 1/4-inch stainless steel bolts with round heads and 1-inch stainless steel washers on each side.
  5. Install 1"x12" wood shelf across back wall at ±3 feet above floor for chemical pumps and miscellaneous supplies. Shelf height shall be adjustable.
  6. Install two chemical feed pumps at each location, including associated piping, fittings and valves for feeding ferric chloride solution directly from 15 gallon container to injection point in valve chamber. Pumps shall be LMI LiquiPro Pump Series A, B & C, with acrylic head, suitable for ferric chloride. Chemical pump capacity shall be based on the wastewater pump rate:

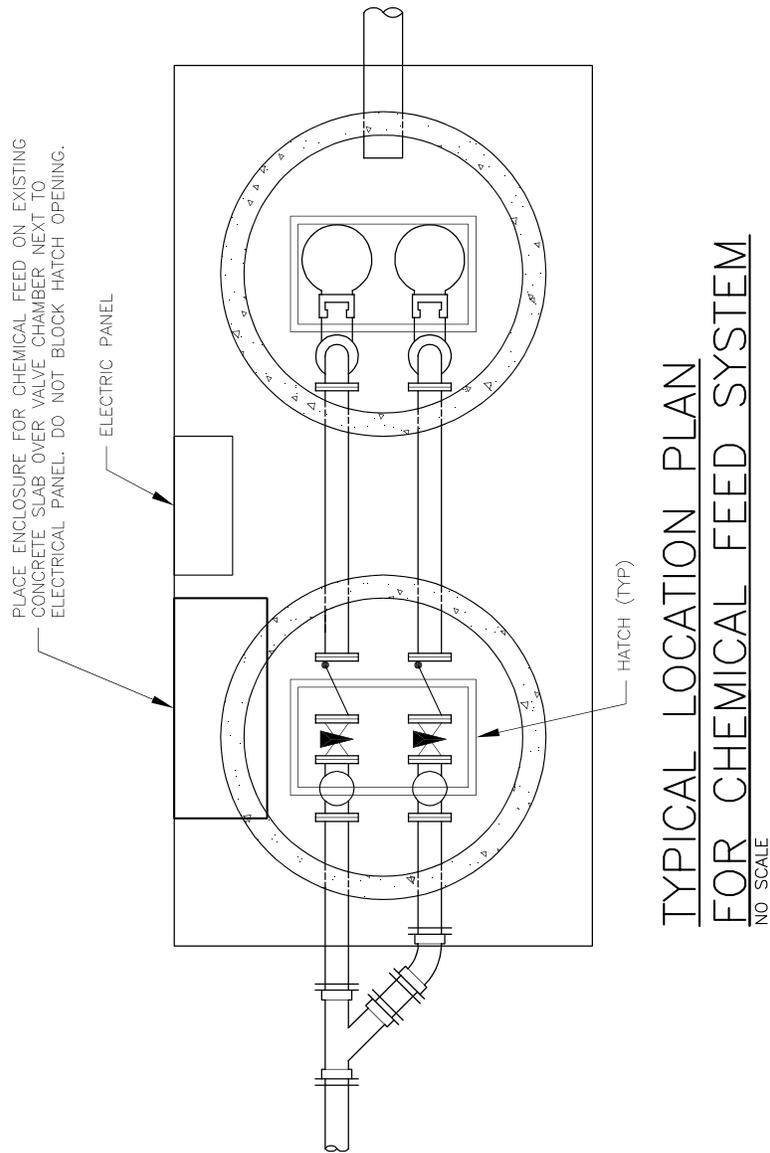
Wastewater Pump Rate	Chemical Pump Feed Rate (each)
< 100 gpm	50 gallons per day
100-200 gpm	100 gallons per day
200-300 gpm	150 gallons per day
> 300 gpm	200 gallons per day

7. Chemical injectors shall be LMI Corporation Stop and Nozzle Assembly suitable for injecting ferric chloride solution in a pressure pipe.
8. Install the chemical injectors for the two pumps in the two pipes in the valve chamber downstream from the valves in accordance with the manufacturer's recommendations. Tap pipes as needed for injectors.
9. Core concrete lid of valve chamber inside enclosure for chemical pump discharge tubing. Locate hole in front left corner. Isolate hole from spill containment area with 2x4 across corner.
10. All chemical tubing must be installed in buried rigid conduit if the enclosure is located adjacent to valve chamber.
11. Install two 110 V, commercial grade, 10 amp, grounded outlet boxes in each enclosure for the chemical pumps. Connect outlets to Motor Control Panel for Lift Station. Each outlet shall receive 110 V power adequate for operating each chemical pump when one of the two lift station pumps operates.

12. All wires between the Motor Control Panel and outlets shall be enclosed in rigid conduit, and meet all state and local requirements for the application.

B. Schedules:

1. Schedule A - Typical Location Plan for Chemical Feed System.



\*\*\*END OF SECTION\*\*\*

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Furnish and install new equipment and appurtenances for electric power to motors:
  - 1. Three phase electric service.
  - 2. Electrical service enclosure.
  - 3. Concrete pad.
  - 4. Power supply and controls.
  - 5. Breakers and switches.
  - 6. Transformers.
  - 7. Conduits and seal-offs.
  - 8. Junction box between wet well and seal-offs.
  - 9. Wiring.
  - 10. Transfer switch.
  - 11. Generator receptacle.

**1.02 SYSTEM DESCRIPTION**

- A. Contractor shall arrange and pay for electric service to the pump station. Provide three phase power unless the City's Director of Public Works determines single phase power is acceptable. Three phase service shall be 460 VAC or 230 VAC. Single phase service, when approved in writing by the Director of Pubic Works, shall be 230 VAC.

**1.03 SUBMITTALS**

- A. Shop Drawings and Manufacturer's Data:
  - 1. Transformers.
  - 2. Motor starters.
  - 3. Wiring devices.
  - 4. Service power surge protection.
  - 5. Electrical service enclosure.
  - 6. Transfer switch.

**1.04 COORDINATION**

- A. Coordinate electrical service connections to components furnished by utility companies.
  - 1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for service entrances and electricity-metering components.

**1.05 CLEARANCES**

- A. Equipment
  - 1. Maintain clearances from electric panels, and other electrical installations as required by NEC.
  - 2. Maintain working clearances around electrical equipment as required for proper maintenance and operation.

**1.06 EQUIPMENT FOUNDATIONS**

- A. Concrete Pads
  - 1. Provide concrete pad adjacent to pump chamber.
  - 2. Size to fit new equipment.
  - 3. Minimum of 6-inches high, reinforced, with level top and chamfered edge.
  - 4. Concrete: Section 03300 - Concrete.

**1.07 IDENTIFICATIONS**

- A. Signs
  - 1. Provide on all equipment, switches, breakers, and panels.
- B. Circuits
  - 1. Provide in each distribution or branch circuit panel a typewritten schedule under glass or plastic identifying each circuit emanating from panel.

**PART 2 - PRODUCTS**

**2.01 CONDUIT**

- A. Rigid galvanized steel, UL listed and 1/2 inch minimum size. ANSI C80.1, threaded only as noted on drawings.
- B. Pull boxes, junction boxes and conduit fittings: UL listed, liquid tight, dustproof, conforming to JIC standards, cast malleable iron gasketed with cast hot dip galvanized blank or nipple covers held in place with stainless steel screws. ANSI C80.41966 (R 1969), sized per NEC Article 370. Fiberglass NEMA 4X junction boxes where shown on drawings.
- C. Hazardous areas are: Class 1, Division 1, Group D.
  - 1. Install in accordance with NEC Article 501.
  - 2. All wiring shall be in conduit, except in wet well where cables go to floats, level transducer and motors.

**2.02 LIFT STATION CONTROL PANEL**

- A. Refer to Section 16900 - Controls and Instrumentation.
- B. Main service breaker:
  - 1. Sized for starting current for two pumps.
  - 2. UL listed for service entrance.
  - 3. NEMA 1 enclosures.
- C. Transfer switch:
  - 1. Double throw safety switch.
  - 2. 3 pole, 600 VAC, 100 amp rating.

3. UL listed.

D. Generator Receptacle: CITY Standard for generator size required for pump station.

**2.03 GROUNDING**

A. Materials: #2/0 bare copper wire and 3/4 inch x 20 feet copperweld ground rod.

B. Connections between grounding elements: Thermoweld where concealed, mechanical where exposed to view.

C. Grounding conductor penetrating concrete surface: 5/8 inch solid copper-clad rod.

D. Ground resistance: 25 ohms or less.

**2.04 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING**

A. Comply with requirements of electrical power utility company meter sockets.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

A. In accordance with drawings, approved shop drawings, manufacturer's recommendations, local and national codes.

B. Install power meter sockets from power company in new panel.

C. Run ground conductor into service enclosures and ground according to National Electrical Code.

**3.02 ELECTRICITY-METERING EQUIPMENT**

A. Install utility company metering equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

**3.03 TESTING**

A. Test station for grounding. Report test results to CITY.

\*\*\* END OF SECTION \*\*\*

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Furnish and install new equipment and appurtenances for controls and instrumentation:
  - 1. Control panel.
  - 2. Wet well level sensor.
  - 3. Float switches (high and low level alarms).
  - 4. Pump controller.
  - 5. Alarms.
  - 6. Telemetry equipment.
  - 7. Conduits and wiring.

**1.02 STANDARDS**

- A. Applicable Standards and Codes:
  - 1. Institute of Electrical & Electronic Engineers (IEEE).
  - 2. Underwriters' Laboratories, Inc. (UL).
  - 3. National Electrical Manufacturers Association (NEMA).
  - 4. National Electrical Code (NEC).
  - 5. American Society for Testing & Materials (ASTM).
  - 6. American National Standards Institute (ANSI).
  - 7. National Board of Fire Underwriters (NBFU).
  - 8. National Fire Protection Association (NFPA).
  - 9. National Electrical Contractors "Standard of Installation" (NECA).
  - 10. Instrument Society of America (ISA).

**1.03 SUBMITTALS**

- A. Shop Drawings:
  - 1. Submit for all equipment.
  - 2. Required information:
    - a. Description and function:
      - 1) Dimensions.
      - 2) Details of construction and installation.
      - 3) Detailed system schematic.
      - 4) Manufacturer's name and model number.
    - b. Logic diagrams with conductor and terminal numbers, coil function description and contact references and cross-references for all instrumentation.
    - c. Control panel layouts.
    - d. Control equipment schematics showing electrical connections to related mechanical equipment.
- B. Operation and maintenance manuals:
  - 1. Submit for all equipment.
  - 2. Required information:
    - a. Equipment function, normal operating characteristics and limiting conditions.
    - b. Assembly, installation, alignment, adjustment and checking instructions.

- c. Operating instructions for start-up, routine and normal operating, regulation and control, and shutdown and emergency conditions.
  - d. Maintenance instructions.
  - e. Guide to "troubleshooting".
  - f. Outline, cross-sections, assembly drawings, engineering data and wiring diagrams.
  - g. Report of path study results using installed equipment, indicating:
    - 1) Background noise level, 5 measurements and average.
    - 2) Signal strength level, 5 measurements and average.
    - 3) Height of antenna used to obtain measurements.
    - 4) Type of antenna used and its gain.
    - 5) Signal path (location of repeater radio).
- C. Path study:
- 1. Submit path study report described in Part 2.

#### **1.04 DELIVERY, STORAGE AND HANDLING**

- A. All instrumentation equipment shall be stored and protected from dampness and humidity.

#### **1.05 SPARE PARTS**

- A. Provide City with two spare relays of each type used.

### **PART 2 - PRODUCTS**

#### **2.01 CONTROL PANEL**

- A. General:
  - 1. Single-door style with stainless steel continuous hinge pin.
  - 2. NEMA Type 4 enclosure.
  - 3. Padlock handle with 3-point latch.
  - 4. Floor stand: 12" high.
  - 5. Data pocket.
  - 6. Swing-out panel.
  - 7. Provide two 4.75"x4.5" louver plates with filters.
  - 8. Coating: Light brown or beige polyester powder coat.
  - 9. Provide 1" x 6" x 1/4" copper ground bus.
  - 10. Provide 9"x5.5" window located to view level indicating controller.
- B. Manufacturers:
  - 1. Hoffman Engineering Company.
  - 2. Or equal.

#### **2.02 PANEL DEVICES**

- A. Pilot lights: Heavy-duty, NEMA Type 4, transformer style, push-to-test , 6-volt incandescent lamp, Square D Type SK, Class 9001 or equal.

- B. Switches:
  - 1. Heavy-duty, NEMA Type 4.
  - 2. Selector switches: Square D Type SK, Class 9001 or equal.
  - 3. Pushbutton switches: Square D Type SK, Class 9001 or equal.
  
- C. Control and auxiliary relays:
  - 1. Plastic enclosed plug-in type with indicator light.
  - 2. Contacts rated not less than 10 amperes.
  - 3. Sockets: Plug-in, snap rail DIN type with screw terminals.
  - 4. Manufacturer: IDEC Corporation, RH series.
  
- D. Phase monitor (PM) relays:
  - 1. Monitor phase failure, phase reversal, undervoltage and voltage unbalance.
  - 2. Manufacturer and model:
    - a. Square D, Class 8430.
    - b. Or equal.
  
- E. Timer relay (TR1,TR2):
  - 1. Manufacturers and models:
    - a. AMETEK National Controls Corporation, Q6F Series.
  
- F. Timer relay (TR3):
  - 1. Operating mode: On-delay.
  - 2. Adjustable time period of 10 seconds to 2 minutes, minimum.
  - 3. Contacts rating: 5A@120VAC minimum.
  - 4. Manufacturer and model:
    - a. Allen-Bradley; Catalog number 700-FEA1SU22.
    - b. Or equal.
  
- G. Intrinsically safe relays (ISR):
  - 1. Supply voltage: 120 VAC.
  - 2. Contact rating: 4A @ 120 VAC.
  - 3. Output type: One SPDT per channel.
  - 4. UL or FM approval for use in Class I, Group D locations.
  - 5. Manufactures:
    - a. R. Stahl Incorporated; Type 9251.
    - b. Or equal.
  
- H. Terminal blocks:
  - 1. Provide DIN rail mount terminal blocks.
  - 2. Manufacturers:
    - a. Square D, Class 9080 Type G.
    - b. Cooper Bussmann, Inc., Model NDN111.
    - c. Or equal.
  
- I. Transformer (TX):
  - 1. Square D, Class 9070 Type TF

- 2. Or equal.
- J. Receptacle:
  - 1. Commercial grade.
  - 2. Leviton Manufacturing Company, Inc., CR20-I.
- K. Elapsed time meters (ETM):
  - 1. Quartz crystal time base insensitive to line frequency.
  - 2. Non-resettable.
  - 3. ENM Company, Model T50B2.
- L. Antenna lightning arrester:
  - 1. PolyPhaser Corporation, Model IS-B50LN-C2.

**2.03 SURGE CAPACITORS (SC)**

- A. General:
  - 1. Rated voltage: 650V, three phase, four wire.
  - 2. Equipped with an internal automatic discharge circuit.
  - 3. Designed for heavy duty service such as motor installations.
- B. Manufacturer and model:
  - 1. Delta Lightning Arrestors, Inc., Model CA603.

**2.04 FLOAT SWITCHES (FS)**

- A. General:
  - 1. Cord: 16 gage, 2 conductor SJOW.
  - 2. Contact rating: 13 amp, 120 VAC minimum.
  - 3. Temperature rating: 32 to 140 degrees F minimum.
  - 4. Non-mercury switch housed in ABS shell.
  - 5. Tether method: Weight.
- B. Manufacturers:
  - 1. Anchor Scientific Inc., Eco Float Type SE.
  - 2. Gems Sensors, Inc., Warrick Type M.
  - 3. Or equal.

**2.05 LEVEL INDICATING CONTROLLER (LIC)**

- A. General:
  - 1. Wall mount.
  - 2. Input voltage: 115 VAC.
  - 3. Provide hand held programmer.
  - 4. Echomax transducer, model XRS-5.
- B. Manufacturer and model:
  - 1. Siemens Energy & Automation, Incorporated, Milltronics HydroRanger Plus.

2. No substitutions.

**2.06 VARIABLE FREQUENCY DRIVE (VFD)**

A. General:

1. Use as a phase converter to operate 3 phase motor from single phase service only with written permission by the Director of Public Works.

B. Manufacturer and model:

1. AC Technology Corporation.

**2.07 TELEMETRY RADIO**

A. General:

1. Model 905U: Frequency hopping spread spectrum 900MHz radio and serial communications.
2. Model 105S: Serial communications.
3. Exception-reporting messaging: Transmit when an input signal changes.
4. Integrated communications and I/O.

B. Manufacturer and models:

- a. ELPRO Technologies, Model 905U-4 Wireless I/O module, Model 105S-2 Serial I/O module.
- b. No substitutions.

**2.08 ANTENNA**

A. Manufacturers:

1. Antenex Inc.
2. Or equal.

**2.09 ANTENNA MAST**

A. General:

1. Antenna heights of 10' shall be implemented with a steel mast mounted on the control panel.
2. Antenna heights greater than 10' shall be implemented using a standard utility pole with a 20' steel mast extending 18' above the pole. At the option of the CONTRACTOR and with approval of the City, a decorative pole may be substituted for a wood pole and steel mast.

**2.10 ANTENNA COAX CABLE**

A. General:

1. Closed cell polyethylene foam dielectric, moisture-free gas injected.
2. Multi-laminar aluminum composite tape bonded to the dielectric.
3. Outer braid of tinned copper.
4. Outer jacket: Polyethylene, UV and weather resistant, with a 20 year service outdoor use design life.
5. Provide waterproofing compound in and around the foil/braid designed to eliminate water migration should the outer jacket become damaged.

6. Provide model number LMR-600-DB cable at a minimum, or LMR-900-DB where signal attenuation requires a lower-loss cable. The radio path study described in paragraph 2.09 will determine the signal strength between radio sites, and shall include an allowance for antenna cable attenuation.

- B. Manufacturers:
1. Times Microwave Systems, Inc.

## **2.11 SCADA SYSTEM INTEGRATOR**

- A. Path study:
1. The lift station uses radio telemetry to communicate with the wastewater treatment plant SCADA software.
  2. Perform a path study to establish:
    - a. Which radio(s) in the existing network will be used to communicate with the proposed lift station.
    - b. Height of antenna necessary to obtain a signal strength of -85 db or better.
  3. Perform path study in accordance with the radio manufacturer's recommendations using a 905U radio rigged (temporarily) for mobile operation.
  4. Submit report of path study results indicating:
    - a. Background noise level, 5 measurements and average.
    - b. Signal strength level, 5 measurements and average.
    - c. Height of antenna used to obtain measurements.
    - d. Length and type of antenna cable used to obtain measurements.
    - e. Type of antenna used and its gain.
    - f. Signal path (location of repeater radio).
    - g. Graphic showing ground elevation along signal path and antenna elevations.
- B. SCADA software programming:
1. Update the SCADA system software to include the proposed lift station.
  2. Programming includes telemetry radio configuration at the proposed lift station, the repeater station(s) and programming the PLC and autodialer located at the wastewater treatment plant.
- C. Aim antenna and measure signal strength. If signal strength is significantly lower than reported in the path study adjusted for installation differences, determine and correct cause of loss.
- D. System integration shall be performed by Windemuller Electric Company.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install the control system in accordance with drawings, shop drawings and manufacturer's recommendations.

- B. Low power DC control signal wires shall be shielded and installed in a separate steel raceway. No AC power or control wires are allowed in the same raceway. The shielded control wires shall be sized to be compatible with the distances involved and the equipment selected.
- C. AC control wires shall be in separate conduit and sized to keep voltage drop within acceptable limits. The minimum size acceptable is #14 AWG.
- D. All wiring terminating in control panel or other devices shall be properly identified with one piece wrap on sleeve type tags or labels with machine lettering.
- E. Before any circuits are energized, all internal and external electrical and mechanical clearances shall be checked to assure that all installed equipment will function safely and properly.
- F. Instrument control panel shall be shimmed level and grouted, shall bear evenly over the full length and be installed plumb.
- G. Nameplates shall be 3 ply, white laminated plastic with engraved black lettering.
- H. All wiring installation shall be grouped, bundled, supported and routed horizontally and vertically, to provide neat appearance. All connections to devices remote from the panel shall be executed through terminal boards.
- I. All internal panel wiring and terminations shall be designed in accordance with the latest applicable standards of the National Electric Code as well as applicable state and local electrical codes. The minimum wire size is #14 AWG except for internal circuits using 5 VA or less #16 AWG is acceptable. Conductors shall not be spliced and shall be continuous from terminal to terminal.
- J. Signal wiring shall be segregated from control power wiring, grouped functionally and arranged neatly to facilitate circuit tracing. No combination of analog, digital input or control output wiring shall be intermixed within the same bundle or duct within a panel. DC signal wires shall be segregated from AC signal wires. Segregate terminal blocks used for DC signals, AC control and power wires.
- K. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals, not exceeding 12 inches.
- L. Where lugs are required, provide locking fork (ring lugs on equipment grounds) with insulating sleeves. Lugs shall be sized according to wire size, and crimped with a ratchet type crimper.
- M. Where shielding is required, shields shall be continuous foil or metalized plastic providing 100% coverage. A drain wire in continuous contact with the shield shall be included. Shielding shall be grounded at panel end only.
- N. Conductors shall be stranded copper with 600 volt Type MTW insulation. Wiring from sub-panel to a hinged door or panel shall include a loop in bundle to relieve the tension and allow door to open 150° minimum.

- O. Control panel wiring shall be identified at each termination by marking with a number to correspond with the diagrams. Wire identification shall be one piece wrap on or sleeve type with machine lettering and numbers. Conductors shall be color coded as follows:
  - 1. AC line and load circuits . . . . . black
  - 2. AC control circuits . . . . . red
  - 3. DC control circuits . . . . . blue
  - 4. Interlock control circuits on the panel energized from external source . . . . . yellow
  - 5. Equipment grounding conductors . . . . . green
  - 6. Current carrying grounded conductor (neutral) . . . . white
  
- P. Touch up or refinish damaged paint on control panel.

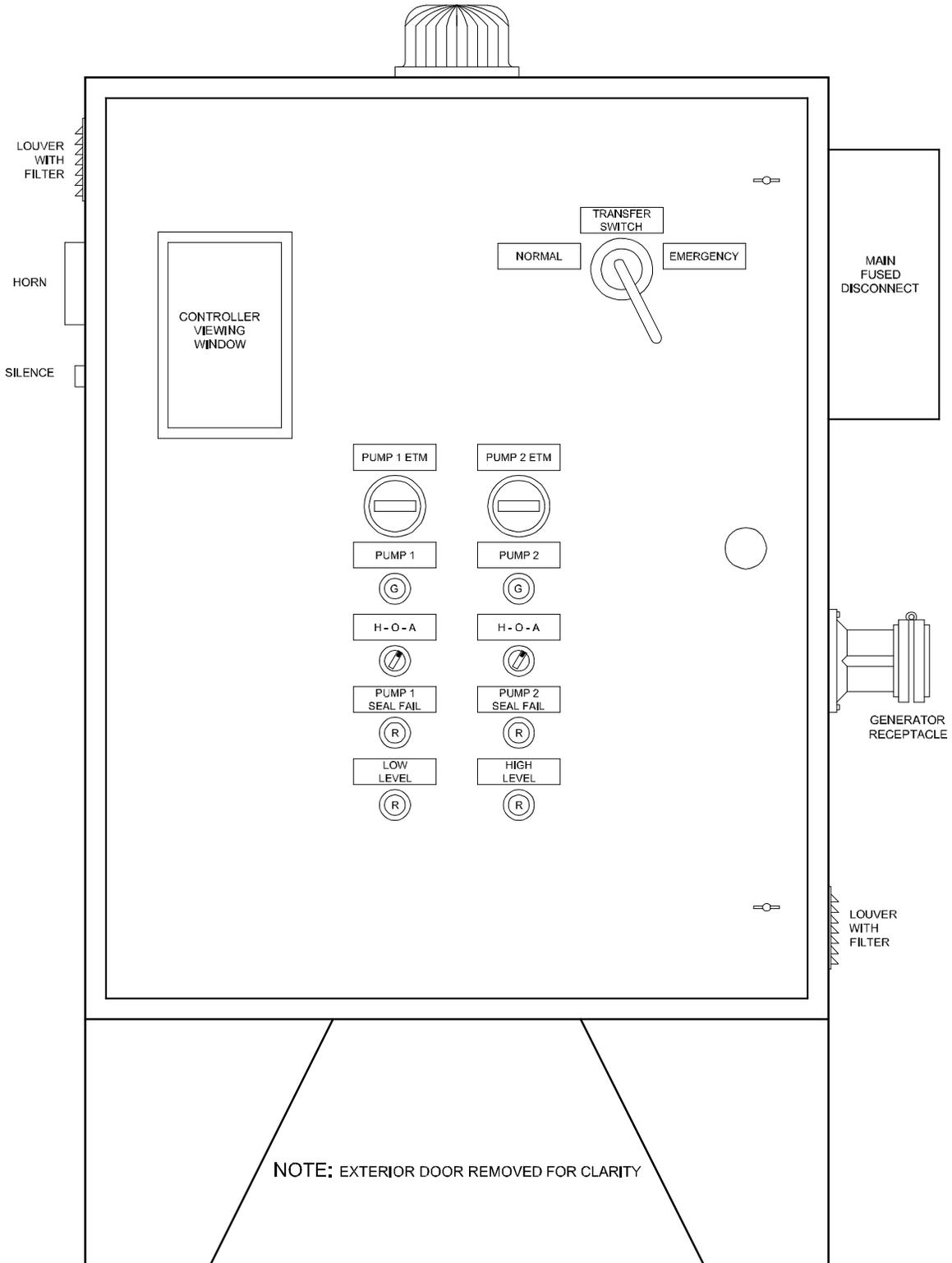
**3.02 FIELD QUALITY CONTROL**

- A. Control panel Fabricator's field service:
  - 1. Arrange and pay for Fabricator's representative to provide the services indicated below.
  - 2. Fabricator's representative: Check work.
  - 3. Promptly make all changes and additions required by Fabricator's representative.
  - 4. Fabricator's representative:
    - a. Assist in start-up.
    - b. Demonstrate operation and maintenance to City's personnel.
  - 5. Submit Fabricator's representative's written approval of installation.
  
- B. Start-up and training:
  - 1. Start-up assistance:
    - a. Includes:
      - 1) Calibration of field equipment before and during facility operation.
      - 2) Line-by-line logic verification with City representative.
      - 3) Equipment installation verification.
      - 4) Other related equipment start-up assistance.
    - b. Does not include:
      - 1) Installation time.
      - 2) Training time.
    - c. Duration:
      - 1) Minimum: 4 hours.
      - 2) Or more as necessary to complete start-up.
    - d. Schedule:
      - 1) CONTRACTOR shall coordinate with City and subcontractors to complete the start-up procedures.
      - 2) Submit to City written schedule prior to startup listing dates, tasks to be accomplished, systems to be checked out.
  - 2. Training:
    - a. Includes:
      - 1) Operation and maintenance training on all equipment specified under this Section.
      - 2) Equipment calibration training on all equipment specified under this Section.
      - 3) Trouble shooting methodology.

- b. Minimum duration: 4 hours.
- c. Schedule: CONTRACTOR shall coordinate with City in accordance with schedule approved by City.

**3.03 SCHEDULES**

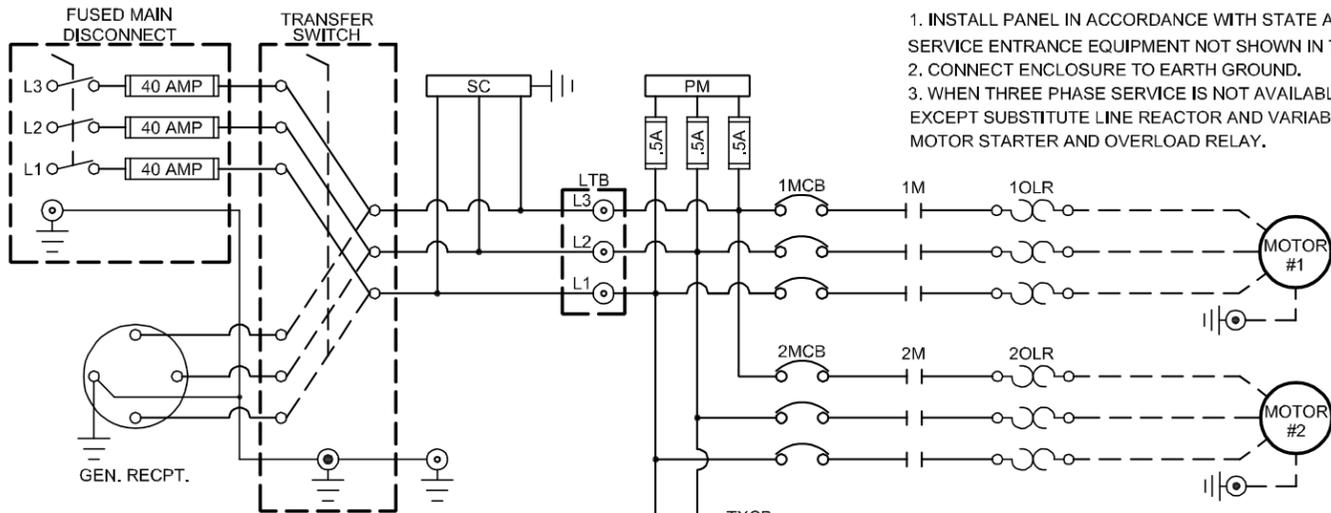
- A. Control panel front elevation.
- B. Control diagram for 3 phase service.
- C. Control diagram for single phase service.



SCHEDULE A - CONTROL PANEL FRONT ELEVATION

**NOTE:**

1. INSTALL PANEL IN ACCORDANCE WITH STATE AND LOCAL CODES, INCLUDING SERVICE ENTRANCE EQUIPMENT NOT SHOWN IN THIS CONTROL PANEL.
2. CONNECT ENCLOSURE TO EARTH GROUND.
3. WHEN THREE PHASE SERVICE IS NOT AVAILABLE, CONTROLS ARE SIMILAR EXCEPT SUBSTITUTE LINE REACTOR AND VARIABLE FREQUENCY DRIVE FOR MOTOR STARTER AND OVERLOAD RELAY.

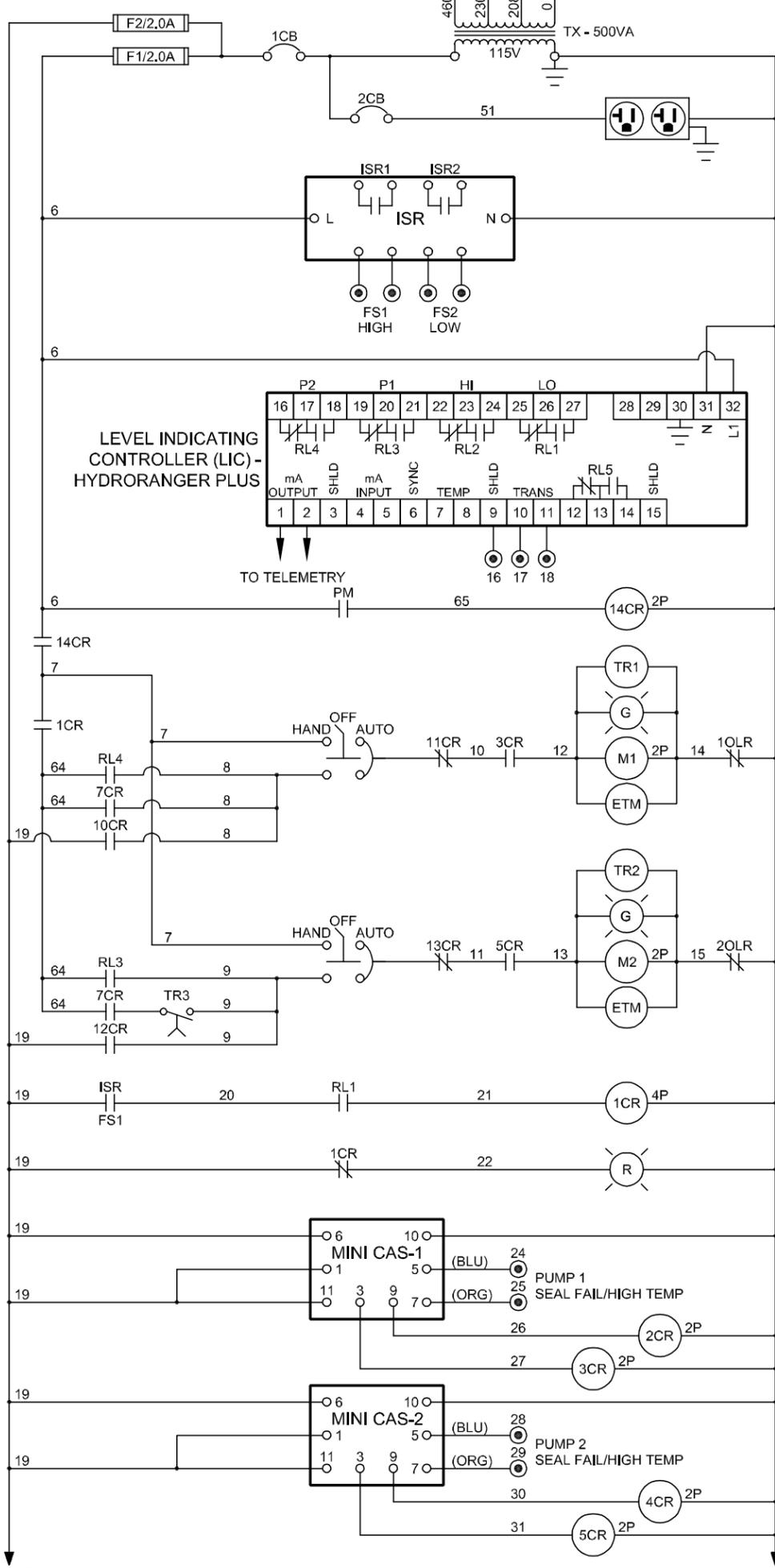


MOTOR DATA  
460 VAC 3 PH 60 HZ  
\_\_\_ HP @ \_\_\_ FLA

MOTOR DATA  
460 VAC 3 PH 60 HZ  
\_\_\_ HP @ \_\_\_ FLA

**INCOMING SERVICE**

460 VAC  
3 PH  
60 HZ  
3 W



DUPLEX RECEPTACLE

LEVEL INDICATING CONTROLLER (LIC) - HYDRORANGER PLUS

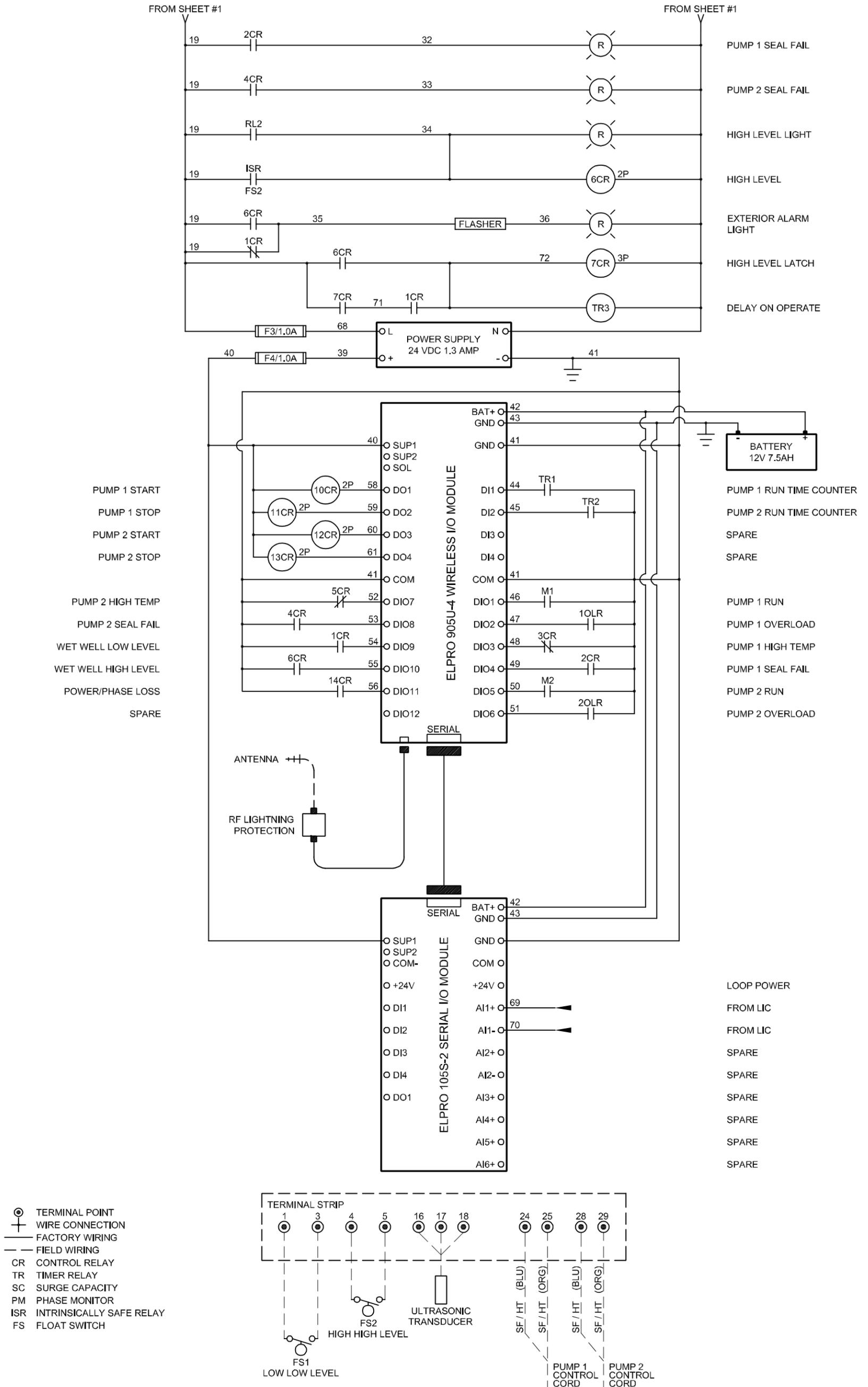
**NOTE 1:** TIMER RELAYS (TR1,TR2) GENERATE TIMED PULSES WHEN PUMP RUNS. RADIO TERMINALS DI1 THROUGH DI4 (ONLY) HAVE PULSE COUNTING CAPABILITY. SCADA SOFTWARE CONVERTS PULSES INTO A RUN TIME THAT IS INDEPENDENT OF TELEMETRY TRANSMISSION DELAYS. SIGNALS M1 AND M2 ARE AFFECTED BY TELEMETRY TRANSMISSION DELAYS AND SHALL NOT BE USED FOR DETERMINING PUMP RUN TIME.

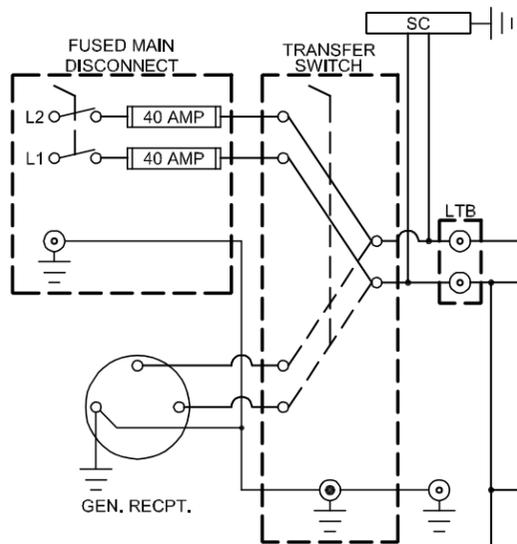
**NOTE 2:** TIMER RELAY TR3 DELAYS PUMP START 30 SEC.

- ⊙ TERMINAL POINT
- ⊕ WIRE CONNECTION
- FACTORY WIRING
- - - FIELD WIRING
- CR CONTROL RELAY
- TR TIMER RELAY
- SC SURGE CAPACITOR
- PM PHASE MONITOR
- ISR INTRINSICALLY SAFE RELAY
- FS FLOAT SWITCH

TO SHEET #2

TO SHEET #2





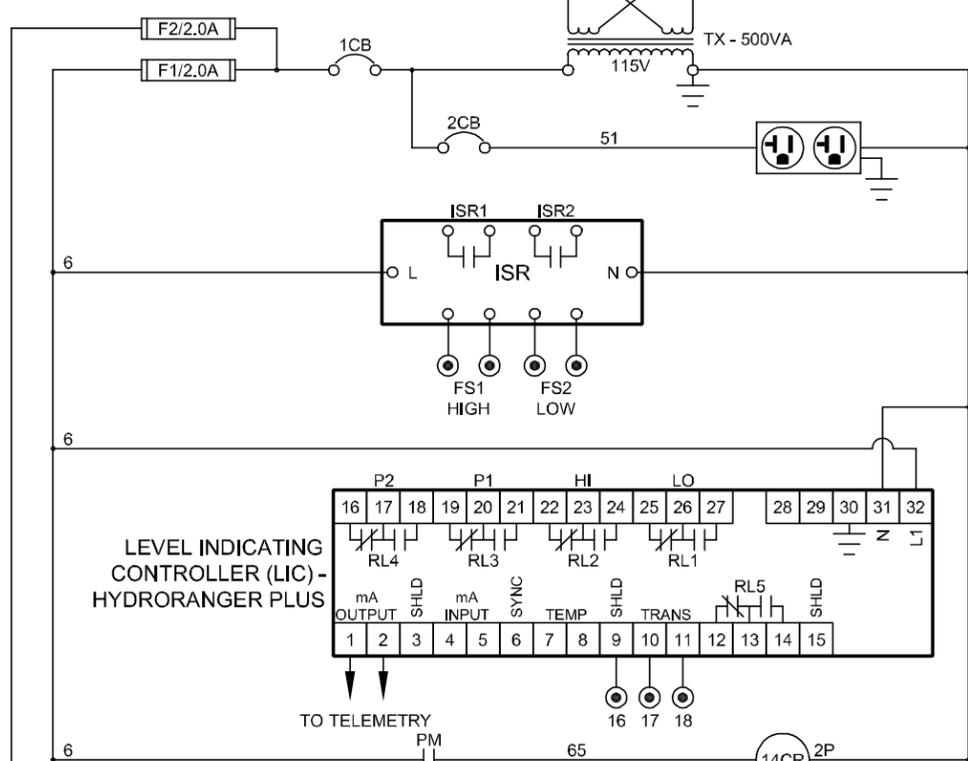
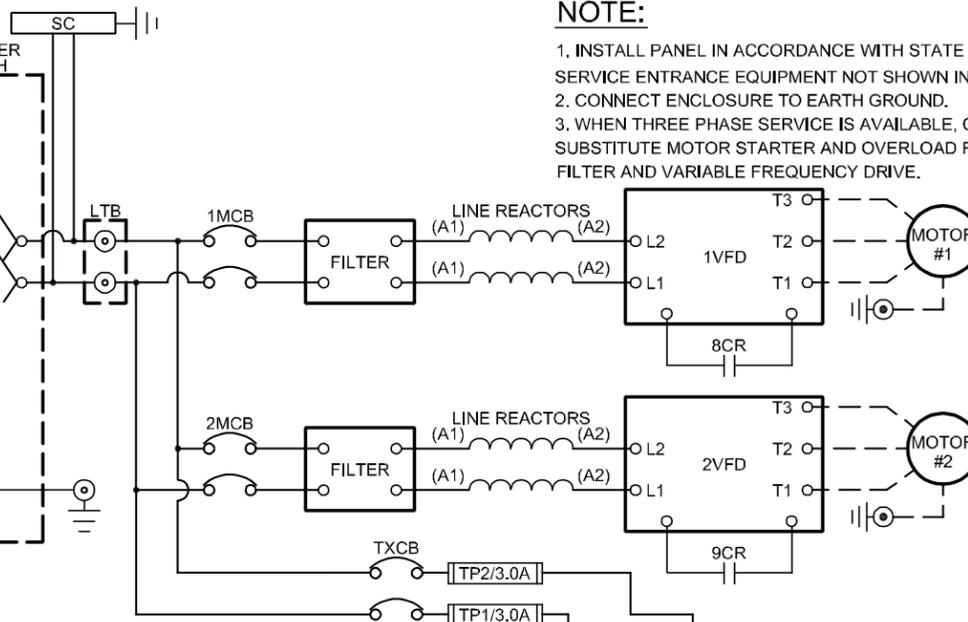
**NOTE:**

1. INSTALL PANEL IN ACCORDANCE WITH STATE AND LOCAL CODES, INCLUDING SERVICE ENTRANCE EQUIPMENT NOT SHOWN IN THIS CONTROL PANEL.
2. CONNECT ENCLOSURE TO EARTH GROUND.
3. WHEN THREE PHASE SERVICE IS AVAILABLE, CONTROLS ARE SIMILAR EXCEPT SUBSTITUTE MOTOR STARTER AND OVERLOAD RELAY FOR LINE REACTOR, FILTER AND VARIABLE FREQUENCY DRIVE.

MOTOR DATA  
230 VAC 3 PH 60 HZ  
\_\_\_ HP @ \_\_\_ FLA

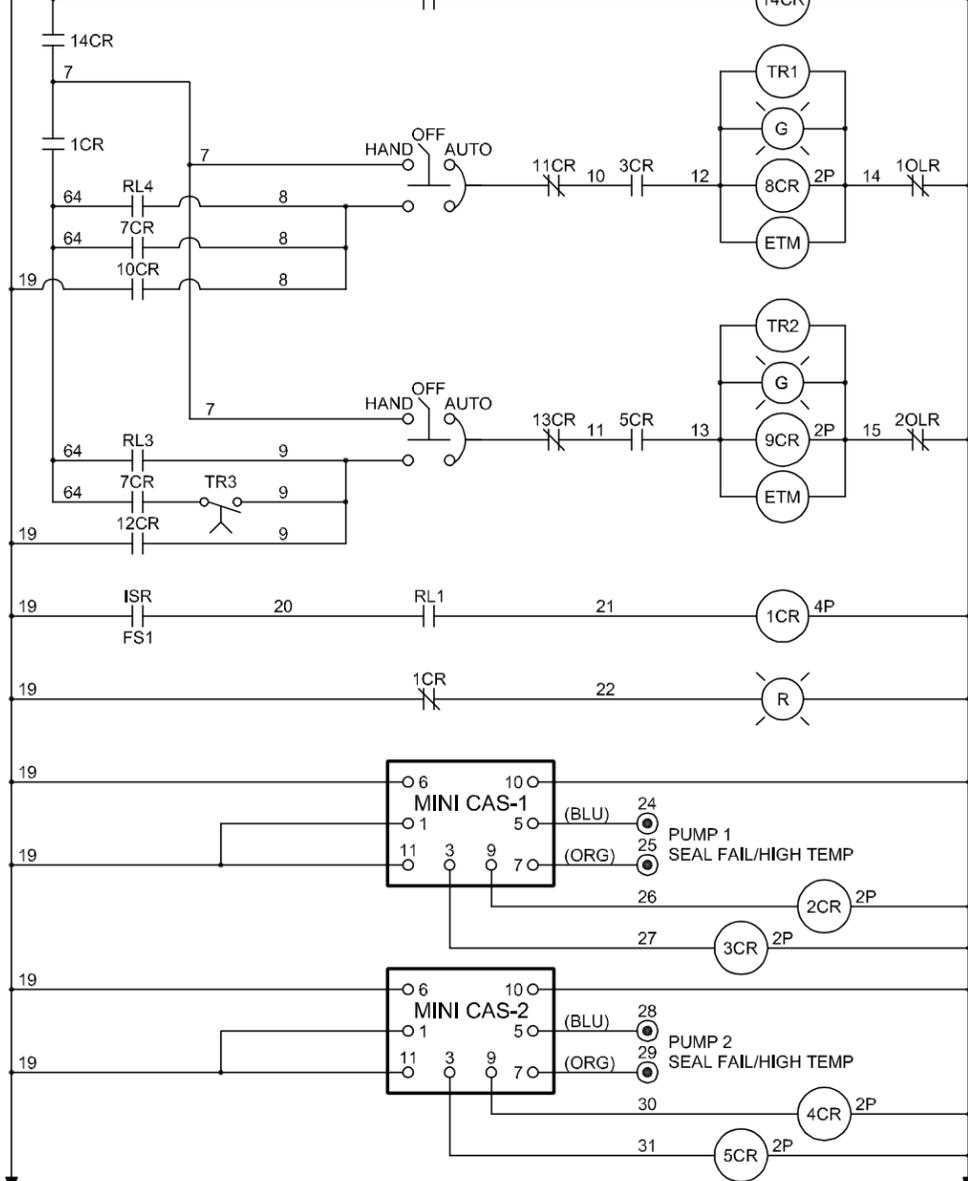
MOTOR DATA  
230 VAC 3 PH 60 HZ  
\_\_\_ HP @ \_\_\_ FLA

**INCOMING SERVICE**  
230 VAC  
1 PH  
60 HZ  
2 W



**NOTE 1:** TIMER RELAYS (TR) GENERATE TIMED PULSES WHEN PUMP RUNS, RADIO TERMINALS DI1 THROUGH DI4 (ONLY) HAVE PULSE COUNTING CAPABILITY. SCADA SOFTWARE CONVERTS PULSES INTO A RUN TIME THAT IS INDEPENDENT OF TELEMETRY TRANSMISSION DELAYS. SIGNALS M1 AND M2 ARE AFFECTED BY TELEMETRY TRANSMISSION DELAYS AND SHALL NOT BE USED FOR DETERMINING PUMP RUN TIME.

**NOTE 2:** TIMER RELAY TR3 DELAYS PUMP START 30 SEC.



- ⊙ TERMINAL POINT
- ⊕ WIRE CONNECTION
- FACTORY WIRING
- - - FIELD WIRING
- CR CONTROL RELAY
- TR TIMER RELAY
- SC SURGE CAPACITOR
- PM PHASE MONITOR
- ISR INTRINSICALLY SAFE RELAY
- FS FLOAT SWITCH

TO SHEET #2

TO SHEET #2



\*\*\* END OF SECTION \*\*\*