

XVII. WASTEWATER LIFT STATIONS

It is CMUD's policy to minimize the need for wastewater lift stations and to limit their construction and use within the system. The basis for this policy is that lift stations can cause disproportionate expense in order to provide service to a limited customer base and that failure of lift stations poses significant environmental risks.

It is recognized however, that there are situations where lift stations are a feasible alternative to certain small, permanent treatment facilities as well as a feasible temporary solution for new development. CMUD provides the large regional lift stations it deems necessary for orderly system development and operation under the CIP. CMUD will also consider, on a case by case basis, requests to accept new developer funded lift stations in the situations described below.

- The lift station can be eliminated by a project or combination of projects, all of which are included for funding in the approved 5-year CIP.
- The lift station can be eliminated by a project being done under a reimbursable program and the funds have been made available to CMUD for construction.
- The new development is in an area designated by CMUD for service by low pressure sewer systems and the proposed station size and location is in accordance with the "Lake Area Sewer Study" plan, dated March 8, 1991.
- The proposed lift station is at an appropriate location and has adequate capacity or expansion capacity to serve as a permanent or long term facility and gravity service is cost prohibitive or not possible due to other circumstances.
- The construction of the proposed lift station would include elimination of one or more existing lift stations.
- The construction of the proposed lift station would facilitate significant progress toward achievement of land use goals and strategies described by current, officially approved planning documents and no other reasonable options are available for service.

In all cases, the receiving system must have available capacity to carry the proposed lift station discharge. Any upgrades required will be the responsibility of the customer requesting the lift station.

A. OPERATIONAL AND PERFORMANCE STANDARDS

Lift stations shall ordinarily be of the wet well/dry well type with at least one standby pump and shall be sized to pass the peak daily design flow with the firm station pumping capacity (i.e. the capacity with the largest pump out of service). The pump cycle rate shall not exceed three per hour for any individual pump. Force main velocity shall be at least 2 fps and not greater than 8 fps with the station operating at its firm capacity. A daily peak velocity of at least 3.5 fps is desirable to re-suspend settled solids.

The firm capacity of a sewer lift station is the maximum pumping rate that the station can sustain with its largest pump out of service.

Lift stations with less than 2 MGD firm capacity and which will be eliminated by gravity sewer projects in the five year CIP may be pre-packaged canister type stations. Wet well mounted stations may be approved by CMUD for very low flow temporary applications. Stations with firm capacity of 2 MGD or greater shall be individually designed and housed in a building appropriate for the specific application.

Lift stations serving relatively large basins with low initial flow may be designed with variable speed pumps, or with fixed speed pumps with downsized impellers to be replaced with full sized impellers when flows increase to a predetermined level. Under these conditions some compromise of initial minimum force main flow velocities may be necessary.

Where adjacent waters are classified as WS-I, WS-II, WS-III, B, SA, or SB or when the pump station capacity is 2 MGD or greater, the pump station shall be equipped with on site standby power or separate dual power feed to the site. All other pump stations shall be equipped with automatic power failure/high level telemetry alarm system and shall be equipped with a manual transfer switch for connection to portable standby power equipment.

GENERAL PROVISIONS

- I. **SEWAGE PUMPING STATION:** The Contractor shall furnish and install (substantially to the lines, grades, elevations, and dimensions as shown on the Plans) one complete factory-built automatic, underground pump station with all needed equipment, factory installed and factory tested in either a welded steel pump chamber or a pre-cast concrete pump chamber. The station shall be furnished of sufficient dimensions as outlined in these specifications. The principal items of equipment shall include a minimum of two vertical motor-driven non-clog sewage pumps with flexible coupling between pump and motor; valves; internal piping, motors, disconnect switches, automatic power failure and high water alarm with low water cut-off; lighting, sump pump, motor-driven ventilator, dehumidifier, panelboard with circuit breakers, starters, controls and all internal wiring.

OPERATING CONDITIONS: Each pump supplied shall be capable of delivering the specified GPM at the specified total dynamic head. Pump speeds shall not exceed 1200 RPM unless it can be demonstrated to the Engineer that higher pump speeds are necessary for head requirements, increased operating efficiencies, etc. The maximum allowable speed shall be 1800 RPM. Every effort shall be made to utilize the pumps and motors of the highest available efficiencies. The horsepower rating of each pump motor shall be sufficient to operate the pump under normal operating conditions without being overburdened. All openings and passages shall be large enough to permit the passage of a sphere 3" in diameter and any trash or stringy material which can pass through a 4" hose collection system.

A. **PUMPS:**

1. **FLEXIBLE COUPLED PUMPS:** The pumps shall be vertical ball bearing, non-clog sewage pumps with flanged discharge openings. The pumps shall be plain fitted and shall have flexible coupling and drive shaft between the pump and motor.

The impeller shall be of the enclosed non-clog type with the forward ends of the blades generously rounded to avoid catching trash; the blades shall be tapered toward the periphery of the impeller so as to generate the maximum possible shut-off head; and the outer tips of the blades shall occupy only a negligible portion of the area of the impeller throat or periphery. The impeller shall be made of close grained cast iron and accurately balanced before assembling in the pump.

The pump shall be supported by a fabricated steel or cast iron base rugged enough to support the full weight of the pump and motor and have openings large enough to permit access to the suction elbow and cleanout handhole.

The casing shall be made of close grained cast iron and shall be large enough at all points to pass any size of solid which can pass through the impeller. Handholes with removable covers shall be provided when available in the casing of all pumps 4" and larger for inspection

purposes. The casing shall be arranged so that the impeller may be removed without disturbing the suction or discharge piping.

The pump shaft shall run in ball bearings, one of which shall be of the radial type and one of the combined radial and thrust type. The bearings shall be grease lubricated and carefully sealed to exclude moisture and contaminants. The two pump bearings shall carry all radial and axial thrust of the pump completely independent of the motor bearings.

The shaft shall be turned and ground to accurate dimensions from high grade alloy steel and furnished with stainless steel shaft sleeves. The sleeve material shall meet or exceed ASTM A-473 and shall protect the shaft through the stuffing box. The protecting sleeves shall be of sufficient hardness to resist abrasions and shall be removable so that they can be replaced when necessary without replacing the whole shaft. Stuffing boxes shall be furnished which will permit the use of conventional packing or mechanical seals. They shall be sufficiently deep to accommodate necessary packing of a seal cage.

- a. Mechanical Seals (Ceramic Seals): In lieu of conventional packing, shaft sealing shall be provided by installing double type mechanical seals in the pump seal housing. The seals shall have precision lapped seats for true sealing. The mechanical seal shall be lubricated directly from the pump discharge. The water used for the seal shall be filtered through a replaceable cartridge type filter as recommended by the manufacturer. The manufacturer and model number of the seal to be used shall be submitted for approval prior to approval of the pumps. The Contractor shall supply three (3) spare seals and three (3) spare filters to the Engineer.
 - b. Pumps shall be as manufactured by Aurora, Allis-Chalmers, Fairbanks-Morse, or approved equal and furnished with special heavy duty frames capable of handling the specified operating conditions.
 - c. Shop drawings, characteristic curves, or any other information regarding the materials, as required or deemed necessary by the Engineer shall be submitted to the Engineer for approval prior to ordering equipment. For larger size pumps, the Engineer may require the Contractor to furnish certified factory test curves for each pump guaranteeing pumping rates, efficiencies, and horsepower draw.
2. BUILT-TOGETHER PUMPS: The pumps shall be vertical ball bearing, non-clog sewage pumps with flanged suction and discharge openings.

The impeller shall be of the enclosed non-clog type with the forward ends of the blades generously rounded to avoid catching trash; the blades shall

be tapered toward the periphery of the impeller so as to generate the maximum possible shut-off head; and the outer tips of the blades shall occupy only a negligible portion of the area of the impeller throat or periphery. The impeller shall be made of close grained cast iron and accurately balanced before assembling in the pump.

The pump shall be supported by a fabricated steel or cast iron base rugged enough to support the full weight of the pump and motor and shall have openings large enough to permit access to the suction elbow and cleanout handhole.

The casing shall be made of close grained cast iron and shall be large enough at all points to pass any size of solid which can pass through the impeller. Handholes with removable covers shall be provided when available in the casing of all pumps 4" and larger for inspection purposes.

The pump and motor shaft shall be stainless steel with radial bearings at the top and combination radial and thrust bearings at the bottom. The bearings shall be grease lubricated and carefully sealed to exclude moisture and contaminants. The minimum shaft diameter for pump and motor shall be 1-7/8" for motor frame sizes 213 through 286, 2-1/8" for motor frame sizes 324 and 326 and 3" for motor frame sizes 364 and larger. The overhang distance from lower bearing to top of impeller hub shall be held to a minimum.

- a. Mechanical Seals (Ceramic Seal): Shaft sealing shall be provided by installing mechanical seals in the pump seal housing. The seals shall have precision lapped seats for true sealing. The mechanical seal shall be lubricated directly from the pump discharge. The water used for the seal shall be filtered through a replaceable cartridge type filter as recommended by the manufacturer. The manufacturer and model number of the seal to be used shall be submitted for approval prior to approval of the pumps. The Contractor shall supply three (3) spare seals and three (3) spare filters to the Engineer.
- b. Pumps shall be as manufactured by Aurora, Allis-Chalmers, Fairbanks-Morse, Smith and Loveless or approved equal and furnished with special heavy duty frames capable of handling the specified operating conditions.
- c. Shop drawings, characteristic curves, or any other information regarding the materials as required or deemed necessary by the Engineer shall be submitted to the Engineer for approval prior to ordering equipment. For larger size pumps, the Engineer may require the Contractor to furnish certified factory test curves for each pump guaranteeing pumping rates, efficiencies, and horsepower draw.

- B. MOTORS: The motors shall be 3 phase, 60 Hertz, 460 volt vertical, shielded, drip-proof motors with service factor of 1.15. They shall have normal starting torque and low starting current characteristics. The motor shall not be overloaded beyond the name plate rating at the design head nor beyond the name plate rating plus the manufacturer's service factor at any head in the operating range. The motor shaft shall be of adequate strength and stiffness for the service intended. It shall be supported on heavy grease lubricated ball bearings one of which shall be a combination guide and thrust bearing and the other a guide bearing. The motors shall be compatible with the controls provided with the station. Each motor shall have an "anti-plugging" device to prevent application of power to the motor when the rotor is turning in reverse or anti-reverse ratch on motor.
- C. CONTROLS: (See Electrical Material Specifications for additional requirements) The system shall include all auxiliaries required to operate constant speed pumps. Pumps will alternate at the end of each complete pumping cycle and discharge at the station influent rate within design capacity, without flow surges.

The operating sequence shall be arranged wherein the lead pump for an individual running cycle will handle normal flows. When the capability of the lead pump is exceeded, the second pump will start in sequence at predetermined water elevations. As the flow decreases, the reverse sequence is to occur. The operating sequence shall be 1, 2 lead lag operation, with each running cycle commencing with the other pump to insure equal wear on both pumps. The air flow meters shall be calibrated in C.F.H. and shall be adjustable.

The system shall also be furnished with an automatic "low water level shut-off" with manual over-ride to prevent pump damage.

The bubbler air compressors shall be of the piston type with adjustable pressure switch. The compressors shall be mounted below the controls cabinet of the pump station. Two compressors shall be fitted to a common tank and shall be equipped with the necessary controls for alternating operation in event of one compressor failure. Failure of a compressor to operate shall be indicated by appropriate lights on the control panel. Bubbler air compressors shall be as manufactured by ITT, or approved equal. Tank shall meet ASME standards.

Thermal-magnetic circuit breakers and reduced voltage motor starters, as part of a motor control center shall be provided and located within the pump station.

1. Automatic Power Failure And High Water Alarm: The Contractor shall furnish and install a fully automated power failure and high water sensing alarm and notification system. This system shall be the ADAS™ Dialog Kaye Instruments, Inc., Human Voice - 8 channel. The unit shall be furnished with sensors for dry well flooding,

highwater alarm in the wet well and power failure. The sensors shall operate to close normally, open relay contacts or a mechanical switch to activate the automatic dialing and message transmittal procedure. When a call is successfully completed, the person receiving the call shall have a means to signal that the call has been completed, whereupon the system shall reset itself without placing any more calls.

The system shall have an adjustment which will delay the starting of the synthesized message from 2 seconds to at least 90 seconds. If, during this delay time, or at any time that the system is placing calls, the activating contact is reopened, the system shall immediately reset itself at the beginning of the first number to be called. The tripping circuits shall be desensitized with filters so that the time response shall be the same as a telephone type relay (approximately 10 milliseconds). Input pulses of less than 10 milliseconds shall be filtered out to eliminate false tripping due to lighting or voltage surges.

The system shall not require a special direct or leased telephone circuit. A regular rotary dial, non-directory listed private line telephone circuit will be provided by the Owner. Connection into the telephone line shall be through an alarm coupler furnished by the local telephone company. The system shall have the proper connecting cable for connecting into the alarm coupler and shall provide the necessary power and control switching for the coupler, with no auxiliary equipment or power source necessary. All dial pulses and voice message inputs to the coupler shall meet the requirements as published by the telephone companies.

The system shall be equipped with nickel-cadmium batteries for stand-by operation, with a recharging circuit powered by 117v, 60Hz and shall be fused by means of a .5 amp fuse which may be replaced without removing the cover of the unit. A pilot light shall indicate when the A.C. power is on. The stand-by capacity shall be sufficient to sustain one hour of recycling, or eight hours with the system in stand-by, after complete power failure.

The alarm system shall be housed in a 16 gauge steel cabinet, suitable for wall mounting. An "off-on-about" switch shall be provided to be used when installing and testing the system. The control switch shall be inaccessible when the cover is on the unit.

The manufacturer must warrant that for the period of the Contractor's warranty, the alarm system shall be free of defects in materials and workmanship, and that upon any breach of such warranty, the manufacturer shall repair or replace the defective system upon return of same to its factory or a designated repair facility within the United States.

- D. PIPING: Pump suction lines shall be Class 50 Ductile Iron Pipe. Suction lines 6-inch and larger shall be fitted with turned-down flare fittings. Suction lines smaller than 6-inches may use square edge inlets at the foot of the wet

well slope. Inside the pump station each suction line shall be fitted with an eccentric plug valve (See Valves).

Pump discharge lines shall include increasers (if needed) and flexible rubber expansion joints. Bends shall be base bends with appropriate size pipe supports. The discharge lines shall be fitted, either vertically or horizontally, with both a cushioned swing check valve and a manually operated eccentric plug valve. The swing check valve is to be mounted between the pump and the plug valve. See Valve Section for further specifications.

The discharge header shall be Ductile Iron Pipe. Passage through the pump station wall shall be through the use of either a mechanical joint wall sleeve or a plain end wall sleeve with nonshrink flexible caulking around the discharge header. The installation shall be neat and watertight and painted to match the other piping.

All piping in the pump station shall be minimum Class 50 Ductile Iron Pipe and all fittings shall be flange fittings unless otherwise specified. The pipe and fittings shall have a minimum of twelve inches (12") clearance from interior walls.

- E. FLANGE JOINTS AND ACCESSORIES: All fittings inside pump station shall be flange joint ductile iron fittings. Flange joints shall be either Class 125 or Class 250, as required. Flanges, flange bolts and nuts, and gaskets shall conform to the dimensional requirements of ASA B16.1 for Class 125 or ASA B16.2 for Class 250. Bolts shall have standard square heads unless hexagonal heads are required for clearance and shall be provided with standard hexagonal cold pressed nuts. Unless otherwise specified, bolts and nuts shall be made of the best quality refined iron or mild steel and shall have sound, well fitting threads.

- F. SUMP PUMPS: Installed in the sump shall be a submersible sump pump with a 1/2 HP motor mounted directly above the impeller. It shall have a minimum capacity of 1000 GPH at 30' TDH. The pump shall be controlled automatically by a float switch capable of operation on a 4" differential water level. It shall discharge back into the wet well through a 1-1/4" schedule 40 steel pipe with two check valves and a gate valve within the pump chamber. The pipe shall enter the wet well at as high an elevation as practical. An enclosure of 1/4" heavy steel mesh shall surround the sump pump to keep out debris.

- G. DEHUMIDIFIER: A packaged dehumidifier assembly with hermetically-sealed Freon refrigeration type compressor, expansion coil, fan and condenser coil shall be furnished to maintain the relative humidity of the air low enough to keep the electrical equipment dry and to prevent condensation on the walls. Dehumidifier capacities shall meet or exceed those in table below for the appropriate type station:

7-foot diameter	20 pints per 24 hours
8-foot diameter	25 pints per 24 hours
8-foot diameter (over 8'high)	35 pints per 24 hours
6x8 Quad (and smaller)	25 pints per 24 hours
Larger than 6x8 Quad	35 pints per 24 hours

All capacities are taken at 80 F and 60% relative humidity. The dehumidifier shall be controlled automatically by an adjustable humidistat with a low temperature cut-out, which in turn operates a heavy duty relay of adequate capacity for the dehumidifier motor. The cabinet shall be rust resistant painted steel with a plastic grille. The unit shall be fitted with a 3/4" male threaded outlet for connection to a drain line.

The unit shall be UL listed, 120 volt, 1 phase.

The dehumidifier shall be installed in a complete, neat and secure manner including all fittings, clamps, appropriate sized drain line, and any other necessary hardware. The condensate shall be drained to the sump.

- H. EXHAUST FANS: Exhaust fans shall be sized according to the enclosed volume of the pump station. The fan shall be of adequate capacity to change the air volume 30 times per hour. Fan performance shall be based on tests conducted in accordance with AMCA Standard 210 and fan shall bear the AMCA Certifier ratings seal. Fan motor, drive and ball-bearings shall be mounted in a compartment isolating these components from the air handled by the fan.

An inlet shall be provided to allow fresh air to enter through the entrance tube. Exhaust air shall be picked up 12-inches from floor by an appropriate sized steel duct and carried to outside discharge. Both the intake and discharge vents shall be fitted with suitable covers to prevent the entrance of rain, snow, rocks, rodents, or other foreign materials and shall be above the 100 year flood elevation where applicable.

A combination manual and automatic switch shall be mounted on the top of the entrance tube for operation of the lights and blower. The switch shall be of the mercury tube type mounted such that when the cover is raised it is automatically switched on or may be switched on manually when the cover is closed.

- I. LIGHTS: Adequate lighting shall be provided by one or more fixtures each containing two 40 watt rapid start fluorescent tube lamps. Each light shall be protected by a glass cover. The ballast for fluorescent lamps shall be self-

protecting type "p" for lamp type required, high power factor, 60 cycle ballast for 120 volts. Ballast shall be certified by E.T.L. as conforming to C.B.M. requirements. All fixtures are to be securely attached to the ceiling of the pump station.

Lights are to be controlled as outlined in Exhaust Fan Section. See Lighting Section of Electrical Material Specifications for further specifications.

J. **FACTORY TESTS:** The completed pump station shall be given a running test of all equipment at the factory to check for excessive vibration; for leaks in all piping; for correct operation of the automatic control system; and of all auxiliary equipment. The pump station and discharge lines shall be connected to a reservoir and the pumps shall re-circulate the water, simulating actual service conditions. The automatic control shall be adjusted under such actual operating conditions to start and stop the pumps at the levels required by the job conditions.

K. **WORKMANSHIP:** All workmanship and materials throughout shall be of the highest quality.

L. **INSTRUCTION:** The Contractor shall require the manufacturers of the major components of the pump station to conduct instructional classes (of adequate duration) in the operation and maintenance of their respective equipment. The Contractor shall further provide five (5) copies of an overall operational manual. The manual shall cover all equipment in the pump station, wet well or elsewhere on the site.

The operational manual shall be submitted for review prior to start-up and must be submitted and approved prior to final acceptance.

M. **START-UP:** The Contractor shall be required to provide the necessary personnel for start-up and testing of the completed station, including representatives from equipment suppliers.

Start-up and testing procedures will be satisfied when the components are operating as specified and/or with the approval of the Engineer.

N. **WATER SERVICE:** In areas where a potable water supply is available, the station shall be furnished with a 3/4-inch water service and a frost proof yard hydrant.

II. **WET WELL:** The wet well shall be constructed to the lines, grades and elevations as shown on the Plans or as amended by the Owner. The wet well shall include all the structures, materials, equipment and other items shown on Plans and as necessary for a complete and satisfactory installation. Items not specifically covered in this heading of the specifications are subject to requirements in other headings of these specifications and the direction and approval of the Owner.

A. **WET WELL:** The wet well structure shall be either circular pre-cast sections

or a cast-in-place structure. Both types of structures shall be materially as outlined in other portions of these specifications.

Wet wells are to be open at the top with either steel or aluminum grating covering the entire opening. The grating shall be designed such that portions may be removed to allow passage of a basket screen and personnel. The removable sections may be mounted on hinges. See "Steel Frames and Grates" for further specifications.

A personnel opening shall be located 90 to the basket screen and the wet well shall have steps down to the floor. The steps shall be on 16-inch vertical centers and of an approved design.

The wet well shall be typically as shown on the Standard Details.

- B. **BASKET SCREEN**: Aluminum basket screens shall be fabricated, furnished and installed as shown on plans.

Aluminum surfaces shall be coated or otherwise isolated as necessary to protect the metal from damage by contact with concrete, masonry, steel or other materials that will corrode or damage aluminum. Such protection shall conform with the aluminum manufacturer's instructions. Aluminum material shall be 6061-T6 or equal.

Shop drawings and physical properties of the proposed basket screen must be submitted to the Owner for approval prior to fabrication.

- C. **BASKET HOIST**: A hoist shall be supplied and installed by the Contractor/Developer for the purpose of lifting and cleaning the basket screen. The hoist shall be fabricated of steel angle members and fitted with a hand operated brake winch (W. W. Grainger 4Z082 or approved equal) capable of 1000 pound working loads, equal to . Pulleys and steel cable shall be supplied with appropriate working strengths to provide a complete and smooth operating mechanism. The hoist shall be constructed such that once the basket is raised the hoist may rotate to the side to allow easy access to the basket.

A typical hoist design appears on the Standard Details. Other designs or variations shall be approved by the Owner prior to fabrication or purchase by the Contractor/Developer.

The hoist assembly is to receive protective coating as specified in the "Painting" Section of the Specifications.

- III. **VALVES**: Within the station dry well, each pump suction line shall be fitted with an eccentric plug valve and each pump discharge line shall be fitted with a cushioned swing check valve and an eccentric plug valve. The eccentric plug valve shall be downstream of the swing check valve. Outside the pump station, the force main shall be fitted with an eccentric plug valve. Downstream of this valve shall be a tee with a riser pipe extending vertically to the surface. The riser pipe shall have an eccentric plug valve fitted on the end. This plug valve shall have a blind flange with

a two-inch tap and a two-inch plug on the outlet (top) side. The buried plug valve shall operate with a two-inch square nut and the surface plug valve shall operate with a wrench. The Contractor shall furnish a valve key and a wrench as part of the permanent station equipment. The surface plug valve shall be set in a drain bed of #67 crushed stone at least six inches deep and shall be housed in a 2'x3' pre-cast vault.

Each sump pump shall be fitted with a union coupling, two check valves and a gate valve. Potable water and washdown water piping shall use hose bibbs and yard hydrants as applicable.

All valves are to be as specified below or elsewhere in this document.

- A. GATE VALVES (THREE INCHES AND SMALLER) shall be all bronze construction with iron pipe thread, screw ends, wedge gates, nonrising stems, open by turning to the left, furnished with a T-head or hand wheel, as required and having a working pressure of 200 PSI WOG. Materials for such gate valves shall be in accordance with the most recent edition of AWWA Specification C-500 and such ASTM Designations as apply with reference to chemical requirements as set forth in Table I of ASTM Specifications B-62. Such gate valves shall be Kennedy #427; Jenkins #370, or equal.

- B. SWING CHECK VALVES: Shall be either horizontal or vertical swing check valves furnished with iron bodies, bronze mounted, single disc, swing type full opening, with outside spring and lever assist (compatible with the specified pumps and working pressure) and with flange ends conforming to ASA Specification B16.1. All working parts shall be removable through the top of the valve unless otherwise required by the installation.
 - 1. Materials used in the construction of swing check valves required herein shall be in accordance with the following specifications:
 - a. Valve body, cover, levers and disc arm shall be cast iron in accordance with ASTM 126, Class B.
 - b. Valve discs shall be cast iron in accordance with ASTM 126, Class B.
 - (1) Valve Position: All swing check valves shall be assembled for installation either above ground in a horizontal line with the main shaft horizontal or below ground in pump station housings in a vertical assembly all as shown on the Plans and approved by the Engineer.
 - (2) Shaft Seals: Shaft seals shall be designed for the use of Standard O Ring Seals, or for a conventional stuffing box.
 - (3) Inspection: The manufacturer shall furnish to the Engineer written certification that all valves and material furnished under this specification have been tested and found to

conform with the requirements of AWWA Standards for valves and ASTM and ASA requirements for materials as applicable.

- (4) Coating: Shop painting of swing check valves shall be in accordance with AWWA C-504.
- (5) Valve Body Types: Valve bodies shall be manufactured with flanged ends conforming in dimensions and drilling to ASA B16.1 Class 125 Cast Iron Flanges. The short style valve body will be furnished as required to complete the installation as shown on the Plans.
- (6) Valve Drawings: Plans for valves and assemblies will be approved by the Engineer prior to construction.

C. PLUG VALVES: All valves for pressure sewers and force mains shall be eccentric plug valves as follows:

1. Plug valves shall be non-lubricated, with a plug facing of a material specifically recommended by the valve manufacturer for the indicated service and shall have stainless steel permanently lubricated upper and lower plug stem bearings. Valve seats shall be nickel. Valves shall be designed with adjustable seals which are replaceable without removing the bonnet. The bearing and seal area shall be protected with grit seals.

Area of port opening for all valves shall be no less than 81% of full pipe area.

12-inch and smaller valves shall be rated at 175 psi. 14-inch and larger valves shall be rated at 150 psi. Bi-directional shutoff is required.

Plug valves shall be as manufactured by Dezurik Corporation, Milliken, Keystone, or approved equal.

- a. Buried valves and other valves where specifically indicated shall have mechanical joint ends conforming to ANSI A21.11.
 - b. Valves with flange ends shall be provided where indicated. Flanges shall be in accordance with ANSI B16.1 except that the four holes straddling the principal axis of the valve may be tapped and connected to the adjacent piping with cap screws of adequate size as recommended by the valve manufacturer and approved by the Engineer.
2. Plug valve operation shall be as indicated on the Plans and as follows:
 - a. Buried valves shall have 2-inch square operating nuts.

- b. Where gearing is required for proper operation of valves the gearing shall be located in enclosed gear cases. Gearing shall be in accordance with the valve manufacturer's recommendations as required to permit easy operation of the valve by one man without excessively large hand wheel or cranks. Hand wheels shall not exceed 16 inches in diameter.
 3. Extension stems, stem guides, operating levers, and other miscellaneous items required for a complete installation shall be provided in accordance with the requirements and recommendations of the valve manufacturer.
 4. Valves shall be installed in/on concrete support pad and shall be provided with a valve box conforming to Standard Details. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut, with the box cover flush with the surface of the pavement or other existing surface. Where the box is not set in pavement, the top section shall be anchored by a concrete pad, or an approved precast concrete pad, set flush with the existing terrain. The top section will be encased into the concrete pad.
 5. Valve Blocking: All end of line valves whether they be on main lines or stubs, will be securely wedge blocked with concrete bearing against, and cut into the excavated sides of the trench. Care shall be taken in forming and pouring the "wedge" blocking so that fitting joints will be accessible for repair and/or plug extraction.
- D. HOSE BIBBS AND HYDRANTS: Hose bibbs shall be Chicago No. 7T, Tanner Manufacturing Company No. 1225, Dick Brothers Company No. 7001, or equal, with vacuum breaker. Lines feeding hose bibbs below Level 3 of pump station shall have cutoff valve on Level 3 and be fitted with two (2) backflow preventers between cutoff valve and hose bibb. Yard hydrants shall be mounted 30-inches high, frost-proof and equipped with stems and seat washers which are removable through the top of the hydrant. Operating rod shall be brass. The yard hydrant shall be installed complete with washed stone drain-back bed of at least 1 cubic foot.
- E. AIR AND VACUUM SEWER VALVES: These valves may be standard height or short body design with 2-inch diameter screw-threaded inlet. Body of valve shall be cast iron with brass float rod and stainless steel float. Valve body shall have a removable bonnet to facilitate maintenance of the internal working parts. Outlet is to be screw-threaded. Air and vacuum sewer valves shall be mounted to force main through the use of a gate valve with handwheel as outlined in the Specifications. Air and vacuum sewer valves shall be equipped with the manufacturer's back flush option. Shop drawings shall be submitted to the Engineer for approval prior to ordering materials.

Air and Vacuum Sewer Valves shall be Crispin Model S20AB (or S20ASB), Golden Anderson SAV-901, or approved equal.

- F. SWING CHECK VALVES - 3-INCHES AND SMALLER: Swing check valves three-inches and smaller shall be the iron body-bronze mounted type with replaceable rubber disc facing. The valves shall be furnished with screwed ends unless otherwise approved. Access to valve interior shall be through a removable bonnet. The valve shall be suitable for vertical installation, and shall be as manufactured by Kennedy Valve Company, Figure 105A, Mueller Model A-2602-8, or approved equal.
 - G. PLUG DRAIN VALVE: Plug drain valves to be used in stilling wells, etc., shall be of the rising stem type with cast iron body. All bolts and nuts shall be stainless steel and all other parts are bronze. Plug drain valves shall be furnished with handwheel and with stem extensions to position the handwheel within 4-inches below the stilling well cover when valve is in closed position. Plug drain valves shall be furnished with either flanged end or spigot end and shall be Clow Model F-3085 or F-3088, Mueller Model A-25611 or A-25612, or approved equal.
 - H. BALL VALVES: Thermoplastic ball valves shall be PVC full port 1/4 turn furnished with "T"-handle. Operation shall open by turning clockwise. Valves shall be furnished with teflon seats. End shall be of true union type with Schedule 80 solvent weld adaptors. Ball valves shall be 1-1/2" Hayward.
 - I. BACKFLOW PREVENTERS: Backflow preventers shall be Reduced Pressure Principle Assembly. All backflow prevention devices shall be in accordance with the CMUD Backflow Prevention Manual.
- IV. PIPING**: All force main piping shall be ductile iron, PVC or reinforced concrete as specified below. All force main within street or highway rights-of-way shall be clearly identified with green plastic locator tape made specifically for that purpose. The tape shall be marked with black lettering clearly identifying the pipeline as sanitary sewer. The tape shall be Type III Detectable Marking Tape as manufactured by Lineguard, Inc., or approved equal.
- A. DUCTILE IRON SEWER FORCE MAIN: All ductile iron pipe furnished shall be for a working pressure not less than 200 PSI or as directed by the Engineer, conforming to the requirements of Federal Specifications WW-P-421C. All pipe furnished for use beyond Station 0+00 shall be minimum pressure Class 350 unless otherwise specified.
 - B. PVC SEWER FORCE MAIN: Unless amended on the Construction Drawings, all four, six and eight-inch sewer force mains may be PVC 1120, furnished in accordance with AWWA Standard C-900. PVC Force main must be Pressure Class 150 with a SDR of 18 or less. All PVC pipe shall be shipped, stored, and strung at the project in such a manner as to be protected from total accumulated exposure to sunlight and possible ultraviolet radiation of no more than four (4) weeks.

Minimum cover for PVC force main shall be three feet, maximum cover shall be twenty feet.

Pipe jointing will be by ELASTOMERIC GASKET JOINTS only, conforming to AWWA Standard C900. Pipe bells shall be integral to the pipe. Sleeve couplings are not permitted. All fittings for 6-inch and 8-inch PVC pipe shall be Ductile Iron or Cast Iron.

Whenever a PVC sewer force main crosses over or within 1.5 feet below a water main, the PVC pipe shall be replaced with ductile iron pipe with standard cement lining. The ductile iron pipe shall extend not less than 10 feet on each side of the water main.

- C. CAST IRON AND DUCTILE IRON FITTINGS: All fittings used inside the pump station shall be flange joint Ductile Iron fittings. All other fittings furnished under this contract shall be Pressure Class 250 cast from either Gray or Ductile Iron. Fittings shall have a cement-mortar lining of standard thickness. Joint type to be furnished shall be either mechanical joint or flange, as indicated on the Plans. All fittings will be furnished bell and bell unless otherwise indicated on the Plans. All fittings shall conform in all respects to ASA Specifications A21.10 (AWWA C110). All fittings shall have a cement-mortar lining of standard thickness in accordance with ASA Specification A21.4.
- D. COPPER TUBE AND FITTINGS (Water Service): All copper tubing furnished shall conform to the requirements of the latest issue of ASTM Specification B-88 Type K. Fittings for copper tubing shall be red brass containing 85% copper and 5% each lead, tin and zinc. Fitting may be flared or compression as applicable in accordance with AWWA C800. Compression fittings shall utilize a compression nut and/or split clamp with tightening screw.
- E. REINFORCED CONCRETE CULVERT PIPE: Reinforced concrete culvert pipe shall meet the requirements of AASHTO M 170 for the class of pipe called for on the Plans and in the Proposal Section, except that the permissible wall thickness outside of the joint configuration shall not be more than that shown in the design by more than 5 percent of 3/16 inch, whichever is greater. The design wall thickness shall be either the wall thickness shown in AASHTO M 170 for the applicable class and wall or the wall thickness shown in a modified design which has been approved by the Engineer. A wall thickness greater than permitted by the above tolerance will be cause for rejection of the pipe. The circumferential steel in single cage pipe shall not be more than 3 inches from either end of the pipe section excluding the tongue and groove. On double cage pipe one cage shall be placed so that a circumferential wire shall be not less than 2 inches from the outer end of the barrel of the pipe.
- F. POLYETHYLENE PIPE (Water Service): Water service pipe to be installed to the proposed pump station may be Polyethylene Pipe 3408 in accordance with ASTM C-901. The pipe will be a minimum working pressure of 200 PSI with a SDR of 9, municipal service tubing ASTM D2737. Fittings shall be as specified for copper tube.
- G. ANCHORAGE FOR BENDS, PLUGS, CAPS AND TEES: All plugs, caps, tees and bends deflecting 11-1/4 degree or more on pressure mains 2-inch in

diameter or larger shall be provided with thrust blocking, placed as shown on the plans and/or as directed by the Engineer, and consisting of ready mix concrete having a compressive strength of not less than 3600 lbs. per square inch at 28 days.

Bagged mix concrete may be used for blocking, anchorage, concrete valve pads, etc. on pressure mains and valves 4-inches and smaller, when less than 1/2 yards are required.

Blocking shall be placed between solid ground and the fittings to be anchored. The area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer. The blocking shall be so placed that the pipe and fittings will be accessible for repair.

1. Marking: The following information shall be clearly marked on each section of pipe:
 - a. The pipe class and type of wall if reinforced.
 - b. The date of manufacture.
2. Joint Filler shall be a non-bituminous type meeting the requirements of AASHO M 153 for Type I, II or III; or shall be bituminous type meeting the requirements of AASHO M 213.
3. Joint Sealer shall be hot poured rubber asphalt conforming to AASHO M173, except as otherwise provided below:

The joint sealer shall be free of all foreign material. When melted it shall be free of lumps. The composition of the material shall be a mixture of virgin synthetic rubber or reclaimed rubber, or a combination of both, with asphalt, plasticizers, and tacifiers. Under no circumstances shall ground cured rubber scrap be used in place of virgin or reclaimed rubber.

The requirements of AASHO M 173 for flow and bond shall be modified as follows:

Flow test at 140 F 1.0 cm. max.

Bond test shall be performed at 20 F instead of at 0 F.

Ductility shall be not less than 40 cm. when tested in accordance with ASTM D113.

4. Preformed Neoprene Joint Seal shall meet the requirements of AASHO M 220.
5. Flared End Sections are subject to same specifications as reinforced concrete culvert pipe.

V. **STRUCTURES**: Structures, structural materials and related items are to be as specified below or as specified elsewhere in these specifications and at the direction and approval of the Engineer.

A. **STEEL PUMP STATIONS**: The pump station shall be built by the manufacturer in two sections consisting of the chamber itself and the entrance tube. The two sections shall be joined at the job site by welding. All field welds are to be cleaned and coated with epoxy paint. The manufacturer shall supply an ample supply of epoxy paint.

1. **Structural**: The pump chamber and entrance tube shall be constructed of 1/4 inch thick ASTM A283 Grade C Steel Plate.

a. The entrance tube shall be stiffened at top and bottom, typically by square bar or angle. The bottom shall be designed and constructed to ensure a good fit with the pump chamber. The top of the tube shall be fitted with a hinged cover. The cover shall be balanced for easy opening, shall have a suitable drip lip with heavy duty rubber gasket, and shall have additional ladder rungs welded to underside to form an extension of the ladder when the cover is in the open position. The cover shall have a mechanism to hold the cover open under normal load. The cover shall have a lock of the pin tumbler type which can be opened from the inside. Each section of entrance tube shall have two lifting lugs for ease of installation.

b. The pump chamber shall contain all the pumps, piping, controls and other accessories. The chamber shall be a vertical circular cross section. Reinforcing beneath the floor shall consist of a minimum of two large main beams capable of withstanding uplift forces, and additional beams horizontal to the main beams to stiffen. All beams are to protrude at least one foot beyond the outside of the chamber to facilitate anchoring. The top of the pump chamber shall be reinforced with no less than two structural members capable of carrying the full overburden. Passage of suction and discharge lines through the chamber walls shall be through the use of steel sleeves welded inside and outside to the chamber wall. The void between the sleeve and the pipe is to be filled with expanding cement grout to provide a watertight seal. Two lifting eyes shall be supplied on top of the chamber for ease of handling and installation, and lifting lugs shall be supplied above each pump for lifting the motors.

After completion of the pump station the manufacturer shall test the pump chamber for watertightness by sealing off the entrance tube opening and the suction and discharge lines and applying a positive air pressure to the chamber interior. Leakage shall be identified and sealed prior to shipment.

2. Dimensions: The entrance tube shall be a minimum of three feet in diameter. If any of the equipment in the pump chamber cannot pass through a three foot diameter tube with the ladder in place, then a four foot diameter tube shall be used. If the equipment in the pump chamber cannot pass through the four foot diameter tube with the ladder in place, then a three foot diameter entrance tube with ladder shall be used along with a separate five or six foot diameter equipment tube.

Pumps shall be arranged such that the minimum distance between pump centerlines is three feet, no part of pump assembly, pipe, or valves is less than twelve inches from chamber walls and no flange shall be less than twelve inches from chamber walls. Circular stations shall have a minimum diameter of seven feet and rectangular stations shall have minimum dimensions of six feet by eight feet. As pump sizes increase, the distance between pump centerlines shall increase to afford enough room between pumps for easy passage and ease of maintenance.

Vertical clearance above pump motors shall be one-half motor height plus twenty-four inches. Minimum chamber inside height shall be seven feet.

3. Access Ladder: The access ladder may be constructed of either steel or aluminum and fastened to the wall with steel brackets. The brackets are to be welded to the walls with the ladder bolted to the brackets to allow easy removal of the ladder. The rungs shall be of non-slip design and on 12-inch centers.
4. Protective Coating: After the manufacturer has completed all welding operations, the entire pump station assembly shall be grit blasted inside and outside to remove all rust, mill scale, weld spatter and weld slag to produce the mil profile necessary for proper paint adhesion. Immediately after cleaning, all surfaces shall be coated. All interior surfaces and exterior surfaces above grade shall receive a single coat of epoxy primer with a minimum dry film thickness of 1.5 mils followed by at least two coats of epoxy having a minimum dry film thickness of 2 mils each coat. All exterior surfaces below grade shall receive a coating of coal tar epoxy with a minimum dry film thickness of 16 mils. All coatings shall be applied in accordance with the coating manufacturer's recommendations. A touch up kit shall be provided for repair for coating damaged during shipping or installation.

Areas in front of the control panel and along normal walkways shall be covered with heavy duty synthetic rubber mats. These mats shall be cemented to the floor.

5. Corrosion Protection: One of the following methods will be required as shown on the plans.
 - (a) Galvanic protection shall be provided by four (4) seventeen (17) pound magnesium anode packs with insulated copper

leads for connection to grounding lugs spaced at equal intervals around the station walls. The bottom of the anode packs shall be at the same elevation as the bottom of the equipment chamber.

An anode tester shall be installed within the equipment chamber with the anode leads brought into the structure through a junction box above grade. An ammeter with milliamp scale shall be provided to allow measurement of current flow to each anode. An adjustable resistor connected in series with each anode circuit independently shall be provided for current flow adjustment. A switch shall be provided for each anode for testing or normal positions.

- (b) Cathodic protection shall be provided by an impressed current cathodic protection system designed by a National Association of Corrosion Engineers (NACE) accredited corrosion specialist. The system shall be the pump station manufacturers standard and shall be factory installed.

- 6. Installation: The complete packaged pump station shall rest on a concrete pad of sufficient size and weight to counterbalance any buoyant forces acting on the pump station. The pump station is to be anchored to the pad by means of anchor bolts and straps, or as approved by the Engineer. Once the pump station has been placed on the pad and anchored then all voids beneath the pump station are to be filled with grout. Special care shall be taken to insure that tilt blocks are properly installed under the appropriate side of the pump station.

- B. CONCRETE PUMP STATIONS: This section does not include the wet well structure. In no case shall the wet well and dry well be cast as one structure sharing a common wall. The wet well shall be a separate structure as discussed in "Wet Wells."

All concrete pump station structures shall meet or exceed the applicable material specifications as set forth in the Material Specifications. Additionally, all horizontal load bearing members shall be designed according to the overburden load. The engineer may require the manufacturer to submit calculations for any part or all of the pre-cast structures.

- 1. Structural: The pump station may be either circular or rectangular in cross-section. The pump station may be either a multi-level structure with direct entrance or an underground chamber with an entrance tube.
 - a. The station shall be constructed in such a way as to minimize the number of joints. Cold pour joints shall be checked thoroughly for watertightness. If the station consists of two or more sections then the section joints shall be either tongue and groove type or bell and spigot type. Sectional joints shall be

sealed with bitumastic compound and caulking on the interior face. If the pump chamber itself consists of multiple sections, then the manufacturer shall provide some means of positively securing the sections to one another, such as weld plates and straps to be field welded, etc. After installation all exposed steel shall be coated for corrosion protection.

- b. Suction lines shall be integral in the wall pour. Mechanical joint cast iron wall sleeves may be used at the manufacturer's option. The discharge piping passage shall be through the use of mechanical joint cast iron wall sleeves. If wall sleeves are used they must be installed at time of wall pour.
2. Dimensions: Concrete pump stations are subject to the same minimum clearances, heights and distances as steel pump stations.
 3. Access Ladder And Cover: The access ladder may be constructed of either steel or aluminum and fastened to the wall with steel brackets. The brackets are to be imbedded a minimum of four inches into the concrete. The ladder shall be bolted to the brackets to allow easy removal. The rungs of the ladder shall be of non-slip design and spaced on twelve-inch vertical centers.

The cover shall be of aluminum and balanced for easy opening, shall have a suitable drip lip with heavy-duty rubber gasket, and shall have additional ladder rungs welded to the underside of the cover to form an extension of the ladder when the cover is open. The cover shall have a mechanism to hold the cover open under normal load and shall be fitted with a lock of the pin tumbler type which can be opened from the inside.

4. Sump: The pump station floor shall be sloped such that drainage is collected into a cast-in-place sump. The sump dimensions shall be of adequate size for operation of the sump pump controls.
5. Waterproofing: Contractor shall furnish all labor, materials, equipment, and appliances required for providing and applying waterproofing as hereinafter specified, including all supplementary items necessary for a complete installation. All waterproofing shall be guaranteed against defects in materials and workmanship in accordance with the requirements of the General Conditions. Upon completion of work, remove all debris, surplus materials, and equipment incidental to this work from site.
 - a. Membrane Waterproofing shall be tar type.
 - b. Surfaces To Be Waterproofed: Install 4-ply membrane waterproofing on outside face of all exterior walls below grade that enclose habitable rooms and spaces (drywells). Waterproofing shall extend from top outer edge of footing to top of concrete.

c. Materials For Tar Type Waterproofing:

- (1) Pitch. ASTM D450, Type B.
- (2) Primer (Creosote). ASTM D43.
- (3) Tarred Fabric. ASTM D1668.

d. Installation:

- (1) Prime and otherwise prepare surfaces to be waterproofed as recommended by manufacturer of waterproofing materials.
- (2) Coat surfaces to be waterproofed with bitumen and, while hot, embed layer of fabric. Follow with alternate moppings of bitumen and layers of fabric until 5 moppings of bitumen and 4 layers of fabric have been applied. Apply bitumen in such manner as to leave no pinholes, breaks, or other defects in coating. Lay fabric so that no wrinkles, buckles, blisters or pockets occur.
- (3) Apply a total of not less than 150 pounds of bitumen per 100 square feet of completed waterproofing.
- (4) Waterproofing shall be installed in strict accordance with manufacturer's specifications and in a manner to make treated surfaces and areas completely waterproof.
- (5) Protection: Apply a 1/4-inch thick layer of board over exterior wall waterproofing, W.T. Meadows Seal Tight Hydromat Asphalt Liner, or Elastibord Vapor Stop by Phillip Carcy, or equal.
- (6) Waterstops: Waterstops are to be installed in all expansion and construction joints located in concrete slabs and walls below grade, and in all joints in water-bearing structures. Joints are to be made watertight by the use of preformed sections installed in accordance with manufacturer's recommendations. The Contractor shall exercise every effort to maintain sections straight and true to line during placement of concrete.
 - a. Waterstops shall be D6-14 Dumbell, R6-316 Ribbed, or RB6-316HR Ribbed with center-bulb, all by Vinylex Corporation; No. 6316 Ribbed with center-bulb by W. R. Meadows, Inc., DB-2 Dumbell, No. 13 Serrated, or No. 4 Serrated with center-bulb, all by W. R. Grace and Company; or approved equal. Contractor is to provide

manufacturer's standard waterstop fittings, adhesives, and accessories.

- (7) Liquid Hardener and Sealer: All exposed interior concrete floor areas are to receive liquid hardener and sealer treatment. The surfaces are to be clean and dry for application, and application is to be in two or more coats in strict accordance with manufacturer's instructions. Completed surfaces shall be free of discolorations and traces of excess hardener.

Liquid hardener and sealer shall be Hardtop by Gifford-Hill or equal.

- C. PAINTING: Furnish all labor, material, equipment, testing instruments and supplies required to complete all painting as specified herein including all new construction and repainting of existing painted surfaces damaged or otherwise affected by work under the contract. Existing surfaces to be repainted shall extend in all directions to the nearest complete break in the surface - for example, a projecting column, beam or other building member or feature.

Perform painting only under approved conditions of adequate ventilation. Provide adequate protection against toxic fumes, and adequate safeguards against fire and explosion.

Maintain temperature of rooms at 70 degrees F. or more where enamel is being applied and at 55 degrees F. or more during other interior painting. Exterior painting shall be performed when the air temperature is 55 degrees F. or higher and in drying weather.

Prime coat may be omitted on surfaces that are specified to be primed under other sections of these specifications.

Items specified to receive factory or shop applied finish coats under other sections of these specifications require no painting or finishing under this section unless specifically scheduled hereinafter.

Stainless steel, non-ferrous metal and chromium plated items shall not be painted.

Where joints are specified to be caulked, the surfaces of the joints in contact with caulking materials shall not be painted. Unless the color of sealant closely matches the color of adjacent walls, the sealant shall be painted to match the walls.

Finish painted surfaces shall have a neat and acceptable appearance.

Do not paint heating, ventilating and air conditioning control dampers and louvers.

1. Surface Preparation: All surfaces shall be smooth, dry and thoroughly clean before paint is applied.
 - a. Ferrous Metal Surfaces shall be cleaned free of rust, dirt, scale, grease and imperfectly bonded priming coats. Cleaning of ferrous metal surfaces shall be in accordance with Steel Structure Painting Council Specification SP 2 for hand cleaning or SP 3 for power tool cleaning. All welding flux, slag and weld spatter shall be completely removed. Slick or burnished areas resulting from wire brushing shall be sanded or ground as required to eliminate such slick or burnished areas.
 - b. Galvanized Metal Surfaces including exposed surfaces of metal plaster accessories, shall first be treated with a solution of 8 ounces of copper sulphate or copper acetate dissolved in one gallon of water, applied with a brush. After solution has dried, surface shall be brushed free of all precipitate. At Contractor's option, a proprietary material approved by the Engineer may be used in lieu of the above specified treatment.
 - c. Concrete Surfaces: Contractor shall not proceed with concrete surface treatment until form marks, fins and other projections have been removed, and cracks, pits and honeycomb have been filled as specified in Section J of Detailed Specifications. All surfaces shall be allowed to dry before paint is applied. Adjacent surfaces shall be protected from damage.
 - (1) New concrete walls and ceilings, scheduled to receive a paint finish, shall be washed with a solution consisting of 3 pounds of zinc sulfate crystals per gallon water. A small amount of pigment may be added to obtain visual assurance of uniformity of treatment. Allow solution to dry at least 48 hours and then remove all protruding crystals by brushing. Where concrete surfaces are so smooth that proper adhesion of paint to the surface is questionable, the smooth areas shall be lightly roughened by either acid washing, light sandblasting, or rubbing with abrasive stones. At the Contractor's option, new concrete walls and ceilings may be acid etched with a solution of one (1) part 35% muriatic acid and two (2) parts water applied by brush or spray until solution runs. After solution stops bubbling, the surface shall be washed with water and scrubbed with a stiff brush to remove concrete salts. Etching shall be repeated as necessary to obtain a slightly granular surface.

- d. Masonry Surfaces shall be checked for moisture content as specified above for plaster. Joints in masonry surfaces shall be properly pointed, and surfaces shall be brushed clean of all mortar, sand, dirt, and other objectionable matter before painting is started.
2. Paint Application: All material shall be evenly spread and smoothly flowed on without pinholes, voids, holidays, runs, sags, or application marks. Only skilled mechanics shall be employed. Application of each type of paint or other finish shall be in strict accordance with manufacturer's direction.
 - a. General Requirements:
 - (1) Each coat of paint shall be of a color that will contrast with prepared surface or previously applied coat, as applicable, and following coat.
 - (2) All coats shall be thoroughly dry before applying succeeding coats. Minimum drying time between coats shall be as recommended by paint manufacturer, and shall be extended as necessary to assure first class results when required by prevailing temperature, humidity, wind velocity, or the atmospheric conditions.
 - (3) Thickness of completed paint film shall be not less than the thickness obtained by brush application, regardless of the method of paint application used. Completed paint film on ferrous metal surfaces shall be at least 5 mils thick, except where otherwise specified, thickness shall be measured with an Elecometer, Mikrotest, or other approved instrument. Where the measured dry film thickness is less than that specified above, additional coat or coats shall be applied as required at the Contractor's expense.
 - (4) Prime coated butts shall be painted to match door or frame to which they are attached.
 - (5) Defects in shop priming coats shall be repaired by spot priming in field. Spot priming of structural steel shall be done immediately after erection of steel using same type primer used for shop coat.
 - (6) Field welds, rivets, and bolts shall be spot primed.
 - (7) All suction spots or hot spots in concrete after application of first coat shall be touched up before applying second coat to produce an even result in finish coat.

- (8) All painted ferrous metal surfaces shall be free of holiday, pinholes, and voids when tested with a Tinker & Razor M-1 Holiday Detector, or other approved instrument.
- (9) Each coat of paint shall be inspected by the Engineer before following coat may be applied. Only coats of paint inspected and found satisfactory by the Engineer will be considered in determining the minimum number of coats applied.
- (10) The number of coats specified in "Schedule in Painting" is minimum number required. The number of coats scheduled herein are not guaranteed to provide the specified minimum required dry film thickness; the specified minimum dry film thickness must be provided. Contractor shall apply additional coats of paint or other finish as required to provide specified minimum dry thickness, to completely cover surfaces being painted or otherwise finished, and to provide uniform color and appearance.
- (11) The Contractor shall provide the necessary devices as called in (3) and (8).

b. Protection Of Other Surfaces And Items:

- (1) Contractor shall mask, cover and otherwise protect adjacent and surrounding surfaces and items as necessary to prevent any damage to such surfaces and items from spatter, drippings, spray, etc.
- (2) Before painting, remove hardware, accessories, plates, lighting fixtures and similar items that have already been installed, or where removal is not practical, provide ample protection for such items. Walls and other surfaces shall be painted up to switch boxes, outlet boxes, and other such items before installation, or reinstallation, of plates and other such items.
- (3) Nameplates of equipment and machinery shall be covered by masking which shall be applied prior to any painting and shall be maintained until all painting in the vicinity is completed.
- (4) Removable and hinged covers for access panels, electrical panels and other such items shall be removed and painted separately or painted in the open position, as applicable, so that upon subsequent removal or opening of such covers no break will occur in the paint or other finish coats. Removable covers shall be

reinstalled and hinged covers shall be closed only after paint is completely dry.

(5) Grilles, registers and diffusers scheduled to be painted shall be removed and painted.

c. Methods Of Field Application: Generally, paint or other finishes may be field applied by either brush or roller method; also, mitt application may be used on piping, conduit, and similar surfaces. Spray painting will be permitted only where surfaces or conditions make brush, roller, or mitt work impractical and where spraying is approved by the Engineer.

(1) Perform spray painting only under approved conditions of adequate ventilation. Spray painting shall be done only with the use of airless spray equipment; the use of hot spray or conventional spray equipment will not be permitted. Provide adequate protection to surfaces that are not to be painted, adequate protection against toxic fumes and adequate safeguards against fire and explosions.

(2) Prime coats, and touch-up of damaged shop coats, shall be brush applied regardless of the method of application approved for applying subsequent coats.

3. Samples:

a. Prior to general application of paint by spray method, Contractor shall finish a sample wall, not less than 100 square feet in area, for the Engineer's inspection. Sample, in order to meet with the Engineer's approval must be entirely free of spray marks. Should general spray painting and finish on sample wall be approved, finish on surfaces painted by this method shall match approved sample in all respects.

b. Prior to general application of paint by roller method, Contractor shall finish a sample ceiling, not less than 100 square feet in area, for the Engineer's inspection. If requested, a sample wall of equal area shall also be finished for the Engineer's approval, must be a neat and uniform application, entire free of all runs, sags, or roller marks. Should general roller painting and finish of samples be approved, surfaces painted by this method shall match approved samples in all respects.

4. Schedule Of Painting:

a. Exterior:

(1) Ferrous metal not otherwise specified.

1 (one) coat Devoe Bar-Ox Kromokote Primer Orange
2 (two) coats Devoe Bar-Ox Finish Coats

(2) Steel valve stands:

3 (three) coats Devoe Mirrolac Aluminum 7018

(3) Submerged ferrous metal surfaces including structural steel, miscellaneous metal, pumps, piping, valves, machinery, equipment, etc.:

1 (one) coat Devoe Chem-Fast Epoxy Primer 46700
1 (one) coat Devoe Chem-Bar Hi-Build Intermediate Coat
1 (one) coat Devoe Chem-Bar Finish Coating

NOTE: Total dry film thickness of completed system shall not be less than 8 mils.

(4) Galvanized metal surfaces including piping, conduit, base of diesel engine, etc.:

1 (one) coat Zinc Dust Primer
2 (two) coats Devoe Mirrolac Interior-Exterior Gloss Enamel

b. Interior:

(1) Ferrous metal surfaces not otherwise specified including piping, pneumatic tubing, pumps, motors, miscellaneous metal, equipment, etc.:

1 (one) coat Devoe Quick Dry Red Lead Primer, Orange
2 (two) coats Devoe Speed-Rex Finish Coat

(2) Submerged ferrous metal surfaces, including structural steel, miscellaneous metal, piping, valves, pumps, machinery, equipment, etc.:

1 (one) coat Devoe Chem-Fast Epoxy Primer 46700
1 (one) coat Devoe Chem-Bar Hi-Build Intermediate Coat
1 (one) coat Devoe Chem-Bar Finish Coating

NOTE: Total dry film thickness of completed system shall not be less than 8 mils.

(3) Galvanized metal, including piping, conduits, etc.:

1 (one) coat Devoe Zinc Dust Primer

- 2 (two) coats Devoe Mirrolac Interior-Exterior Gloss Enamel
- (4) Insulated piping, ductwork, and other insulated surfaces:
 - 2 (two) coats Devoe Speed-Rex Finish Coat
- (5) Concrete walls and concrete ceiling of pump station:
 - 1 (one) coat Devoe 13XX Tru-Vy-Kote Vinyl-Acrylic Flat Exterior Masonry Paint with 1 pint 16200 Wonder Bond Mixing Liquid per gallon.
 - 2 (two) coats Devoe 13XX Try-Vy-Kote Vinyl-Acrylic Flat Exterior Masonry Paint.

- D. STEEL FRAMES & GRATES: Steel grating is to be welded rectangular design. Main bearing bars are to be 2"x3/16", spaced 1-3/16" center to center. Cross bars are to be resistance welded at right angles to the bearing bars and have a hexagonal cross section. They shall be placed 4 inches center to center. No notching of bearing or cross bars before welding is permissible.

Grating is to safely sustain a uniformly distributed load of 337 pounds per square foot on a 7 foot span and deflect 0.441 inches.

Grating shall be galvanized and coated in accordance with Section C - Painting.

Overall dimensions, details, and direction of bearing bars as shown on plans. Shop drawings and physical properties of the proposed frames and grates must be submitted to the Engineer for approval prior to operating.

- E. STAIRS: Steel stairways for use in the Pump Station are to be fabricated from steel channel stringers with steel grating stairway treads bolted in place. Stairways shall be constructed as shown on plans and coated as outlined in Section C - Painting.

Stringers shall be constructed of ASTM A36 carbon steel C10x15.3 American Standard channels. Stairway tread gratings are subject to same specifications as steel frames and gratings and should be fabricated with a cast iron abrasive nosing. Bearing bar size shall be a minimum size of 1-1/4" x 3/16". Bolts for attaching treads to stringers should be of sufficient size and strength to support full design load of stairway tread. Structural tubing, weld plates, etc., all shall be fabricated according to plans.

Shop drawings and physical properties of the proposed stairways must be submitted to the Engineer or approval prior to ordering.

- F. HANDRAILS:

1. Steel Handrails: All steel handrails and standards are to be fabricated of steel pipe, Schedule 40. All joints shall be welded, ground and polished. Attachment of rails or standards to steel by use of a tab welded to tubing and bolted to steel. Anchor standards to concrete with a flat plate welded to standard and bolted to expansion bolts in concrete. Unless otherwise

noted on drawings, pipe railings and standards shall be 1-1/2" I.D. size. Handrails, standards, and all other related items shall receive a coating of corrosion preventive paint in accordance with Section C - Painting.

Shop drawings and physical properties of the proposed handrails must be submitted to the Engineer for approval prior to ordering.

2. Aluminum Handrails: All aluminum handrails shall be fabricated of aluminum pipe, Schedule 40. All joints shall be welded, ground and polished. Anchor standards to concrete by setting into previously placed pipe sleeves and filling space between standard and sleeve with an expansion type grout suitable and approved for this application. Unless otherwise noted on drawings, pipe railings and standards shall be 1-1/2 inch I.D. size. Standards shall be fabricated as detailed with all exposed joints welded, ground smooth and polished. Handrails, standards and all other related items shall have clear satin anodized finish with 2 coats of clear methacrylate lacquer protective coating.

Aluminum surfaces shall be coated or otherwise isolated as necessary to protect the metal from damage by contact with concrete, masonry, steel, or other materials that will corrode or damage aluminum. Such protection shall conform with the aluminum manufacturer's instructions.

Shop drawings and physical properties of the proposed handrails must be submitted to the Engineer for approval prior to ordering.

- G. KEYS: Keys to the pump station shall be properly tagged and turned over to the Department upon completion of the installation. The Contractor shall furnish three sets of keys for each lock. Keys shall be mastered to the Schlage G73394 pattern.
- H. DRAINS: Drains shall be provided as indicated. Bodies shall be cast iron with wall thickness not less than 1/4" and with tops of nickel-bronze, chrome plated bronze, or cast iron as herein specified. Castings shall be gray cast iron or ductile iron and shall be smooth and well cleaned inside and out, with all fins and roughness removed, and provided with manufacturer's standard protective coating or other protective coating indicated or specified. The size of the drains shall be as indicated on drawings.

All drains installed in connection with waterproofed floor shall be equipped with a clamping device. When drains are installed with metal waterproofing, the metal shall be clamped, caulked, or soldered watertight to the drain. All drains shall be provided with traps either integral with drain body or separate, except where otherwise indicated or specified. Manufacturer's model number indicated and/or specified are intended for ease of identification and comparison. Equivalent products manufactured by Zurn, or J.R. Smith, as equal in appearance and construction, will be acceptable.

1. Equipment room drains shall be equal to Josam Series No. 49300-52, Wade No. W-2530 8x8x6 or equal.

- I. CLEANOUTS AND ACCESS COVERS: Cleanouts and access covers shall be

provided as herein specified and as required. Manufacturer's model numbers listed are intended for ease of identification and comparison. Equivalent products manufactured by Zurn, or J.R. Smith, as equivalent in appearance and weight, will be acceptable.

1. Cleanouts in Floors: Josam No. 8500-20 (Wade 8590-A) caulking ferrule with Josam No. 8610 (Wade 8480) or equal, satin finish, nickel-bronze, scoriated access cover in finished area and bronze scoriated top in storage and similar unfinished areas. Where required, cover shall be arranged with extended anchor lugs for tile or terrazzo floors and with cleanout marker for carpeted floors.
2. Cleanouts in concrete floors on grade in storage areas, or traffic areas inside or outside of the building: Josam No. 8310 (Wade 7130-Z) or equal, cast iron floor cleanout plug, and adjustable head with heavy duty scoriated cover.

VI. SITE: The Contractor/Developer shall provide for the pump station a properly deeded and recorded tract of land to the City. The deeded tract shall include the immediate pump station site and any access drive necessary. The tract shall be large enough to locate the pump station, wet well, an area suitable to locate an emergency generator and have enough space to park and maneuver maintenance vehicles. Driveway and parking areas shall be graveled with a minimum of 6-inches of ABC stone or paved with asphalt according to the treatment of drives in the vicinity. Selection of treatment of these areas shall be by approval of the City and shall be further as specified in other sections of these specifications. The Contractor/Developer shall submit to the City an overall site plan for approval of size, layout, storm water treatment and protection and materials section.

Miscellaneous materials are to be as specified below.

- A. **FENCING:** The Contractor/Developer shall furnish and install or cause to be installed fencing and fencing accessories as required to provide fencing as shown on the drawings, complete and ready for service. Fence shall be 7'-0" high overall.
 1. **Installation:** Fencing shall be installed true to the line and grade indicated or directed. Fabric shall be pulled tight and shall maintain a 2-inch clearance above grade. Unless otherwise specified, fencing shall be installed in strict accordance with the manufacturer's instructions. At ditches and low points, rods, bars, or extra fabric shall be used to close the area.
 2. **Fabric:** The fabric shall be composed of 9 gauge steel wire helically wound to form a continuous chain link fabric having a 2-inch mesh. Top and bottom edges shall have a twisted and barbed finish. The fabric shall be manufactured in accordance with ASTM A-392.
 - a. Fabric shall be hot-dip galvanized after weaving to produce a zinc coating not less in weight than 2.0 ounce per square foot of uncoated wire surface.

- b. Wire in the fabric shall meet minimum breaking strength of 1,290 pounds after galvanizing.
3. Line Posts shall be 2-1/4"x1-7/8" High Carbon H-Beams hot galvanized (2 oz. per square foot). Posts to be spaced approximately 10 feet on centers and set full 3 feet in bell-shaped concrete footings, crowned to shed water.
4. Top Rail shall be 1-5/8" O.D. standard pipe hot galvanized (2 oz. per square foot) and shall be furnished in random lengths averaging not less than 20 feet, jointed with extra long pressed steel sleeves, hot galvanized, making a rigid connection but allowing for expansion and contraction.
5. Fabric Ties for attaching fabric to line posts, top rail or top wire, shall be aluminum strip or wire. Used on top rail every 24-inches; on line posts every 14-inches.
6. Barbed Wire: The fabric shall be surmounted with 3 strands of barbed wire. Each strand shall consist of 2 (two) No. 12-1/2 W&M gauge twisted copper-bearing steel line wires, Class 3, hot galvanized, with No. 14 W&M gauge aluminum 4 point barbs spaced not more than 4-inches apart. The barbed wire shall be manufactured in accordance with ASTM A-121.
 - a. Barbed Wire Extensions: All intermediate, gate, and corner posts shall be equipped with extension arms for supporting barbed wire. The base shall be malleable iron and the extension pressed steel hot galvanized after fabrication. Intermediate arm shall have provision for passing top rail and corner arm casting to have set screw.
7. End and Corner Posts shall be standard hot galvanized (2 oz. per square foot) basic open hearth copper-bearing steel pipe 3 inches O.D., weighing 5.79 pounds per foot, for setting full 3 feet deep in bell-shaped concrete footings crowned to shed water.
8. End and Gate Posts Tops shall be galvanized malleable iron, drive fitting outside of post to exclude moisture.
9. Brace and Tension Bands shall be unclimbable beveled edge type with 3/8-inch diameter square shouldered aluminum carriage bolts, non-removable from outside fence.
10. Bracing: All corner, gate, and terminal posts shall be braced by means of 1-5/8-inch O.D. horizontal compression member, securely attached to terminal and first line posts with malleable iron fittings, beveled edge bands, and truss braced from first line post to bottom of terminal by 1/2-inch rod and turnbuckle. Corner posts to be so braced in each direction.

11. Tension Bars for attaching fabric to terminal posts shall be 3/16" x 3/4" high carbon steel attached to terminal posts by means of beveled edge bands.

Fencing Alternate: In lieu of the preceding specifications, post, rails, and bracing pipe may be Triple Coated Lightweight Steel Pipe manufactured by cold rolling electric resistance welding. High tensile-yield strength low carbon steel strip used in the manufacture of the pipe shall conform to ASTM A569-69T as amended or revised. Triple coating shall consist substantially of 1.0 oz/ft.²± of hot dipped zinc coating in accordance with ASTM B6 (internal and external), chromate conversion coating of 30 micrograms/in²± (external) and thermoplastic electrostatically applied acrylic external finish coat. Material furnished under this alternative shall be of the same O.D. sizes indicated in lieu of aluminized finished pipe of weights hereinbefore specified.

VII. TESTING, INSPECTION, AND STARTUP:

The entire pre-assembled pump station shall be factory tested for satisfactory operation. A trained representative of the manufacturer shall inspect the completed installation, assist in start-up, and train operating personnel in operating and trouble-shooting procedures. Three copies of a detailed manual on operation, adjustment, and trouble-shooting shall be provided.

A. Motor Tests:

1. Motor Overload Test:

- Check Motor nameplate HP and ampere rating.
- Install the proper overload relays in motor starter in accordance with the manufacturer's instruction furnished with starter.
- If the recommended heaters do not hold a load, or motors "kick-out" frequently with no evidence of obvious over loading, install a relay large enough to hold the load and measure the input with a watt meter, check current and voltage frequently.
- Report the problem to the Owner's representative together with the data obtained.

2. Other Motor Tests:

- Check all motors for correct direction of rotation, reconnecting if necessary.
- Take megger readings before energizing a circuit or motor.

B. Start-up: Provide the following services as a minimum. All start-up sessions shall be scheduled in advance with the Owner, who will have the right to have his designated representatives witnessing the operation.

1. Set water levels in the wet well as directed by the Owner.

2. Verify the operation of low and high level alarm system and silence switch.
 3. Instruct Owner representatives of the proper operation of all level controls and make adjustments as necessary. Also provide instructions for recalibration of these controls and for procedure in changing the wet well level settings.
 4. Verify the automatic operation of the pump station as specified here.
 5. Verify that there is the proper time delay between pump starts, and adjust time delay relays, as applicable.
 6. Check and verify automatic and manual operation of pump station while connected to emergency standby power. Portable generator set shall be provided by the City.
 7. Verify that pumps will operate when H.O.A. switch is in the hand position.
 8. Verify that the pump alternator sequences operates and the manual pump selector switch operates as indicated.
 9. Verify that the "panic on-off" switch at each pump will effectively turn "off" the pump motor and prevent its restarting (on multi-level stations only).
 10. Verify that the antiplugging switch effectively prevents the starting of the pump motor when the pump is rotating in the reversed direction. The use of an ohmmeter to verify the continuity of the control circuit is acceptable as an initial check. However, a true test with shaft rotating in reverse and pump start switch in the "on" position shall be required.
 11. Verify the proper functioning of the automatic pump station alarm system. This can be done while other specified features are being tested.
- C. Requirement for start-up procedures:
1. Provide the following personnel as a minimum:
 - Contractor representative
 - Manufacturer and/or control system factory technician
- D. Post Start-up documentation. After all tests and start-up procedures have been successfully accomplished. Provide two sets of corrected control wiring diagrams. Use copies of existing control diagrams, shop drawings, modified as required, to reflect new changes.

ELECTRICAL SPECIFICATIONS FOR PACKAGE PUMP STATIONS

I. GENERAL PROVISIONS:

A. SCOPE: The work covered by these specifications consists of furnishing all labor, equipment supplies and materials, and performing all operations, including trenching, backfilling, cutting, channeling, chasing and patching necessary for the installation of complete wiring systems in strict accordance with these specifications, the Package Pump Station Specifications, the applicable drawings and all other applicable contract documents.

B. APPLICABLE SPECIFICATIONS AND STANDARDS: The applicable provisions of the following Specifications and standards shall form a part of these Specifications:

1. STANDARDS OF UNDERWRITERS' LABORATORIES, INCORPORATED

Attachment Plugs and Receptacles
Audible Signal Appliances
Cabinets and Boxes
Circuit Breakers, Branch Circuit and Service
Dead Front Switchboards
Electrical Lighting Fixtures
Electrically Activated Transmitters
Enclosed Switches
Flexible Steel Conduits
Fuses
Grounding and Bonding Equipment
Industrial Control Equipment
Outlet Boxes and Fittings
Panelboards
Power Outlets
Rigid Metallic Conduit
Rubber Insulated Wires and Cables
Service Equipment
Snap Switches
Specialty Transformers
Tanks, Steel, Underground For Flammable and Combustible Liquids
Thermoplastic-Insulated Wires and Cables
Valves for Flammable Liquids and Fuel Gases
Wire Connectors and Soldering Lugs
Wireways, Auxiliary Gutters and Associated Fittings

2. NATIONAL FIRE PROTECTION ASSOCIATION:

Flammable and Combustible Liquids Code No. 30
Life Safety Code No. 101
National Electrical Code No. 70
Stationary Combustion Engines and Gas Turbines No. 37

3. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION: Circuit
Breakers, Low-Voltage Power, SG3
Circuit Breakers, Molded Case, AB1
Connectors, Electrical Power, SG1
Control, Industrial Enclosures for, IS1.1
Control, Industrial, ICS
Cross-Linked Thermosetting Polyethylene Insulated Wire and
Cable for Transmissions and Distribution of Electrical Energy, WC7
Dry-Type Transformers for General Applications, ST20
Fuses, Cartridge Low Voltage, FU1
Lightning Arresters, LA1
Motors and Generators, MG1
Panelboards, PB1
Rubber-Insulated Wire and Cable WC3 (IPCEA S-19-81, 5th
Edition)
Switchboards, Dead Front Distribution, PB2
Switches, Enclosed, KS1-1
Switches, A-C General Use Snap, WD3
Thermoplastic-Insulated Wire and Cable, WC5
Transformer, Specialty (Except General Purpose Type), ST1
Wiring Devices, General Purpose, WD1
Wiring Devices, Specific Purpose, WD5

4. AMERICAN NATIONAL STANDARDS INSTITUTE, INC.:
C2 National Electrical Safety Code

C. INSTALLATION shall comply with the applicable rules of the National Electrical Code and rules and regulations of the State Building Code and local codes. In no case shall the materials and workmanship fail to meet the minimum requirements of the National Electrical Code.

1. The regulations of the local utility shall govern service connection and metering provisions.
2. An electrical inspection certificate shall be issued by the local authority before the pump station installation will receive final approval.
3. The contract drawings indicate the extent and general arrangement of the electrical work. The drawings and specifications shall be considered supplementary, one to the other, so that materials and workmanship indicated, called for or implied by the one and not by the other shall be supplied and installed as though specifically called for by both. All labor and material required to perform all work in conjunction therewith whether or not indicated or specified shall be furnished and installed as part of this work.
4. The Contractor shall repair any damage done by himself or his workmen.

D. MATERIALS: All materials used in this work shall be new and listed by the Underwriters' Laboratories in every case where they have established a standard for the particular type of the material to be installed.

1. All lighting fixtures shall bear the label of Underwriters' Laboratories or be listed under their Re-examination Service.
 2. Catalog numbers and trade names in these Specifications and noted on the drawings are intended to describe the material, devices or apparatus wanted.
 3. The manufacturer shall immediately upon request present samples and test data from a recognized independent testing laboratory of the proposed substitute items so that the Engineer's judgment may be based upon comparison of actual items rather than just catalog cuts.
- E. TESTS: A full scale test, with all light, equipment, and appliances in operation shall be conducted by the manufacturer at his expense, and the electrical system shall be proven satisfactory for operation and free from defects. Particular attention shall be paid to the balancing of the single phase loads on the three-phase system. Any and all defects shall be promptly remedied.
1. The manufacturer shall test all wiring and connections for continuity and grounds before fixtures are connected, and, when directed, he shall demonstrate by megger test the insulation resistance of any circuit, or group of circuits. Where such insulation resistance test indicates the possibility of faulty insulation, the Contractor shall locate the point or points of such faulty insulation, and he shall pull out the conductor at fault, replace with new conductor, and demonstrate by further test the elimination of such fault, all at his own expense.
- F. GROUNDING: The conduit and neutral conductors of the wiring systems and all electrical equipment shall be grounded. The ground connection of the electric system neutral and conduit system shall be made at the main service switch or circuit breaker.
1. A THW copper ground conductor sized in accordance with the National Electrical Code shall be extended in conduit from the main service equipment to the point of entrance of the water service. The conduit shall be bonded to the grounding conductor at each end of the conduit. Connection to the water pipe shall be made by suitable ground clamp or by lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the supply side of the flange connection. A supplementary made grounding electrode shall be also provided and connected to the service equipment as detailed on drawings.
 2. Unless connected to a separate grounding conductor, grounding continuity between the grounding circuit of a receptacle and its grounded outlet box shall be established by means of a bonding jumper between the outlet box and the receptacle grounding terminal unless the receptacle is UL tested for grounding through receptacle yoke.
 3. Secondary neutral, at each dry type transformer, shall be properly grounded as a service ground.
- G. SHOP DRAWINGS AND CONSTRUCTION RECORD DRAWINGS shall be submitted to the Owner.

1. SWITCHBOARD SHOP DRAWINGS shall include the following information:
 - a. Front, rear, end and plan views of the switchboard with material lists and nameplate schedule.
 - b. Front or rear view, and sectional view of switchboard showing switchboard construction, size, current rating and location of all bussing and cabling furnished as part of the switchboard.
 - c. Schematic wiring diagrams showing sequence of automatic operation for service circuit breakers and meter wiring.
 2. PANELBOARD SHOP DRAWINGS shall show bussing, circuit breakers or fused switch sizes located and numbered as shown on the drawings.
 3. LIGHTING FIXTURES: Complete lighting fixture brochures showing catalog cuts of the fixtures appropriately marked shall be provided.
 4. MOTOR STARTER SHOP DRAWINGS shall be provided completed in accordance with NEMA Standards for class and type specified.
 5. TRANSFORMER SHOP DRAWINGS shall show dimensions, electrical characteristics, impedances, taps, and decibel ratings.
 6. POSTING OF CONSTRUCTION RECORD DRAWINGS
 - a. PANELBOARDS: Each panelboard shall have an engraved phenolic nameplate attached to the outside of the panelboard which agrees with the identification on the Panel Schedule and Riser Diagram. In addition to the typed panelboard schedule on the interior of the door, all new panelboards shall have a copy of the panelboard shop drawing mounted in a similar manner.
 - b. SWITCHBOARDS: New black or red, as applicable, phenolic nameplates engraved with white characters shall be provided for each component of the switchboard. The nameplate shall indicate the designation of the component, the circuit breaker frame and trip units or fused switch size, and fuse type and size, and the equipment or device served.
 7. MANUFACTURER'S OPERATION AND MAINTENANCE INSTRUCTIONS for all electrical protective or operable equipment shall be furnished, in quadruplicate, to the Engineer for distribution.
- H. PAINTING: All equipment, except where otherwise specifically noted, shall be furnished with factory applied and baked finish coats. All prime coated equipment shall be touched up where prime coats are chipped, scratched, or otherwise damaged. All prime coated equipment shall be thoroughly cleaned and left ready for finish painting. No painting will be required on factory finished items, except that any damaged or abraded areas shall be touched up to match surrounding finish.

- I. COST OF UTILITY COMPANY SERVICE: The Contractor/Developer shall arrange for the service and assume the cost of Duke Power Company's "Contributions and Aid to Construction" for the service to the pump station site.
- J. COST OF TELEPHONE SERVICE INSTALLATION: The Contractor/Developer shall arrange, in coordination with the Owner, for the telephone service and assume the cost of Southern Bell installation charges.
- K. OUTSIDE LIGHT: Each station shall be provided with a mercury vapor outside light operated by an all-weather manual switch. The switch shall be mounted in an accessible location inside the station fence. The light shall be sized and located to illuminate the entire fenced station area.

II. BASIC MATERIALS AND METHODS:

- A. WIRING: All wiring to the point of connection of power sources shall be the responsibility of the manufacturer. Complete control and wiring diagrams shall be provided by the manufacturer. All wiring shown on the contract drawings unless larger conduit sizes are indicated on the drawings, shall be based upon conduit fill tables of the current edition of the NEC. Branch circuit conductors shall not be smaller than No. 12 AWG, except the conductors for branch circuits whose length from panel to center of load exceeds 75 feet for the 120/208-volt system or 150 feet for the 277/480-volt system shall not be smaller than No. 10 AWG from the panel to the first outlet box in the circuit. Unless otherwise noted or specified, conductors for signal and pilot control circuits may be No. 14; No. 16 AWG, for 50 volts or lower, unless otherwise noted. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes, troughs and gutters. Junction boxes may be utilized where required. No "conduit" type fitting shall be used on any service conduits. All solid conductors, namely those sized No. 10, No. 12 and smaller shall be spliced by means of twisting securely and by means of hot-dipped solder plus gum rubber tape, plus friction tape, or plastic tape UL approved as sole insulation. The Contractor shall use plastic wire-nuts for recessed lighting fixture lead splices to branch circuit conductors. As an option, instead of solder and tape, the Contractor may use Ideal "Wingnuts", 3M "Scotchlocks", or equivalent connectors for branch circuit splices (No. 10 and No. 12) in junction boxes and light fixtures, except recessed fixtures as noted above. All conductors which are stranded, namely No. 8 and larger, shall be spliced by approved mechanical connectors plus gum tape, plus friction tape, or plastic tape UL approved as a sole insulation. Solderless mechanical connectors for splices and taps, provided with UL approved insulating covers may be used instead of mechanical connectors plus tape. All connectors used shall have UL approval for use at 600 volts.
 - 1. CONDUIT SYSTEMS: Unless otherwise specifically noted, all wiring for power, lighting or receptacle circuits, shall be installed in rigid conduits, 3/4" minimum size meeting all requirements of the National Electric Code (NEC). The conduit shall be zinc coated rigid Schedule 40 tubing of best quality steel or Schedule 40 PVC tubing. All fittings shall be UL approved for concrete tight and rain tight construction. Conduit, and flexible conduit except for individual connections to recessed lighting fixtures shall be of 1/2" minimum size.

Flexible conduit shall not be used without prior permission of the Engineer.

Flexible steel conduit connectors shall be UL listed nylon-insulated all steel or malleable metal, single set screw or equal. Conduit shall not have been stored in the weather. All installation requirements for rigid conduits stated herein and any special requirements of Article 345 of the NEC shall apply:

- a. **INSTALLATION:** Conduits shall be concealed within the walls, ceilings, and floors, where possible, and shall be kept at least 6" from parallel runs of flues, steam pipes, or hot water pipes. Exposed runs of conduit shall have supports spaced not more than 10 feet apart. Conduit run exposed or concealed in or under floor slabs shall be installed with runs parallel or perpendicular to walls, structural members, or intersection of vertical planes and ceilings with right-angle turns consisting of cast metal fittings (where exposed) or symmetrical bends. Bends and offsets shall be avoided where possible, but where necessary shall be made with an approved hickey or conduit bending machine. Conduit or tubing which has been crushed or deformed in any way shall not be installed. Expansion fittings or other approved devices shall be used to provide for expansion and contractions where conduit or tubing crosses expansion joints. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure conduit supports. Conduit or tubing shall be supported on approved types of galvanized wall brackets, ceiling trapezes, strap hangers, or pipe straps, secured by means of toggle bolts on hollow masonry units, expansion bolts in concrete or brick, machine screws on metal surfaces, and wood screws on wood construction. Nails shall not be used as the means of fastening boxes or conduits. Conduits shall be installed in such manner as to ensure against trouble from the collection of trapped condensation, and all runs of conduit shall be arranged so as to be devoid of traps where feasible. The Contractor shall exercise the necessary precautions to prevent the lodgment of dirt, plaster, or trash on conduit, tubing, fittings, and boxes during the course of installation by the use of plastic or steel plugs: T&B pushpennies, Appleton pennies, or equivalent. A run of conduit or tubing which has become clogged shall be entirely freed of these accumulations or shall be replaced. Conduit shall be securely fastened to all sheet metal enclosures with double galvanized locknuts and insulated bushings, care being observed to see that the full number of threads project through to permit the bushing to be drawn tight against the end of conduit, after which the locknuts shall be made up sufficiently tight to ensure positive ground continuity between conduit and box. Double locknuts shall be used on all feeder and motor circuit conduits and where insulated bushings are used. Insulated bushings of molded bakelite shall be used on all conduit entrances 1" or over in size, into junction boxes, panel boxes and motor starters having sheet metal enclosures. When conduit is installed underground or in concrete on ground, joints shall be made watertight with polyetraflyorothylene white tape. Conduit installed underground 5 feet or more from the building shall have a minimum cover of 2 feet, and if possible, shall be graded so as to have a fall of at least 3" per 100 feet toward a drainage point. All underground conduits shall be thoroughly coated with 2 coats of asphaltum or bitumastic and shall be retouched as required after being made up.

Conduit penetration through outside walls above or below grade shall be waterproofed and provided with sleeves. Space between conduit and sleeve shall be caulked with lead and oakum then covered with layer of thiocaulk (or other approved equal) flush with finish surface. All work is to be coordinated with waterproofing subcontractor and accomplished prior to application of waterproofing on walls.

- (1) Underground conduits shall be installed after the site has been backfilled to essentially final grade. Excavation requirements shall be as outlined in the Detailed Specifications Section of pipelines.
2. WIREWAYS OR TROUGHS shall be of the size shown on the drawings and or code gauge galvanized steel. Sizes 6"x6", and smaller, wireways, and all troughs, shall be of the hinged cover type except as otherwise noted on drawings. Larger sized wireways shall be of the flangeless screw cover lay-in type. All shall be without knockouts, and shall be provided with fittings, supports, and appurtenances as required.
3. SECONDARY CONDUCTORS: A complete system of conductors shall be installed in the raceway systems. Only powdered soapstone or other non-deleterious lubricant approved by the Engineer may be used in pulling in conductors. Unless specifically noted on drawings, all conductors shall be copper. Conductors, unless otherwise noted, shall be heat and moisture resistance grade, thermoplastic insulated, Type THW or THWN Conductors No. 8 AWG and larger shall be stranded copper; No. 12 AWG and No. 10 AWG shall be solid copper. Home runs may be combined in one conduit, provided all connections are in accordance with National Electrical Code requirements and the maximum unbalanced current in the neutral does not exceed the capacity of the conductor and the conductors are not required to be de-rated to below circuit capacity. All conductors, feeders, and branch circuits shall be color coded by phases: 480Y/277-volt systems - Phase A, Brown; Phase B, Yellow; Phase C, Orange; 208Y/120-volt systems -Phase A, Black; Phase B, Red; Phase C, Blue. Grounding conductors shall be green. Scotch tape of proper color may be used to identify the phase conductors of the larger feeders. All feeders, sub-feeds to panel, motors, etc., shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C from front to rear, top to bottom, or left to right when facing equipment. However, actual connections shall be made as scheduled on the plans.
4. SERVICE DROPS: Service drops, whether overhead or underground shall be connected to a pole mounted meter and disconnect switch. The poles to be used may be either six-inch or larger diameter creosote-treated wooden poles, or four-inch minimum diameter galvanized steel poles. Steel poles are to be imbedded in concrete. Two or more poles shall be used and the service equipment shall be attached to slotted galvanized steel channels fastened across the poles. Centerline distance between poles shall be not less than three feet.

III. ELECTRIC MOTORS AND CONTROLS:

- A. APPLICABLE SPECIFICATION AND STANDARDS: All wiring and devices furnished under this section shall conform to applicable requirements of Electrical Detailed Specifications.
- B. MOTORS: Motors shall be provided under the respective equipment sections of these specifications; however, the requirements stated herein shall be supplemental to requirements listed in those sections and shall be equally binding on the equipment manufacturer and the Contractor as if they had been stated in the respective sections. All motors shall comply with the applicable requirements of the standards hereinbefore listed. Generally, motors shall be NEMA Design B, Normal Torque, Normal Starting Current, but each motor and its driven equipment shall be properly coordinated so that with the starter specified or shown on the drawings the motor will start and accelerate on the first starting step and continue to accelerate smoothly on the second step where two step or other reduced voltage starting is specified, or on across the line starting where so specified, until rated speed is reached without overstressing any winding of the motor. Motors for autotransformer starters shall preferably be designed for proper starting with 50% taps on the autotransformer, but shall start smoothly on 65% tap setting and accelerate to a speed such as to prevent the inrush to the line side of the motor controller being greater than 275% of the full load current of the motor (25% being allowed for the magnetizing current of the autotransformers). All motors shall have proper starting and accelerating and running torque for the load requirements. Particular attention shall be placed upon the efficiencies of the motors under their design conditions, and full information as to these efficiencies shall be submitted with the shop drawings of the equipment. Motors for equipment other than pumps shall be so sized that the driving requirements shall not exceed the rated horsepower of the motor. Motors for pumps shall be so sized that under design conditions the driving requirements shall not exceed the rated horsepower of the motor and so that under any conditions of loading over the complete range of the head capacity curve of the pump the motor shall not be loaded to more than its rated horsepower plus one-half of the difference between its rated horsepower and its rated horsepower times its service factor. Insulation for motors shall be specifically impregnated for protection against moisture and complete motor shall have standard service factor for enclosure specified. Motors shall be designed for the voltage and phase characteristics as specified or noted on the drawings. All motors shall be rated for continuous duty.
- C. MOTOR CONTROL EQUIPMENT: The manufacturer shall furnish the motor control equipment as required hereinafter under this section. All motor controls must be lock-out capability. The equipment shall be in NEMA Type 1 enclosure designed for 480Y/277 volts, 3 phase, 60 hertz alternating current service and shall consist of the controls and accessories listed herein.
1. The components shall be arranged in an approved manner as shown on the contract drawings. The equipment shall conform to and a test shall be conducted in accordance with the latest applicable standards of the American Standards Assoc., the National Electrical Manufacturers Assoc., the Institute of Electrical and Electronic Engineers and the National Electrical Code.
 2. The motor control center shall have combination motor control starters with circuit breakers, or fused switches, as scheduled on drawings. Motor circuit protectors are not acceptable. Feeder fused switches and control

dry type transformer and panelboard shall be provided as per motor control drawings and schedules. A control cubicle, factory wired, as required by the control functions specified here, shall also be provided.

3. The control center shall be completely assembled and wired in a completely dead-front NEMA Type 1 enclosed control assembly of Class 1, Type B construction. The main busses shall have ampere capacity and bracing for the applicable loads within the station. The combination starters shall have an RMS Symmetrical ampere short circuit interrupting capacity adequate for the motors installed. The complete design shall be in accordance with applicable NEMA and AIEE Standards. All components shall be mounted inside control center enclosure. All motor starters shall be combination type with thermal magnetic circuit breaker or motor circuit protector, unless otherwise noted, and with proper thermal overload relays and heaters (one in each phase conductor) and interlocks and auxiliary contacts and relays as required by operations sequence for motors as covered in their respective sections of the specifications or on control drawings. Autotransformer starters shall be closed transition type. The control center shall include the components as listed on the drawings. The enclosure shall be finished in medium light gray finish. An engraved phenolic nameplate shall be furnished for and mounted on each component. A ground bus shall be furnished in each unit. Structures shall be 15-20 inches deep, designed for, bussed, and ventilated for front access only.
4. Service shall be 480Y/277 volts, 3-phase, 4-wire, grounded system. The motor control center shall be provided with a main circuit breaker, and shall be labelled as suitable for use as "Service Equipment."
5. Control power shall be 120-volts, 60 hz from 120/240 volts, single phase, 3-wire panelboard internally mounted in the motor control center.
6. A dry type transformer complete with primary and secondary protection shall be provided as power source to the internally mounted panelboard.
7. Each combination unit shall be provided with auxiliary contact (s) on circuit breaker, or disconnect switch, to isolate control circuit when breaker is open. Each starter shall be provided with all necessary auxiliary contacts to perform the control functions specified here. In addition, each starter shall have an extra spare normal open and normally closed auxiliary control contact.
8. Provide phenolic nameplates for each component of the motor control center. Panelboard shall have a typed circuit directory. Use black lettering on white background.
9. Control Devices and Features: The following control devices shall be provided in the control cubicle.
 - a. For all motor starters provide as a minimum:
 - Hand-off Automatic Switch
 - "Run" pilot light

- "Fail" pilot light
- b. Provide duplex alternator for the following motors:
 - Controls air compressors
 - Main sewage pumps
- c. For the sewage pump starters:
 - Hand-off Automatic Switch
 - Running hour meter, with not less than five digits
 - Adjustable time delay relays to prevent the starting of two pumps at the same time after a power interruption. Provide not less than 12-second intervals between starts.
 - Automatic shut down from antiplugging switch. Anti-plugging switch is to be provided complete, installed and connected. The antiplugging switch shall be wired to prevent the energization of the pump motor when the pump shaft is rotating in reversed direction.
 - Remote cut-off from panic button at pump (on-off push-button, maintained contact) - for multi-level pump stations only.
 - Solid state bubbler control system as specified in this section.
 - Two pump alternator/sequence.
 - Manual pump selector switch.
- d. Pump sequence of operation shall be as follows:
 - The sequence of operation shall be pumps #1 then #2 on the first rising and each level thereafter the lead pump is alternated into the standby position. The sequence of operation then becomes: #2 then #1. Should the flow increase to the point that one pump cannot handle the flow, the second pump will automatically be brought into service. During each cycle of operation, the last pump on shall be the first off.

- A high wet well alarm condition shall occur at an elevation to be set at Engineer's direction.
 - A low wet well alarm condition shall occur at an elevation high enough to prevent the suction lines from drawing a vortex and shall prevent any pump for starting.
 - A wet well level gauge shall be provided to indicate the level of water in the wet well at all times.
 - An alarm station with silencer shall be provided to indicate high and low wet well conditions.
- e. Provide adjustable 15 to 60 minute automatic timer to run pump station exhaust fan during periodic intervals.
10. Automatic pump control shall be by a bubbler system provided under this section. The bubbler controls shall be of the solid state design with plug-in modules that are easily field adjustable with the use of a test set supplied by the manufacturer. Two compressor units, mounted separately or to a common base, and connected to a common tank with appropriate valves and piping shall be supplied for the air source to the wet well. A two circuit alternator shall be provided for standby service for the bubbler control system. Pressure regulating valves shall be provided as a part of the bubbler system.
11. Pump Station Alarm System. Provide a pump station remote alarm annunciation system by means of an automatic telephone dialing system as specified here. The system shall be ADAS DiaLog 137 Kaye, with Telemax surge protector, capable of sending the following messages:
- Pump station flooding
 - Normal power off
 - High water alarm
 - Spare
 - Spare
 - Spare

The system shall be able to call up to five pre-arranged telephone numbers and transmit the message to the first available non-busy number. The system shall require acknowledgement feature.

Pump station flooding detector shall be mounted near the floor of the pump station lower floor.

12. Provide a lock-out control feature that will prevent the automatic start and running of more than two pumps when power is being supplied by an emergency generator set. (For stations that have more than two pumps).
- D. OUTLETS: Outlets shall be installed in the locations shown on the drawings; however, the Owner shall have the right to make slight changes in the position of the outlets if the manufacturer is notified before roughing-in is done. The manufacturer shall study the general building plans in relation to the specs surrounding each outlet in order that his work may fit the other work required by these Specifications. When necessary, the manufacturer shall relocate outlets so that, when fixtures or other fittings are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Galvanized sheet steel boxes, of a class to satisfy the conditions for each outlet, shall be used in concealed work only, unless further modified in these specifications or indicated on the drawings. Boxes shall be installed in a rigid and satisfactory manner, either by wood screws on wood, expansion shields on masonry, or machine screws on steel work. Fixture outlet boxes on ceilings shall not be less than 4" octagonal. Fixture outlet boxes in concrete ceilings shall be of the 4" octagonal concrete type, set flush with the finished surface. Fixture outlet boxes on plastered ceilings shall be fitted with open covers set to come flush with the finished surface. Switch, telephone and receptacle outlet boxes on plastered walls shall be not less than 4" square fitting with appropriate plaster covers to set flush with the finished surfaces. One-piece gang or gangable boxes not less than 2" deep shall be utilized where necessary. Unless otherwise noted on the drawings, outlet junction or pull boxes not larger than 5" square or over 8 feet above floor level in exposed work shall be cast steel or alloy with threaded hubs and appropriate covers. Outlet boxes in unplastered masonry walls shall be tile type.
1. PULL BOXES: Pull boxes shall be constructed of code gauge galvanized sheet metal. Boxes shall be of not less than the minimum size recommended by the National Electrical Code and shall be furnished with screw-fastened covers. When several feeders pass through a common pull box they shall be tagged to indicate clearly their electrical characteristics, circuit numbers and panel designations.
 2. DEVICE PLATES: A device plate shall be provided for each outlet to suit the device installed. All plates on walls with flush outlets shall be of "302" or "304" stainless steel with satin finish. Screws shall be of metal with countersunk heads, with finish to match the finish of the plate. Plates shall be installed with all 4 edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed vertically unless otherwise noted and with an alignment tolerance of 1/16". Device plates shall be of the one-piece type, of suitable shape for the devices to be covered. The use of sectional device plates will not be permitted.
- E. SWITCHES AND RECEPTACLES shall be as shown on the drawings and in the symbol schedule, and shall be the products meeting NEMA Standards WD1-1974 and WD-5-1972, of one of the following manufacturers: ArrowHart Electric Company; Bryant Electric Company; General Electric Company; Harvey Hubbell, Inc.; Leviton Mfg. Company; Slater Electric, Inc.; Pass & Seymour, Inc.; or equivalent.

- F. CABINETS: Cabinet boxes shall be constructed of zinc coated sheet steel and shall conform with the requirements of Underwriters Laboratories' "Standards for Cabinets and Cutout Boxes." Trims shall have a corrosion inhibiting primer and a lacquer finish.
- G. EQUIPMENT CONDITIONS: The manufacturer shall connect all equipment requiring electrical connections, including control wiring connections.
1. SPECIAL OUTLETS: Unless otherwise specifically noted, where special outlets or receptacles are shown on the plans, they are considered to be the electrical connection for the equipment.
 2. EQUIPMENT: Equipment connections shall be made through raceways as previously specified except that connections to motors shall be through liquid tight flexible metal conduit. All starters and electrical controls not specifically specified or shown on drawings to be furnished with the equipment under other sections of the Specifications shall be provided under this section.
 3. EACH MOTOR shall be provided with an approved disconnecting device where required by the National Electrical Code even though not indicated on the drawings.
- H. NAMEPLATES: An engraved phenolic nameplate shall be provided on each individually mounted switch or circuit breaker, unless function is obvious due to proximity to the load and obvious connection. The nameplate shall indicate the type and location of the load, and shall be black in background in color for all systems rated 120/208 volts, white lettering; and red with white lettering for 277/480 volt systems.

IV. ELECTRICAL POWER EQUIPMENT:

- A. VOLTAGE OF SERVICE shall be 480Y/277 volts, three-phase, 4-wire grounded neutral from power company's pad-mounted transformers.
- B. SWITCHBOARDS shall consist of a stationary structure assembly and molded case circuit breakers as specified herein. The switchboard shall be designed, manufactured, and tested in accordance with the latest standards of AIEE and NEMA. In addition, all circuit breakers and transfer sequences including both transfer circuit breakers in the open position shall be tested at the factory prior to shipment. The switchboard shall be finished in a similar color to the station walls for exterior and interior surfaces, and all sheet metal parts shall be rustproofed after fabrication and prior to painting. The switchboard shall be designed for 3-phase, 4-wire, grounded neutral service. Phenolic nameplates engraved with white characters shall be provided for each component, the circuit breaker frame and trip units, and the equipment or device service. The switchboard sections shall be mounted on channels provided with the switchboard. Barrier shall be provided to isolate sections of switchboard from each other and main busses from each other. All busses, switching devices, and connections shall be of copper or aluminum and of sufficient size to limit the temperature rise to NEMA Standards and all bus surfaces shall be corrosion resistive conductive plated. All busses shall be factory insulated. Current transformers, ammeter with ammeter switch to indicate amperes in each phase and voltmeter with voltmeter switch to indicate voltage from each phase to neutral shall be provided for the standby bus. Meters shall be switchboard type with 1% accuracy. A 3-phase secondary lighting arresters and surge

capacitor shall be furnished for mounting in separate enclosures on service end of switchboard. Capacitor shall be protected by high interrupting capacity fuses. Connections of the arrester shall be made on the service bus. All thermal magnetic circuit breakers shall be ambient compensate or be calibrated for 40 degrees C.

1. Switchboard shall be front accessible with individually mounted devices.
2. The switchboard shall have full length barriered wiring compartment with insulated busses extended from load side of circuit breaker into the compartment. Lugs for connection to the load side of overcurrent protection device shall be fully insulated.
3. STANDBY POWER TRANSFER: Transfer of power supply from power company to standby generator shall be through the use of manually operated circuit breakers on the supply of each source. Each circuit breaker shall be of an adequate capacity to operate the station in the normal manner. Indicating lights shall be provided for both power sources. The manufacturer shall provide phenolic nameplates for each of the controls and shall supply a warning sign with the following message:

WARNING: DO NOT ATTEMPT TO SUPPLY POWER FROM BOTH SOURCES AS THIS WILL RESULT IN SERIOUS DAMAGE TO THE ELECTRICAL SYSTEM.

Auxiliary switches and relays for the connection of the automatic emergency notification system shall be provided by the manufacturer.

The Contractor shall provide as part of the emergency supply wiring the necessary apparatus to connect to an emergency generator set owned by the City. The Contractor will coordinate with City personnel to insure that proper equipment is supplied.

4. INSTRUMENTS shall be square, not less than 4-1/4 by 4-1/4 inches, with circular type, highly visible, scale extending 180 degrees or more.
 - a. Ammeters and voltmeters shall be provided with phase selector switch, shunts or current transformers, as required. Voltmeter selector switch shall be of the type that provides both phase to phase and phase to neutral indication for each phase of the incoming service. Ammeter shall be installed to indicate amperes in each phase of the service.
 - b. Switchboard instruments and accessories shall be housed in a separate compartment that will provide insulated or metal barriers between the rest of the switchboard and the instrumentation.
5. SECONDARY LIGHTNING ARRESTERS AND SURGE CAPACITORS: Secondary lightning arresters and surge capacitors shall be three-pole, suitable for a voltage range from zero to 650 volts RMS. Arresters shall be of the valve type design with series gap and series valve disk. Arrester shall be mounted as close as possible to the main bus of the switchboard. Surge capacitors shall be of the non-PCB design and shall be mounted in a separate NEMA standard enclosure of the same type as the switchboard enclosure. Capacitors shall be

protected with current limiting fuses, Class J. Leads from the main bus to the arresters shall be No. 8 AWG or larger.

6. SWITCHBOARD: The switchboards shall be of the NEMA Standard switchboard, product of one of the manufacturers listed below, modified as required by these specifications and the drawings, but complete with auxiliary devices, terminal boards, and appurtenances, as applicable:

Gould
General Electric Company
Square D
Westinghouse Electric Corporation, or equal.

- C. PANELBOARDS: shall be of the dead-front safety type. The panelboards shall be provided with lugs only in the mains unless main circuit breakers or fused switches are indicated on the drawings. Panelboards shall be provided with the size and number of single, double, or triple pole branch circuits as indicated on the drawings. Circuit breakers shall be of the automatic thermal magnetic type, quick-make and quick-break for manual and automatic operation. All multi-pole breakers shall be common trip. Panelboards having separate grounding conductors shall be provided with a grounding terminal bar bonded to the cabinet or panelboard frame. Panelboards used as service equipment shall have UL approved as "Suitable for Use as Service Equipment", and shall be so marked. All circuit breakers shall be calibrated for 40 C. or be ambient compensating. Circuit breakers shall have UL interrupting ratings as indicated by class of circuit breaker shown on the drawings.

1. PANELBOARD CABINETS: Cabinets for panelboards shall have a minimum width of 20" and shall be provided with not less than 4" wiring gutters at the side, top, and bottom. Cabinet heights shall not exceed 72". Cabinets shall be mounted so that the distance from the floor to the center of top switch or circuit breaker will not exceed 6'-6". Flush cabinets shall be provided with trims having adjustable trim clamps. Trims shall be fitted with hinged doors having combination lock and latch. All locks shall be keyed alike. One or more directory holders with glass or clear plastic plate and metal frame as required for rendering entire directory visible shall be mounted on the inside of each door. A neatly typed directory properly identifying each circuit, shall be mounted under the glass. A running directory shall be maintained during construction. Panelboard cabinets having feed through feeders shall have a 9" minimum wiring gutter on the feed through side. Panelboards having separate grounding conductors shall be provided with a grounding terminal bar bonded to the cabinet or panelboard frame.

- D. INDIVIDUAL CIRCUIT BREAKERS shall be the molded case type of the frame and trip rating noted on the drawings in NEMA 1 enclosure unless noted otherwise, as manufactured by General Electric, Gould, Square D, or Westinghouse. All circuit breakers shall be ambient compensated or calibrated for 40 C. Circuit breakers shall have UL interrupting ratings as indicated by class of circuit breakers shown on the drawings.

- E. FUSED DISCONNECT SWITCHES shall be heavy duty, General Electric Type TH, I.T.E. Type Vacu-Break, or equal, in NEMA 1 or 3R enclosure, rated for 250 or 600 volts as applicable. Unless otherwise noted, fuses shall be the NEMA Type K-5. Unfused motor disconnecting switches shall be of the same construction as fused switches in

NEMA 1 or 3R, as applicable, enclosures. Switches used as service switches shall bear such UL label and nameplate on switch shall so indicate.

1. SPARE FUSES: One set of 3 spare fuses of each size used shall be furnished the Owner.

F. INDIVIDUAL MOTOR CONTROLLERS:

1. Individual motor controllers shall be suitable for single phase fractional horsepower motors, or for three-phase 3/4 HP motors and larger.
2. Single phase fractional horsepower motor controllers, shall be unless otherwise noted, horsepower rated motor Sentinel switches with overload protection. Switches shall be suitable for the atmosphere where installed.
3. Three-phase motor controllers shall be combination magnetic starter and fused switch in a suitable enclosure for the atmosphere where installed.
 - a. Starters for three phase, 60 Hz squirrel cage induction motors shall be automatic, magnetic type, with overload protection in each phase.
 - b. Starters shall be provided with not less than two normally open and one normally closed auxiliary contacts. Push buttons, selector switches, pilot lights, and remote push button stations shall be provided as schedule on drawings or as indicated by the applicable control diagrams.
 - c. Starters shall include motor overload protection in each phase conductor. Operating coils shall be for 115 volts. Controllers shall be provided with individual built-in 115 volts, 60 Hz, AC control transformer, proper protected, unless shown on drawings to be connected to a separate, external 115 volt control circuit. Starters shall be provided with manual overload reset mounted on enclosure cover.
 - d. If external control circuits are used, an auxiliary cut-off interlocked contact shall be provided in the circuit breaker or switch, so that when any of these devices are turned "off" the control power to the assembly is also cut off.
 - e. Nameplates shall be provided to identify each motor controlled.
4. Contracts and interlocks shall be provided for proper operation of equipment controlled. Heater selection tables shall be mounted on rear or door in each compartment.

- G. DRY-TYPE TRANSFORMERS shall be Westinghouse Type "EPT", General Electric "QHT", or equal, non-ventilated, for 30 KVA and below, and Westinghouse Type "DT3" for 45 KVA and above, General Electric "QHT", or equal, especially selected for quiet operation. Primary voltage shall be 480 volts, 3-phase delta, with a minimum of four 2½% below rated voltage, full capacity taps with secondary 120/208 wye volts, 3-phase, 4-wire grounded neutral. Each transformer shall be mounted in isomode pad dampeners, and all wiring connections to the transformers shall be through flexible conduit of sufficient length to reduce transmissions of vibrations. Secondary neutral at each dry-type transformer shall be properly grounded as a service ground.

H. NAMEPLATES AND TAGS: Engraved non-metallic nameplates of phenolic materials shall be provided for each panelboard, all components of power centers, motor control centers, individual feeder circuit breakers and disconnecting switches and each conductor therein shall be tagged.

1. NAMEPLATES shall be:

a. 277/480 volt systems - white letters on red background.

b. 120/208 volt systems - white letters on black background.

2. TAGS shall be Brady, Thomas and Betts, or equal, labels indicating circuit number on phase conductor, and neutral conductor with corresponding phase circuit number or numbers as applicable.

V. LIGHTING FIXTURES:

A. EXTRA LENS: The electrical contractor shall furnish to the Owner a minimum of one extra lens for each fixture type. Lens shall be suitably packed for ease in storage by the Owner.

B. BALLAST FOR FLUORESCENT LAMPS shall be as noted in Fixture Schedule.

1. Ballast For Other Lamps shall be as noted in Fixture Schedule.

C. HANGING METHODS: All fixtures shall be securely supported in strict accordance with Sections 410-15 and 410-16 of the National Electrical Code.

D. WIRING:

1. Branch circuit conductors in fixture channels shall be Type THW rated 90 C, XHHW, or THHN.

E. LAMPS: The electrical contractor shall furnish and install inside frosted or reflector as noted, 130-volt incandescent lamps or wattage shown in all incandescent fixtures, standard rapid-start in all fluorescent fixtures, and mercury vapor or metal halide in high intensity discharge lamps, as applicable, unless specifically noted otherwise in the Fixture Schedule or on the drawings.

F. ALL FIXTURES: shall bear the label of Underwriter's Laboratories or be in their Re-examination Listing where label service is unavailable.

G. LIGHTING FIXTURE SCHEDULE:

1. As shown on Drawings.

VI. TESTING, INSPECTION AND START-UP:

The entire pre-assembled pump station shall be factory tested for satisfactory operation. A trained representative of the manufacturer shall inspect the completed installation, assist in start-up, and train operating personnel in operating and trouble-shooting procedures. Three copies of a detailed manual on operation, adjustment, and trouble-shooting shall be provided.

A. Motor Tests:

1. Motor Overload Test:

- Check Motor nameplate HP and ampere rating.
- Install the proper overload relays in motor starter in accordance with the manufacturer's instruction furnished with starter.
- If the recommended heaters do not hold a load, or motors "kick-out" frequently with no evidence of obvious over loading, install a relay large enough to hold the load and measure the input with a watt meter, check current and voltage frequently.
- Report the problem to the Owner's representative together with the data obtained.

2. Other Motor Tests:

- Check all motors for correct direction of rotation, reconnecting if necessary.
- Take megger readings before energizing a circuit or motor.

B. Start-up: Provide the following services as a minimum. All start-up sessions shall be scheduled in advance with the Owner, who will have the right to have his designated representatives witnessing the operation.

1. Set water levels in the wet well as directed by the Owner.
2. Verify the operation of low and high level alarm system and silence switch.
3. Instruct Owner representatives of the proper operation of all level controls and make adjustments as necessary. Also provide instructions for recalibration of these controls and for procedure in changing the wet well level settings.
4. Verify the automatic operation of the pump station as specified here.
5. Verify that there is the proper time delay between pump starts, and adjust time delay relays, as applicable.
6. Check and verify automatic and manual operation of pump station while connected to emergency standby power. Portable generator set shall be provided by the City.
7. Verify that pumps will operate when H.O.A. switch is in the hand position.

8. Verify that the pump alternator sequences operates and the manual pump selector switch operates as indicated.
 9. Verify that the "panic on-off" switch at each pump will effectively turn "off" the pump motor and prevent its restarting (on multi-level stations only).
 10. Verify that the antiplugging switch effectively prevents the starting of the pump motor when the pump is rotating in the reversed direction. The use of an ohmmeter to verify the continuity of the control circuit is acceptable as an initial check. However, a true test with shaft rotating in reverse and pump start switch in the "on" position shall be required.
 11. Verify the proper functioning of the automatic pump station alarm system. This can be done while other specified features are being tested.
- C. Requirement for start-up procedures:
1. Provide the following personnel as a minimum:
 - Contractor representative
 - Manufacturer and/or control system factory technician
- D. Post Start-up documentation. After all tests and start-up procedures have been successfully accomplished. Provide two sets of corrected control wiring diagrams. Use copies of existing control diagrams, shop drawings, modified as required, to reflect new changes.

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NOTES: CONCRETE FOOTINGS MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS

FOOTING DIMENSIONS TO BE AS SHOWN OR AS DIRECTED BY THE ENGINEER.

MANHOLE SHALL CONFORM TO CMUD SPECIFICATIONS

ALL CONCRETE SHALL BE 3600 PSI COMPRESSIVE STRENGTH

ALL VALVES SHALL OPEN COUNTERCLOCKWISE

FRAME TO BE FLUSH WITH GROUND IN ROAD R/W AND 2' ABOVE GROUND IN SEWER MH R/W

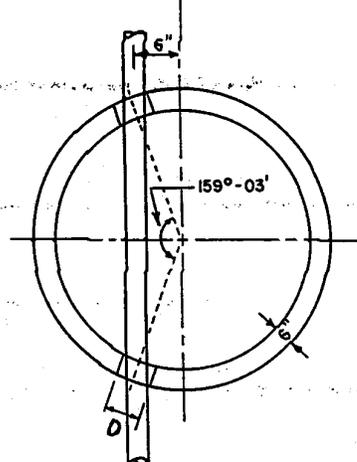
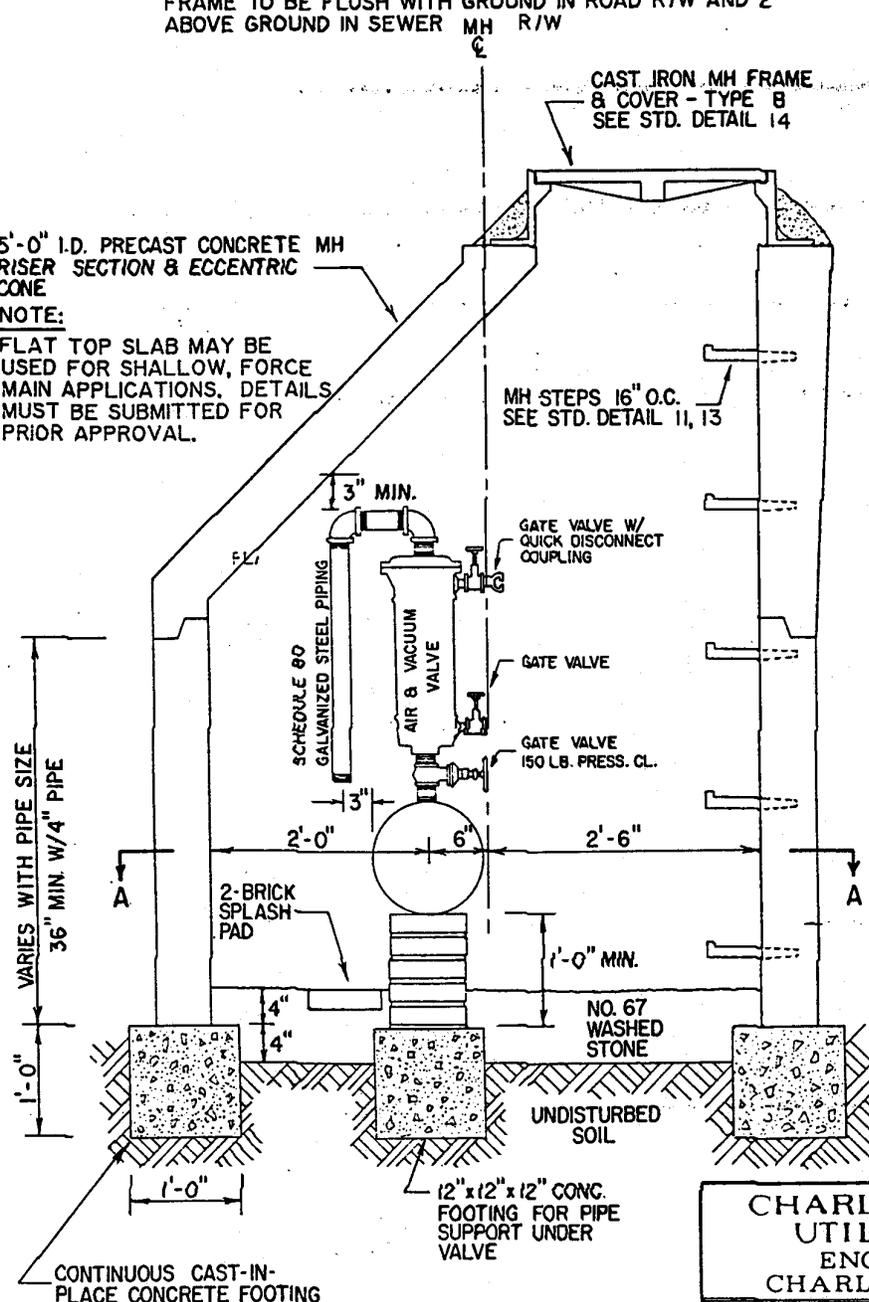
TAPPING METHOD SHALL BE AS APPROVED BY CMUD. SADDLE MAY BE REQUIRED

AIR & VACUUM VALVE TO BE LONG BODY TYPE, SIZED PER MANUFACTURER'S RECOMMENDATION, FURNISHED WITH BACK FLUSHING ATTACHMENTS.

5'-0" I.D. PRECAST CONCRETE MH RISER SECTION & ECCENTRIC CONE

NOTE:

FLAT TOP SLAB MAY BE USED FOR SHALLOW, FORCE MAIN APPLICATIONS. DETAILS MUST BE SUBMITTED FOR PRIOR APPROVAL.



VIEW A-A

PIPE SIZE	PIPE O.D.	MIN. D
4"	4.80"	6.6"
6"	6.90"	9.0"
8"	9.05"	11.4"
10"	11.10"	13.7"
12"	13.20"	16.1"
14"	15.30"	18.5"
16"	17.40"	20.9"
18"	19.50"	23.3"
20"	21.60"	25.7"

WHEN INSTALLING PVC FORCE MAIN, INSTALL VALVE AT MIDPOINT OF 18 FT JOINT OF DUCTILE IRON PIPE

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA

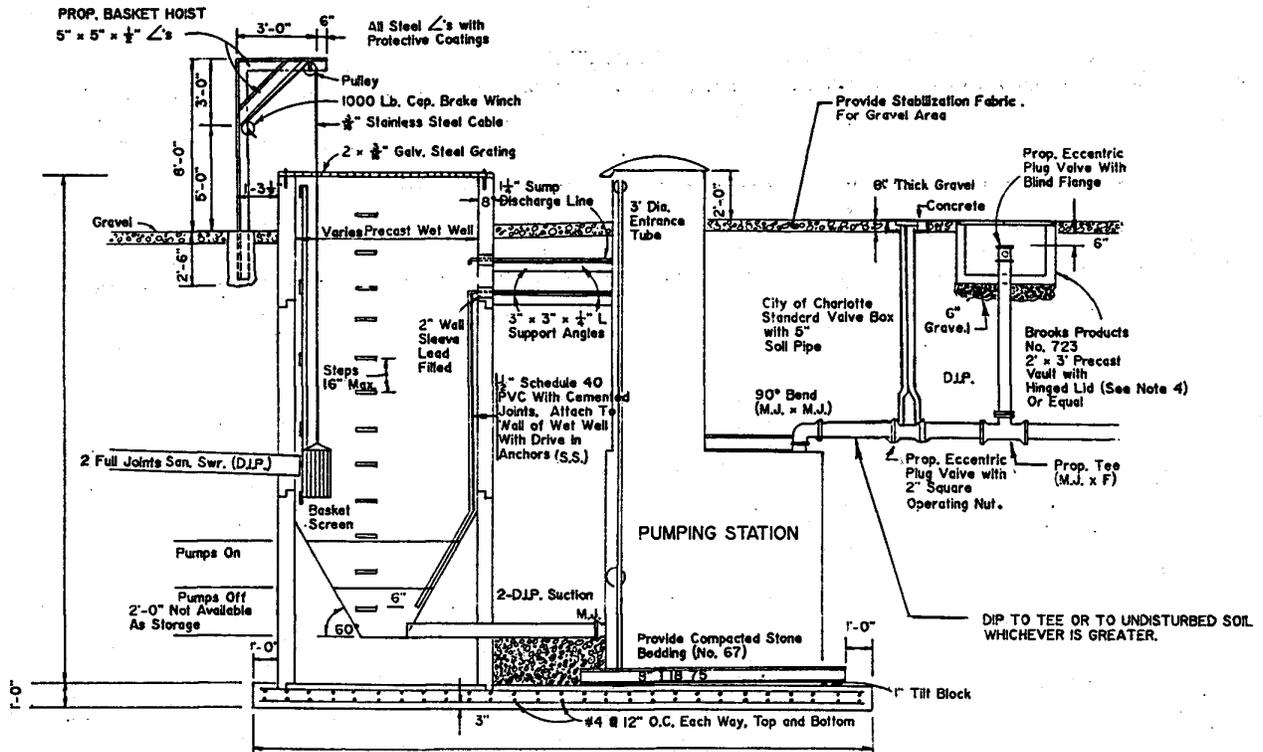
STANDARD DETAIL
SEWER PUMP STATION
PRESSURE LINE
AIR AND VACUUM VALVE

Job No. _____	File No. _____
PLAN Scales NONE	
PROFILE No. _____	Ver. _____
As Built _____	Date _____
Surveyed By <u>BMG</u>	Designed By <u>BMG</u>
Drawn By <u>W.D.C.</u>	Checked By <u>SPALL</u>
Approved By <u>LIMBERG</u>	Date <u>11/83</u>

Sheet 1 of 1

No.	Date	Revised
3	4/87	SBC REVISED
2	2/87	SBC NOTE ADDED
1	11-83	BMG REDESIGNED TO USE PRE-CAST MH

DITZGEN CORP. 198

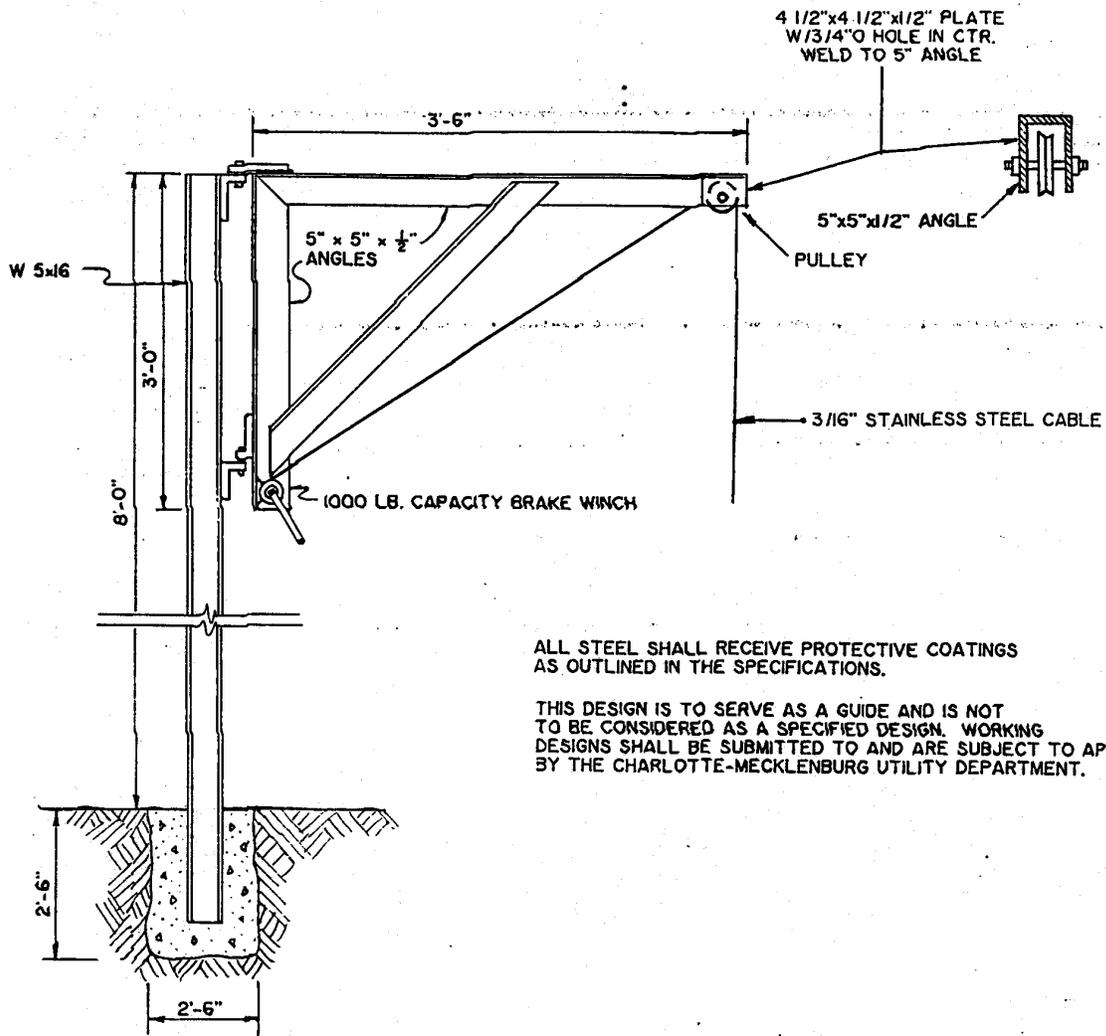


NOTES:

1. FURNISH VALVE KEY EXTENSION (IF REQUIRED BY DEPTH OF NUT) AND STANDARD VALVE KEY FOR BURIED PLUG VALVE.
2. FURNISH OPERATING WRENCH FOR SURFACE PLUG VALVE.
3. DESIGN SHOWN IS INTENDED AS A TYPICAL LAYOUT. ACTUAL LAYOUT MAY VARY IN DIMENSION BUT SHALL REMAIN OTHERWISE SIMILAR. ACTUAL SITE PLAN SHALL BE SUBMITTED TO THE CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT FOR APPROVAL.
4. SEE CMUD WATER STD. DETAIL #21 FOR 2'x3' VAULT FRAME AND COVER.
5. ROD 90° BEND TO TEE AND TO PLUG VALVE WITH 2 - 3/4" GALV. RODS AND GALV. NUTS. 90° BEND TO BE RESTRAINED TO PUMP STATION AS APPROVED BY STATION MANUFACTURER.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA								
Job No. _____		File No. _____		STANDARD DETAIL SEWER PUMP STATION TYPICAL PACKAGE PUMP STATION LAYOUT				
Scales PLAN NONE PROFILE _____								
As Built _____		Date _____		S.B.C.	W.D.C.	<i>B. G. W. G. S.</i>	2/87	Sheet 2 of 2
Surveyed By _____	Designed By _____	Drawn By _____	Project-Engr _____	Approved By _____	Date _____			

No.	Date	By	Revision
4	7-92	JB	ADDED STABILIZATION FABRIC
3	1/88	SC	RELOCATED VALVE TO LEFT SIDE OF TEE.
2	4/87	SBC	REVISED
1	2/87	SBC	REVISED AND REDRAWN



ALL STEEL SHALL RECEIVE PROTECTIVE COATINGS AS OUTLINED IN THE SPECIFICATIONS.

THIS DESIGN IS TO SERVE AS A GUIDE AND IS NOT TO BE CONSIDERED AS A SPECIFIED DESIGN. WORKING DESIGNS SHALL BE SUBMITTED TO AND ARE SUBJECT TO APPROVAL BY THE CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT.

ALTERNATE - HOIST MAY BE MOUNTED ON WET WELL. SUBMIT ATTACHMENT DETAIL TO C.M.U.D. FOR APPROVAL.

CHARLOTTE-MECKLENBURG
UTILITY DEPARTMENT
ENGINEERING DIVISION
CHARLOTTE, NORTH CAROLINA

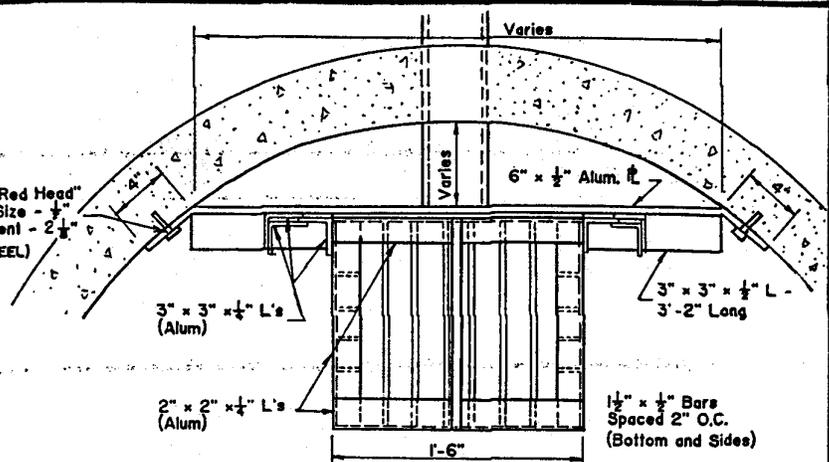
STANDARD DETAIL
SEWER PUMP STATION

TYPICAL BASKET HOIST

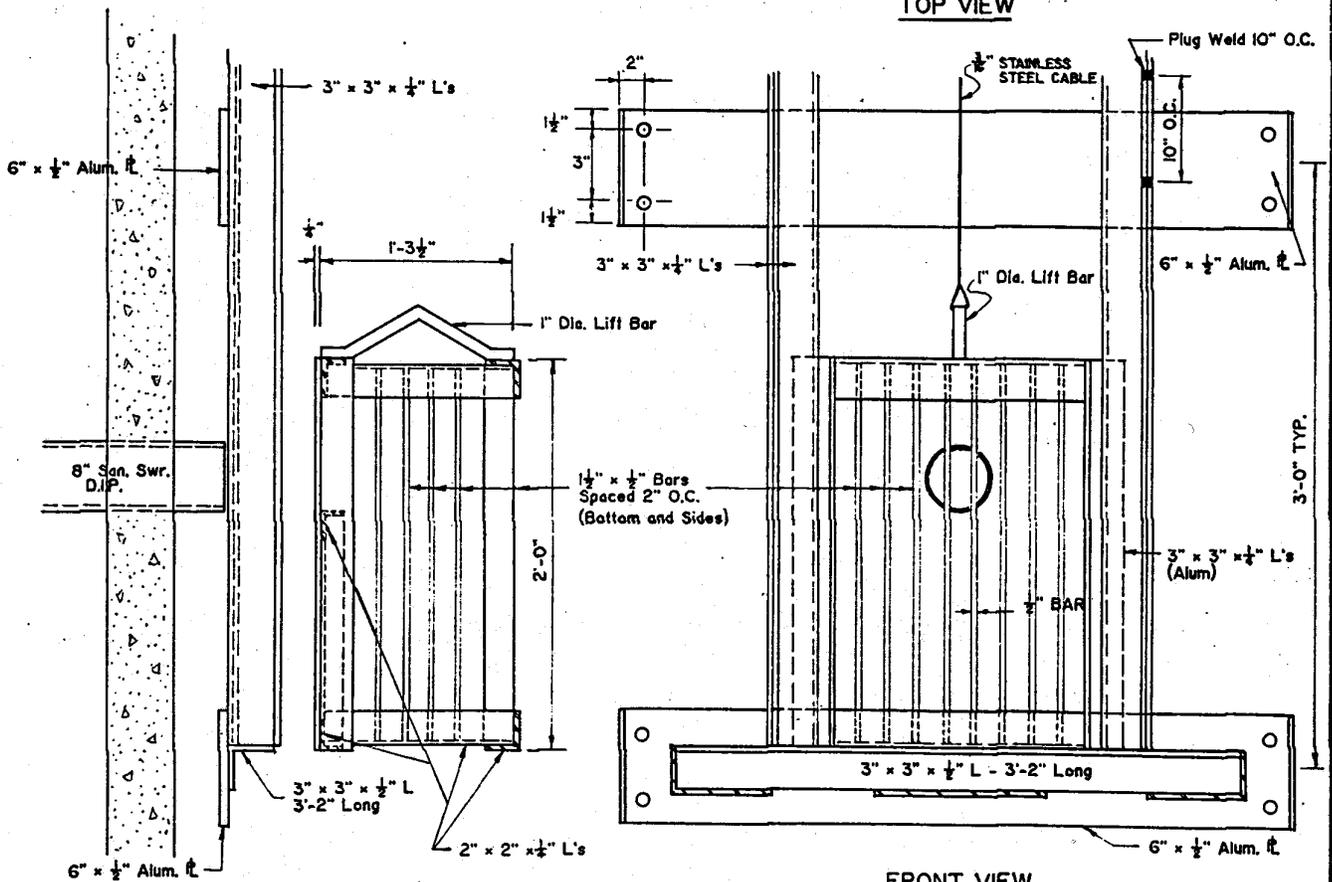
No.	Date	By	Revision
2	7-92	JB	REVISED PULLEY END
1	2/87	SBC	REVISED AND REDRAWN

Job No.	File No.	Scales	
PLAN	NONE	NONE	
PROFILE	Hor.	Vert.	
A. Built	Date		
Surveyed By	Designed By	Drawn By	Project-Eng.
		S.B.C.	W.D.C.
		3/11/87	2/87
		Approved By	Date
			3

NOTE:
Phillips "Red Head"
Anchor Size - $\frac{1}{2}$ "
Embedment - 2 $\frac{1}{2}$ "
(STAINLESS STEEL)



TOP VIEW



SIDE VIEW

FRONT VIEW

NOTE:
ALL SURFACES IN CONTACT WITH CONCRETE TO RECEIVE PROTECTIVE
COATINGS AS OUTLINED IN THE SPECIFICATIONS.
FABRICATED UNIT SHALL BE ALUMINUM.

CHARLOTTE-MECKLENBURG UTILITY DEPARTMENT ENGINEERING DIVISION CHARLOTTE, NORTH CAROLINA			
Job No. _____	File No. _____	STANDARD DETAIL SEWER PUMP STATION	
Scales: <u>None</u>			
PLAN _____	None _____	BASKET SCREEN	
PROFILE _____	Mar _____ Vert _____		
As Built _____	Date _____		
Surv. By _____	Des. By _____	S.B.C. _____	W.D.G. _____
Drawn By _____	Project-Engr. _____	B. G. _____	2/197 _____
		Approved By _____	Date _____
No. _____	Date _____	By _____	Revision _____
		Sheet 4 of _____	