Sammamish Plateau Water®

Technical Standards for Sewer Lift Stations

November 2022

TABLE OF CONTENTS

SECTION 5 - STARTUP, TESTING, COMMISSIONING, AND WARRANTY

SECTION 1

DEFINITIONS AND CONDITIONS OF APPROVAL

1.1 GENERAL

Sanitary sewer lift stations shall only be allowed upon written approval by the District. The Developer shall provide written documentation to support the request for lift station installation. It is intended that the Contractor shall furnish and install a complete, tested, and operational lift station with provisions for standby power and pumping, in accordance with State, District, and local requirements.

Lift stations and their force mains shall be in conformance with the Washington State Department of Ecology (Ecology) Criteria for Sewage Works Design (Orange Book), latest edition, for sewage pump stations. The station shall meet requirement of Class I Reliability, as defined by Ecology.

Sanitary sewer lift stations shall meet the more stringent noise requirements of Washington State, City of Sammamish, City of Issaquah or King County noise ordinances for the municipality in which the station is located.

Sanitary sewer lift stations shall be in compliance with all applicable ordinances and codes, including applicable municipal codes, and regulations enforced by the Puget Sound Clean Air Agency. Sanitary sewer lift stations shall comply with King County's seismic ordinance.

The District may require a lift station to be sized to accommodate flows or hookups in addition to those identified for a specific development/project. The District will provide the sewer basin and tax parcels that the lift station will be required to be designed to serve.

1.2 TYPE OF SEWER LIFT STATIONS – DEFINITIONS

1.2.1 Regional

Serving multiple sewer basins. These require full engineering and are not covered by these Standards. Regional lift stations shall be designed and built to King County Standards.

1.2.2 Neighborhood. Serving More than 100 ERUs.

Neighborhood lift stations shall be a wet well/dry well station as described in the Ecology Orange Book. The dry well shall consist of an access tube and below grade pump room. The station shall accommodate a minimum of two pumps. Pumps shall be designed for pumping raw sewage and capable of passing a minimum 3-inch spherical solid. A building may be required based on the size, location and aesthetic considerations to house controls and generator. All electrical equipment, such as motor starters, control panels, and primary electrical equipment shall be housed above grade and shall not be located in the dry pit.

1.2.3 Mini. Serving Less than 100 ERUs

Mini lift stations shall be wet well submersible pumps stations as described in the Ecology Orange Book. Pumps shall be designed for pumping raw sewage and capable of passing a minimum 3-inch spherical solid. The controls shall be housed in a NEMA enclosure with a kiosk. The generator shall be a permanent onsite generator, unless otherwise approved by the District.

1.2.4 Individual Grinder Pumps

Allowed in basins of less than 25 ERUs if no other means of service can be shown to be possible. A life cycle cost analysis may be required for basins of 25-50 ERUs to verify that gravity collection to a lift station is appropriate. Please see District 2019 Side Sewer Regulations for Grinder Pump System Standards.

1.3 TEMPORARY AND INTERIM LIFT STATIONS

Temporary lift stations are defined as facilities anticipated to be in service for less than 3 years.

Interim lift stations are defined as facilities that are not permanent but are built to permanent standards. The District will consider proposals for interim lift stations where a planned future permanent lift station is not anticipated to be constructed in the foreseeable future. Where interim lift stations are allowed, they shall meet the requirements of Mini Lift Stations.

1.4 LIFT STATION AND FORCE MAIN LOCATIONS

Lift stations and force mains shall be located well out of the buffers for sensitive areas as defined by the local land use jurisdiction. If this requirement cannot be met, additional conditions shall be added by the District to protect and assure adequate environmental protection for the station and adjacent areas.

A geotechnical report stamped by a licensed geotechnical engineer shall be provided for the area proposed for the lift station. The geotechnical report shall include a discussion of seismic faults and conditions in accordance with local building code, groundwater conditions, sensitive slopes, wetlands, proposed retaining walls, recommendation on backfill, subgrade and foundation materials, results of infiltration testing, shoring recommendations and other geotechnical issues. The geotechnical evaluation may be submitted as a supplement to the geotechnical report for the underlying plat and shall include a minimum of one boring at the proposed wet well/dry well site to a minimum depth equivalent to the depth of the proposed wet well structure.

Sufficient land shall be provided to the District for the station for ingress and egress of District equipment for maintenance and operation of the station including fencing for the site. The site shall have enough room to provide access and turnaround for the District's vactor truck, meeting the requirements of the District's Standard Vactor Truck Minimum Hammerhead Turnaround. The land area shall be approved by the District prior to construction approval.

Permanent Lift Stations will be required to be located on a separate tract deeded to the District. Interim and Temporary lift stations may be allowed within an easement. If a permanent lift station is required to be located outside of a proposed development and land acquisition is necessary, it is preferred that the property be provided in fee simple to the District.

The lift station shall be located as far as practicable from existing or proposed built-up residential areas, and a hot mix asphalt access driveway shall be provided. Sites for sewage lift stations shall be of sufficient size for future expansion or addition, if applicable.

1.5 SITE REQUIREMENTS

The lift station site shall meet the following standards:

1. Level yard area, 40 feet x 60 feet minimum exclusive of driveway, off street, turnaround area, parking, landscaping, and required buffers. The

long axis shall be aligned with the access driveway. Maximum yard area slope shall be 3 percent.

2. Access via dedicated right-of-way, deeded property or permanent easement. Access points shall be constructed in accordance with City, County or State standards, as applicable, including driveway slope and site distance.

3. Provide a 15-foot minimum access easement/property for a driveway with a minimum width of 12-feet and with sufficient length to allow one service vehicle to pull completely off the street to open the vehicle access gate. Driveway length shall not exceed 50 feet except as approved with conditions by the District. Access driveways shall be paved and meet the District Standard requirements for sewer. It is preferable that the fencing and gate configuration prevent local parking from impeding access. Access driveways outside of the gate shall be signed "No Parking" to prevent local parking from impeding access.

4. Off street parking shall be provided for a minimum of one 1-ton service vehicle, without impacting vactor access, and in accordance with City and County requirements. The site shall be configured to allow a 1-ton service vehicle to turn around off the street. On-site parking shall be secure to prevent local parking.

5. Vactor access to the wet well, head-in, subject to the following grade limits:

Maximum longitudinal slope:	5%
Maximum side slope:	3%
Max. combined longitudinal and side slope	5%
Maximum reach from truck to wet well:	5 feet

1.6 LIFT STATION FEATURES

At a minimum, the site layout shall provide for the following:

1. Lift station, including wet wells with davit socket cast into wet well lid.

2. Upstream onsite manhole with 2-foot sump "Lift Station Rock Catch Basin" per the District's Technical Standards.

3. Effluent valve vault (for submersible stations).

4. Flow meter vault with bypass for meter maintenance.

5. Bypass pump connection. Connection size and required fittings to be approved by the District.

6. Auxiliary power (standby engine generator and fuel supply), including automatic transfer switch.

7. Electrical service and distribution.

8. Programmable Logic Controller (PLC) based control system that will integrate with the existing or a planned PLC at the District's command center. The PLC will control pump operation in a lead/lag configuration via the 4-20 mA output signal that represents the wet well level from the level sensor and float switches.

9. Telemetry/SCADA. Equipment requirements will be subject to current District requirements for communication.

10. Water service with yard hydrant/hose rack and a reduced pressure backflow assembly (RPBA). RPBA will require heat protection from freezing; either in an insulated standalone enclosure or within a building.

11. Odor control system, as determined by the District.

12. Surge protection as required by the surge analysis.

13. Cuts, fills, and walls to provide level site for maintenance.

14. Asphalt or Portland cement concrete pavement for access and maintenance areas.

15. Six-foot-high chain link 3-strand barb wire fence enclosing the site, with pedestrian and rolling equipment access gates.

16. Overhead weather protection (building or canopy structure) and lighting for all electrical panels normally accessed by District personnel for system maintenance and operation. Orient panels away from direct sunlight exposure.

17. Area lighting (including motion sensor lighting) as required by the District.

18. Site drainage in accordance with City or County standards.

19. Adequate clearances between equipment items and other facilities as required by all applicable codes, and as necessary for reasonable access for maintenance and repair, including access through all doors, hatches and lids.

20. Separation from easements for stormwater detention facilities and other major utility structures.

21. Landscaping needed to meet neighborhood standards for screening.

SECTION 2

DESIGN REPORT

The Developer shall submit a lift station design report prior to submittal of the construction drawings for review. At a minimum, the report shall include the following:

2.1 FLOW CRITERIA

The design loading criteria including existing and future service areas and calculation of inflow rates. This should assume 130 gallons per day per Residential Customer Equivalent (RCE) and an Inflow and Infiltration rate of 1,100 gallons per acre per day.

The peak domestic design flow shall be determined as recommended in the latest revision of the Washington State Department of Ecology Criteria for Sewage Works Design (Orange Book). This analysis shall be compared with the most recent planning information available from the District.

2.2 LOAD SIZING CALCULATIONS

The utility power service and the power distribution system shall be sized adequately to operate the facility with the ability to run two pumps in across the line/Full Voltage Non-Reversing (FVNR) mode.

2.3 FORCE MAIN SIZE, LENGTH AND MATERIAL

Force main should be designed for a minimum velocity of 3 feet per second and a maximum ultimate velocity of 8 feet per second. Force mains shall be Class 52 Ductile Iron (V-Bio poly-wrapped, zinc-coated and epoxy-lined) minimum or HDPE DR 11 minimum.

2.4 PUMP DESIGN SELECTION

1. Pump capacity shall be determined based on peak flow loading, minimum and maximum force main velocity criteria, and pump selection.

2. Provide static, dynamic, and total dynamic head (TDH) calculations and horsepower requirements. Provide a system curve.

3. Pump model, impeller selection, and manufacturer's pump curve information, including pump efficiency curve.

4. Pump redundancy to meet Ecology requirements. Lift station rated capacity shall be the peak design flow with the largest pump out of service.

5. Pump shall be able to pass 3-inch solids.

6. Pump shall be designed and tested to meet the standards of the Hydraulic Institute.

2.5 WET WELL SIZING

1. Wet well sizing and control elevations, including emergency storage. Provide operational storage for 6 starts per hour per pump and a minimum emergency storage volume of 1 hour for the peak hour flow at build out.

2. The minimum wet well diameter is 6 feet.

3. Operational Storage

   The wet well operational storage requirement shall be based on the following formula:

$$V = \frac{QT}{4}$$

   Where:

   V = Wet Well Operating Volume in gallons
   Q = Design Pumping Rate in gallons per minute
   T = Time between starts in minutes = 5 minutes (10 minutes for each pump

4. Emergency Storage

   Required emergency storage shall be calculated based on 1-hour of peak hour flow, including I/I at build out.

   Emergency storage shall be provided between the high level alarm and the invert of the incoming gravity pipe.

2.6 BUOYANCY CALCULATIONS FOR BURIED STRUCTURES

Buoyancy shall assume groundwater levels for the full depth to the surface or;

Geotechnical piezometer groundwater level readings during wet months and a recommendation from a licensed geotechnical engineer are provided in the geotechnical report.

2.7 BACKUP GENERATOR LOAD SIZING CALCULATIONS

Generator shall be sized adequately to operate the facility with the ability to run both pumps across the line. Generator may be sized to stagger the start of pumps through controls.

2.8 STANDBY GENERATOR FUEL CALCULATIONS

Standby generators shall use diesel fuel. Fuel storage shall be adequate to provide 7 days diesel fuel at 25 percent load for the site.

District preference is for sub-base fuel tanks. For generators within buildings, building code may not allow enough fuel to be stored indoors to meet the fuel storage requirement in 2.8.1, so an external, standalone fuel tank may be required.

2.9 SURGE ANALYSIS

The report shall also include a lift station and force main pressure surge analysis (water hammer) to the District as recommended in Ecology's Orange Book in a format acceptable to the District. The analysis shall incorporate calculations for minimum and maximum pressures in the system for the anticipated worst case scenario, including pump starts and sudden power outage shutdowns. Surge protection shall be installed as required by the surge analysis and approved by the District.

Surge analysis is required for force mains with greater than 100 psi normal operating pressure for ductile iron force mains and 75 psi for HDPE force mains. Transient surge pressures shall not be permitted to exceed the rated working pressure of the force main piping.

If required, surge protection could include devices such as: soft starts, use of high strength piping, air and vacuum relief valves, surge anticipator, pressure relief valves, and hydropneumatic surge tanks. Critical surge protection devices shall

protect the system under all operation conditions, including a power outage shutdown while the station is operating at its highest allowed capacity.

2.10 DOWNSTREAM CAPACITY ANALYSIS

Provide a force main discharge location and downstream gravity and lift station capacity analysis.

Downstream analysis shall be conducted from the point of discharge to the nearest identified District interceptor or critical link, unless otherwise identified by the District.

If connection to and sharing of an existing force main is proposed, an evaluation of the impacts of the new lift station on the existing station is required. At a minimum, these impacts shall include the following:

1. Evaluate lift station capacity if both stations are running simultaneously. Reduced capacity of the existing station may necessitate improvements to the existing station.

2. Evaluate transient and surge impacts if both stations are running simultaneously. Significant surge pressure impacts may necessitate improvements to the existing station.

3. Confirm that District force main velocity requirements are maintained in all potential flow conditions.

2.11 PROVIDE RUN TIME CALCULATIONS

Provide proposed start and stop levels for both lead and lag pumps, and high level alarms for pumps.

Provide wet well detention times for average flow and peak flow conditions.

Wet well operation volumes shall be adequate to operate the lift station at a maximum of 6 starts per hour with all pumps in service, and at a maximum of six starts per hour per pump with one pump out of service.

Provide force main detention time for average flow conditions.

Average force main and wet well detention times will be a factor in determining the need for odor control equipment.

2.12 FORCE MAIN DESIGN CONSIDERATIONS

The force main design shall endeavor to provide a constant positive slope to prevent trapping air.

Identify number and location of air/vacuum relief assemblies if required.

Air/Vacuum relief valve vaults shall be drained to the nearest gravity sewer or side sewer lateral, unless the District determines another means is acceptable. Vault floors shall be sloped to the drain.

Surge protection for the force main shall be provided where determined appropriate by the surge analysis. Transient surge pressures shall not be permitted to exceed the rated working pressure of the force main piping. See Section 2.9.2 for transient/surge pressure requirements.

2.13 ODOR CONTROL

Odor control facilities are not required for Mini or Temporary Lift Stations.

For Neighborhood and Regional lift stations, an evaluation of odor potential and proposed mitigation methods will be included in the design report. This shall include:

1. Potential for hydrogen sulfide formation in the force main, including detention time in the force main.

2. Potential locations for odor sources, such as the lift station wet well and force main air/vacuum relief valves.

3. Proposed mitigation measures including carbon filtration, oxygen injection, and chemical addition.

2.14 DESIGN RESPONSIBILITY

The design report and all calculations shall be signed and stamped by a professional engineer licensed in the State of Washington and shall be provide to the District.

SECTION 3

LIFT STATION DESIGN AND APPROVAL

The following section identifies the requirements for approved design drawings for lift station projects.

3.1 PERMITTING

The Developer shall furnish all required permits and variances except those specifically named by the District to be furnished by the District, together with the completed SEPA checklist when required, and shall be responsible for meeting all applicable District, City, County, State and Federal requirements, including but not limited to the following:

- Conditional Use Permit
- Shoreline Management Permit
- SEPA Determination
- Fill & Grade Permit
- Right-of-Way Permit
- Building Permit
- Electrical Permit
- Compliance with Landscaping, Odor, Seismic and Noise Ordinances
- Corps of Engineers 404 Permit

At the District's discretion, the Developer shall provide written determination of permit applicability from agencies with potential jurisdiction.

3.2 DESIGN PLANS

Once the Design Calculations/Design Report has been approved by the District, the Developer shall submit to the District for review and approval complete sewage lift station plans and design that provide for the lift station, electrical service, telemetry/SCADA, control panel, pump controls, and auxiliary generator/transfer switch together with all accessories for a complete, automatically operating installation. Design plans for the gravity sewer and the force main shall be submitted concurrent with the lift station plans. Plans shall be prepared by a professional engineer with experience in lift station design, as further discussed in these Standards.

Design material and drawings shall provide all civil, mechanical and electrical details and shall be consistent with all applicable codes and regulations, and good engineering practice. Drawings shall be prepared in accordance with the District's General Drafting Standards and shall show, at a minimum:

- Locations of proposed and existing streets, rights-of-way, sewers and other utilities in the vicinity of the proposed lift station.

- All known existing structures, both above and below ground, that might interfere with the proposed construction, particularly buildings, water mains, gas mains, storm drains, overhead and underground power lines, telephones lines, and television cables.

- Site layout for the lift station installation at a minimum scale of 1"=10', clearly showing the level of detail required in these standards. The site layout shall show the locations in plan view of all existing and proposed structures, piping, utilities, equipment, easements, property boundaries, slabs, exterior lighting, fencing, access driveway(s), landscaping, drainage and surface restoration. Piping shall be labeled as to type, material and size, and with all special fittings and connections identified. Routing of buried electrical conduits shall be provided on the site layout or on a separate electrical layout and shall identify conduit size and material type, stub up locations, and the number, size, type and general termination location of all conductors. Where the site layout is too crowded to clearly indicate the information required at the minimum scale, the scale shall be enlarged and/or detail views furnished.

  Relative locations of structures and equipment shall be identified and dimensioned on the site layout or associated details, based on preliminary equipment sizing if necessary, and shall specifically allow for adequate clearances for opening of doors, lids and hatches; clearance for code requirements (e.g., Labor and Industries, International Building Code), and reasonable access for repairs and maintenance. Where exact equipment dimensions are not known at the time of design, or where the dimensions are subsequently revised from those assumed during design, the Developer's engineer shall provide a scaled, dimensioned drawing of the lift station layout after submittals have been approved, for District review and approval.

- Mechanical plans for the location and orientation of all mechanical equipment and all connections. Mechanical plans shall include plan and section views of the wet well, valve vault, rock catch manhole and bypass

valve vault, scaled and dimensioned, together with appropriate details, to show: size, number, type, location, elevation, orientation, connection and bracing of the suction piping, discharge piping, level transducer location and stilling well, float switches, drains and vents; pump (level) control elevations/levels; hatch size, type and location; ladder type and location; and wet well grout fillet. Mechanical plans shall also include any required facilities for odor and surge mitigation.

- Structural plans or details for the required overhead shelter(s), housekeeping pads, equipment pads, buildings, and any proposed retaining walls.

- Site grading plan and a minimum of two representative cross sections through the lift station site showing site grading and significant buried and above grade structures.

- Electrical plans and details to include: location of all control, instrument and distribution system equipment and components; electrical schematic for 3-phase power modified to show number, telemetry/SCADA block diagram showing number, schedule of type and size of conduits and conductors; elementary wiring diagram, connection diagram, and interconnection wiring diagrams for electrical controls; electrical rack section views; telemetry panel layout; routing in plan view of all buried electrical conduits; and all equipment and installation detail.

- Any specifications created for use by the installing contractor shall be provided to the District for review and approval at the time that plans are submitted.

- All plan sheets shall be stamped by a professional engineer registered in Washington State. The engineer's stamp provided on the electrical and structural plan sheets shall be that of a registered electrical engineer and structural engineer, respectively.

3.3 GENERAL REQUIREMENTS

- Prior to construction, the design report and lift station plans shall be reviewed and approved in accordance with District's standards and Department of Ecology design guidelines.

- No work shall occur prior to approval of the design drawings.

- Prior to the pre-construction meeting, the Contractor shall provide submittals per Section 4.1.

- Prior to construction, the Contractor shall request and attend a preconstruction meeting with the District.

- Work shall be performed only by contractors experienced in the installation of mechanical, electrical and sewer facilities. All work shall be performed by or under the supervision of a qualified licensed and bonded general contractor.

- Prior to any work being performed, the Contractor shall contact the District to set forth their proposed schedule.

- The Contractor shall attend regular meetings with the District to coordinate technical and administrative aspects of the project.

- Construction of sewer pipes and buried facilities associated with lift station construction shall be in accordance with these standards.

- All metal fabrication shall be subject to District review and approval with respect to materials, fabrication method, coating, installation and testing. Shop Drawings shall be provided for review.

- A single roof structure shall be furnished to provide overhead weather protection for all electrical panels normally accessed by District personnel for system maintenance and operation, including the generator panel, the pump panel, the electrical equipment rack. The roof structure shall extend a minimum of 3 feet horizontally in all directions beyond the edges of electrical panels, shall allow for equipment removal and replacement, shall allow for vertical vactor access to the wet well, and shall include overhead lighting sufficient for operation of all equipment panels and performance of typical maintenance and repair. Structural components shall be steel and shall be hot-dipped galvanized after fabrication. Roofing shall be standing seam metal roofing. Roof shall extend over panel work area. Gutters and downspouts to the drainage system shall be provided. Fasteners shall be stainless steel. Lighting shall be provided for the structure. The structure shall not face directly south and/or should be protected from the sun so as to minimize visibility concerns and heat exposure. The control panel shall be oriented so as the wet well is visible by personnel at the control panel. If sun exposure is unavoidable, a larger

cooling fan may be necessary. Structural plans and details shall be stamped by a structural engineer licensed in the State of Washington.

- A 6-foot-high galvanized chain link fence shall be provided to enclose the site, with vertical vinyl slats in-laid for screening, top and bottom rails, three strands of barb wire, a 3-foot pedestrian access gate and a 12-foot (minimum) rolling vehicle access gate. Landscaping may be incorporated onsite for screening in lieu of the vinyl slats, with District approval. Galvanized fencing components may be overcoated with polyester black powder coating or thermally fused and bonded vinyl, polyester or polyolefin, subject to review and approval of the coating specification by the District.

- A 3/4-inch water service shall be provided, with WSDOH approval reduced pressure backflow assembly, GFCI protected duplex electrical receptacle, and hose bib installed in an above-grade freeze-protected enclosure on a concrete pad. Piping shall be heat traced and insulated. Enclosure shall be Hot Box, or equal. Furnish 50 feet of 1-inch heavy-duty rubber hose.

- Odor control shall be provided where appropriate, as determined by the District, based on an odor mitigation determination to be performed by the District.

- Surge protection facilities for the force main shall be provided where appropriate as identified by the surge analysis and approved by the District.

- Wet well, vaults and similar buried structures with piped connections shall constructed on undisturbed subgrade with structural fill, unless otherwise approved with conditions by the District. Sewage piping installed between lift station structures shall be ductile iron, constructed in accordance with Section 8 of these standards. Restrained joints shall be installed on all pressure piping, and on all ductile iron sewage pipe and fittings, including gravity sewers and drains.

- Buried facilities shall not be backfilled until installation and bedding have been inspected by the District.

- All backfill shall be compacted to 95 percent of modified Proctor maximum dry density per ASTM D1557, or in accordance with County, City and/or State requirements, whichever is more stringent. Copies of the compaction results shall be provided to the District.

- Landscaping shall be approved by the District. Where landscaping is required by City or County codes, the landscaping plan shall incorporate the following features to the fullest extent allowed:

    - Drought tolerant native species.
    - Fabric weed barrier overlaid with mulch, to minimize weed propagation.
    - Dense spreading native groundcovers (e.g., Kinnikinnick).
    - Compact tree varieties with minimal pruning requirements, located so as to minimize leaf litter, mold propagation on lift station facilities, and potential damage to lift station facilities resulting from uprooting and limb breakage.
    - Landscaping that borders the entire site as appropriate.

- Installed conditions shall be field verified after construction by the Developer's engineer and the record drawings revised accordingly. Record drawing information shall be as specified in Section I of these standards. The record drawings shall be signed by a Washington State licensed professional engineer, which shall attest to the fact that the information is in accordance with construction records.

- Following submittal of the approved maintenance and operations materials and record drawings, the District shall, at the Developer's expense, prepare a written narrative description of the basic pump station control strategy, including primary and backup controls, pump protection features, associated alarms and initial wet well level set points.

SECTION 4

MATERIALS

4.1 SUBMITTALS

The Contractor shall obtain approval of materials to be used from the District prior to ordering of materials. Product submittals shall include manufacturer's literature (marked to designate included options and features and to exclude all extraneous information), shop drawings and diagrams (scaled and dimensioned where appropriate), color and material samples, design calculations (where required in addition the design report), and test reports.

4.2 PUMPS

4.2.1 General Requirements

A minimum of two sewage pumps are required for both Neighborhood and Mini lift stations. Each pump shall be designed to handle raw, unscreened, sanitary sewage. The pumps shall have sufficient capacity and capability to efficiently handle the peak design flow, including infiltration and inflow requirements, as determined by the District, with the largest pump out of service.

4.2.2 Dry Pit Pumps

The pump and motor shafts shall be the maximum diameter available for these units.

Pump motors shall be standard 480/277 Volt, 3-phase, 60-cycle, N.E.M.A. Standards, starting Code "G" or better. Motors shall be premium efficiency and have a 1.15 service factor. Motors controlled by a variable frequency drive (VFD) shall be rated for inverter duty and must include a stainless steel nameplate showing "Inverter Duty Motor." Contractor shall supply certification with submittals that the motors meet all requirements of NEMA MG1-2004, Part 31. The pump and rotating assembly shall be easily removable from the motor for full inspection of impeller.

The lift station pump and motor unit shall be suitable for continuous operation in the dry well environment. The pump, mechanical seals and motor units provided under this specification shall be from the same

manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty.

4.2.3 Submersible Pumps

Submersible pump(s) shall be heavy duty, electric submersible, centrifugal non-clog or chopper type units designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use. Pumps shall be Hydromatic, or equal as approved by the District. Non-clog impellers shall pass a 3-inch minimum spherical solid or greater. The pumps provided shall be capable of operating in an ambient liquid temperature of 104 degrees F. Since the high temperature of 104 degrees F is specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM), motors with a maximum ambient temperature rating below 104 degrees F shall not be acceptable.

Submersible pumps shall be submersible dual slide rail type and have the pumps and mechanical slide rail accessories installed in the wet well. Slide rail and accessories shall be a type 316 stainless steel. A hoisting bail shall provide for proper balance of pump and removal from the discharge connection while using a single lift chain. Lifting chain shall consist of a full-length 316 stainless steel chain attached to the pump lifting bail. A clevis shall be provided at the upper end of this chain for attaching to the wet well access frame.

All external surfaces of the submersible pumps coming into contact with sewage shall be protected by a factory applied epoxy coating of 8 mils minimum thickness. All exposed fasteners and lock washers shall be of type 316 stainless steel.

For submersible pumps, thermal protection shall consist of three separate thermostatic switches embedded into the stator windings. Each switch shall open independently and terminate motor operation if temperature of the protected winding reaches the high temperature set point. Any moisture in the motor housing shall be detected by a mechanically activated moisture sensing micro-switch. Use of probes or floats that rely on the presence of liquid to initiate signal is acceptable for Mini lift stations only. The thermal and moisture sensing devices shall be connected to the pump control panel by the Contractor. The pump control panel vendor shall supply an 11-pin relay base, pre-wired to the motor starter unit, so that the moisture relay can be field plugged into the motor starter by the pump vendor. The motor and pump shall be connected to form an integral unit.

1. Motor over temperature shall be provided in all submersible motors and all motors over 25 hp. The method of motor over temperature detection shall be as follows.

   a. Thermal switches – Thermal switches shall be Normally Closed (NC) and shall be sized by the motor manufacturer to open 10 degrees C below the maximum allowed operating temperature for the insulation class and ambient ratings specified herein. These switches shall be internally series connected by the manufacturer with two insulated leads brought to the motor junction box for user connection. These switches shall be suitable for 120 VAC or 24 VDC control circuit applications at 5 Amps.

   b. Thermistors – The manufacturer shall supply a UL listed, DIN-Rail mounted, thermistor setpoint controller (TSPC), with a set of Form C contacts that transition on reaching the temperature setpoint. The TSPC shall be UL listed and shall operate from 120 volts AC with contacts rated at 5 Amps (minimum) at 120 VAC or 24 VDC. The TSPC shall also provide a linear, isolated, 12-bit (minimum), 4-20 mA output corresponding to the motor winding temperature. The Contractor shall be responsible for coordinating the installation and operation of these devices with the motor control center manufacturer or control panel supplier.

   c. Resistance Temperature Device (RTD) – The manufacturer shall supply a UL listed, DIN-Rail mounted, RTD setpoint controller (RSPC), with a set of Form C contacts that transition on reaching the temperature setpoint. The RSPC shall operate from 120 volts AC with contacts rated at 5 Amps (minimum) at 120 VAC or 24 VDC. The RSPC shall also provide a linear, isolated, 12-bit (minimum), 4-20 mA output corresponding to the motor winding temperature. The Contractor shall be responsible for coordinating the installation and operation of these devices with the motor control center manufacturer or control panel supplier.

4.3 PIPE

4.3.1 Ductile Iron (DI)

See Technical Specifications for Ductile Iron (DI) pipe requirements.

4.3.2 High Density Polyethylene (HDPE)

All HDPE shall be butt welded PE 4710 HDPE pipe conforming to ASTM D3350 having a cell classification of PE 445574 or better for 4710 and ASTM D1248 pipe grade resin type III, Class C, Category 5, Grade P34 polyethylene compound. Pipe dimensions and workmanship shall conform to ASTM F714. HDPE pipe shall have a minimum SDR of 11 and shall meet the stated pressure requirements for surge and safety factor. Force mains installed via means other than open trench installation may have additional SDR requirements.

Manufacturer shall provide certification that stress regression testing has been performed on the product. Stress regression testing shall be done in accordance with ASTM D2837. Pipe shall be free of cracks, holes, inclusions, voids or other inclusions. Pipe manufacturer shall meet the minimum quality control requirements of ASTM 3035 and ASTM F174.

Pipe sections shall be joined by butt fusion complying with ASTM F2620 and the joints shall be equal or greater in strength than the pipe. Socket fusion joints shall not be used.

4.3.2.1 Fittings

HDPE Fittings shall be standard HDPE fittings, meet the HDPE pipe specifications, and be manufactured by injection molding or extrusion and machining. All fittings shall have the same working pressure as the pipe.

If ductile iron fittings are used, fittings shall meet the stated requirements.

Class 150, ANSI B16.5 flanges shall be use for connections for flanged connections of another material. Flange backing rings used shall be 316 stainless steel with 316 stainless steel nuts, bolts and washers. All bolts, buried and unburied, shall be coated with anti-seize compound, prior to installation.

4.3.3 PVC

PVC piping shall only be used for gravity conveyance. See District Technical Specifications for gravity sewer mains.

4.4 VALVES

4.4.1 Gate Valves

Gate valves shall meet the District Technical Specifications, with the exception that gate valves located in vaults or buildings shall have hand wheels instead of 2-inch operating nuts.

4.4.2 Check Valves

Sewer check valves shall be AWWA C508 compliant. Check valves shall be swing check, outside lever with weight or spring, ductile iron body and cover, stainless steel seats and shaft, bronze mounted with bronze and stainless steel fittings. Valve shall be provided with fusion bonded epoxy coating and shall provide up to the full pipe flow opening. Valves shall be AWWA C508 compliant suitable for 125 pound service minimum, and shall be as manufactured by Millikin, Mueller, Val-Matic, AVK or equal.

4.4.3 Air/Vacuum Relief Valves

See District Technical Specifications for Air and Vacuum Relief Valve Assemblies for Sewer Systems.

4.4.4 Surge Relief Valves

Sewage surge relief valves, when required, shall be GA Industries Figure 625 or 626 surge relief valves intended for sewer use and sized based on surge requirements as approved by the District.

4.5 VAULTS

4.5.1 Valve Vault

Sewer piping within valve vaults shall be ductile iron or HDPE piping. The valve vault shall be equipped with steps or ladder, H-20 load rated hatch, and a drain (4-inch minimum PVC drain to the wet well with duckbill check

valve or Tideflex Checkmate check valve). Vaults shall provide adequate access for equipment maintenance and removal.

4.5.2 Flow Meter Vault

The flow meter shall be in a vault. The flow meter vault shall be equipped with steps or ladder, H-20 load rated hatch, and a drain (4-inch minimum PVC drain to the wet well with duckbill check valve or Tideflex Checkmate check valve) and a pea trap. Vaults shall provide adequate access for equipment maintenance and removal.

Bypass piping shall be constructed with appropriate valving, to allow for removal of the flow meter. Flow meter vault will also be equipped with fittings and valves and Bauer fitting for an emergency bypass pumping connection. Manufacturer's recommendations shall be followed for accuracy, grounding, and compliance with NFPA 820.

4.6 WET WELL

4.6.1 Sizing

See Section 2.5 for wet well sizing requirements.

4.6.2 Materials

The wet well shall be precast concrete manhole sections and shall conform to manhole specifications in these Standards, as modified herein. Joints between precast wall sections shall be confined O-ring or as otherwise approved.

Alternatively, the wet well may be constructed of Armorock polymer concrete and the lining requirements may be omitted.

The wet well shall be checked to ensure all joints are watertight to prevent infiltration and exfiltration of the wet well.

Provide a separate aluminum access hatch (3' x 3' min.) cast into the cover shall be mounted above each pump to allow pump retrieval. Each hatch shall have safety grate.

The base of the wet well shall include a fillet with a minimum slope of 1:2, sloped to the pump suction inlet for easy cleaning.

4.6.3 Submersible Pump Removal

An access hatch shall be placed directly over each pump and over the wet well ladder.

The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastening to be disconnected or require personnel to enter the wet well.

4.6.4 Coating

The wet well interior and exterior vertical walls, and the underside of the lid shall be factory coated prior to arriving at the lift station site and touched up following installation and grouting. The coating system shall be manufactured by Tnemec, Wasser, Sherwin Williams, Raven, or equal. The appropriate product shall be specified by the manufacturer for the application and environment. All surfaces shall be prepared, filled, primed, finished and applied per manufacturer's recommendations, including recommended recoat intervals.

Coating is not required for Armorock structures.

4.6.5 Hardware

All hardware located within the wet well such as, bolts, nuts, mounting brackets, etc. shall be made of 316 stainless steel.

4.6.6 Vents

Vents shall be located to meet the requirements of NFPA 820 and be a minimum of 5-feet from any electrical equipment. Mitigation of wet well odors shall be provided as recommended in the odor evaluation and as required either by the District or by City or County code through either active or passive means.

4.6.7 Ladders

Wet well access ladders shall be fiberglass, or aluminum, equipped with a ladder-up post. Ladders shall be placed to avoid penetrations to the wet well such as inlet sewers, force main discharge piping, and vent penetrations.

4.6.8 Davit Socket

A stainless steel davit crane socket shall be provided for any structure deeper than 4 feet per the District Standard Detail. Sockets shall be cast into the wet well or vault lid unless approved by the District. Sockets shall be designed to support a minimum weight of 300 lbs. See District Standard Davit Socket Installation Detail.

4.6.9 Equipment Location

Float switches and pressure transducers shall be located so as to avoid interference by inlet flows, bracing, brackets, and other protrusions. Float switches and pressure transducers shall be tethered to a stainless steel cable or chain that is anchored by a weight where necessary to avoid entanglement with wet well piping and support brackets or installed in a stilling well. The location and method of attachment of the float switches, pressure transducers, and cables shall be detailed on the plans.

4.6.10 Emergency Storage

Emergency storage will be provided per the requirements of the design report. Emergency storage can be provided within the wet well, or within a separate, hydraulically connected structure. Emergency storage shall be self-cleaning and shall be coated with the same material as the wet well.

4.7 METAL FABRICATION

Structural components (other than fasteners) subject to emersion, intermittent emersion, or corrosive environments shall be 316 stainless steel or 6061-T6 aluminum alloy. Where structural steel (ferrous metal) is exposed to weather, it shall be zinc coated or galvanized by the “hot-dip” method in accordance with ASTM A123. Fasteners subject to submersion, intermittent submersion, splash or corrosive environments, or for use with aluminum items, shall be 316 stainless steel. Ferrous metal fasteners shall be zinc coated or galvanized. Concrete anchor bolts shall be stainless steel, and where subject to submersion, intermittent submersion, or corrosive environments shall be adhesive type set in epoxy.

4.8 CONCRETE

4.8.1 Concrete

Portland cement concrete for use in construction of reinforced concrete pads and foundations shall contain 6 sacks of ASTM C150 Type II cement per cubic yard of concrete, shall contain an approved air-entraining admixture, shall contain no chloride admixtures and shall have a minimum 28-day compressive strength of 3,500 psi. Provide a concrete mix design for District review and approval. Reinforcing steel shall consist of deformed bars or welded wire fabric as shown on the approved plans. Curing compound shall be liquid type membrane conforming to ASTM C309, Type I, Class A and B.

4.8.2 Grout

Cement grout for ballast and fillets shall be a sand and Portland cement mix only, shall contain 6.5 sacks of ASTM C150 Type II cement per cubic yard of grout, and shall have a 28-day compressive strength of 2,500 psi.

Non-shrink grout used for pipe sleeves, equipment bases, and similar applications shall be Masterflow 928 by Master Builders or equivalent product by W.R. Grace.

4.9 INSTRUMENTATION

4.9.1 Submersible Level Transducer

Wet well level will be monitored via a KPSI 705 Series submersible level sensor. Ultrasonic or radar level sensors maybe considered.

4.9.2 Float Switches

Float switches shall be Flygt Model ENM-10 or approved equivalent manufactured by Warrick Controls, Hydro-Matic, or Anchor Scientific. Mercury switches are not acceptable.

4.9.3 Pressure Transmitters

Pressure Transducers shall be a Gauge Pressure style transducers with either a 3” flange connection or 1/2" NPT connection. Pressure Transmitters shall be a Siemens Sitrans P320 unit. No exceptions.

When a pressure transmitter is installed in a different ground plate from that of the Control Panel, a surge protection device must be supplied integral to the pressure transmitter. Surge protection device shall be a Citel model TSP15M-P-24D3 or equal.

Pressure transmitters must be connected with a field-shortable M12 connector for improved future service / maintenance. A bulkhead male M12 connector is placed on the instrument (Remke model 303P0010N or equal), and a female M12 cable (Remke model 503A0066AR) is cord gripped to the conduit hub. The M12 cable shall be a 3-pole type with 18AWG conductors.

4.9.4 Magnetic Flow meters

Magnetic Flow Meters shall be a Siemens Mag5100W meter tube with a Mag5000 transmitter head (24Vdc). No exceptions.

If the meter is installed in a vault, provide a submergence kit and lighting protection for each meter. In addition, a remote wall mount kit with the required standard/special manufacturer cables are to be supplied so the transmitter head can be mounted separate from the meter tube.

4.10 GENERAL ELECTRICAL REQUIREMENTS

4.10.1 Applicable Codes

Codes and regulations exist at the federal, state, and local level dictating minimum acceptable requirements for electrical systems. The following standards shall be used as a basis for design and review.

- National Electric Code (NEC)
- Occupational Safety & Health Act (OSHA)
- State & Local Building Codes
- National Electrical Code (NESC)
- National Electrical Manufacturers Association (NEMA)
- Underwriters' Laboratory (UL)
- Insulated Power Conductor Engineering Association (IPCEA)
- American National Standards Institute (ANSI)
- Institute of Electrical & Electronic Engineers (IEEE)
- National Fire Protection Association (NFPA)

4.10.2 Power Supply

The local electric utility will be the primary source of electrical power. The Developer shall ascertain proper coordination between the nominal secondary delivery voltage provided by Puget Sound Energy (PSE) and the connection to the lift station equipment.

Where feasible, the electrical service shall be 480-volt, 4-wire, 3-phase, 60 hertz, with a solid neutral terminal at the disconnect or as may otherwise be required by PSE. This shall be confirmed with PSE and confirmed by the suppliers. Underground service shall be provided unless otherwise approved by the District.

All installation shall be approved by PSE and shall be in conformance with the N.E.C. (current issue), U.L., O.S.H.A. and City, County and State electrical codes. Particular attention is directed to the fact that the State of Washington requires that electrical equipment and electrically powered equipment be listed or labeled by a testing laboratory (U/L or other Nationally Recognized Testing Laboratory) acceptable to the Washington State Department of Labor and Industries.

The District shall be furnished with a certificate of final inspection by the inspecting agency.

4.10.3 Conduit

- All wire shall be stranded copper.
- All exposed conduit shall be rigid galvanized. All underground conduits shall be PVC with rigid galvanized PVC-coated elbows and rigid galvanized PVC coated transitions to exposed conduit.
- All underground conduits shall be marked with polyethylene tape placed 6-inches below finished grade and directly above the conduit.
- All conduits shall have a minimum of 24 inches of cover.
- All conduit shall be tagged at each end.

4.11 ELECTRICAL ENCLOSURES

Electrical equipment shall be stored either within a building or on an electrical kiosk with a canopy. Design requirements are listed under "General Requirements" in the Lift Station Design Section of these Standards.

4.12 ELECTRICAL EQUIPMENT

The site shall contain the following electrical equipment:

1. Metering current transformers and enclosure (as required by the PSE).

2. Main disconnect circuit breaker in a NEMA 3R, enclosure, with padlock to District standards.

3. Automatic transfer switch in a NEMA 3R enclosure.

4. A 480-volt distribution panelboard with circuit breakers for each pump starter, one for a 480-240/120V stepdown transformer, and (as required) for other 480-volt loads.

5. A single-phase transformer for ancillary loads.

6. A 24 (or more) circuit panelboard in NEMA 3R enclosure with main circuit breaker and branch circuit breakers for receptacle outlets, engine generator (battery charger, block heater, control panel and other generator heaters or equipment), hot box, site or area lighting, telemetry panel, pump control panel, other loads (as required) and three spares (1-Pole 20A).

7. A 120-volt duplex receptacle outlet.

8. Ground rod(s) and connector wire in conduit to N.E.C. standards for grounding.

9. Motor starters shall be solid state with FVNR by-pass unless otherwise approved.

10. Control panel in a NEMA 3R enclosure with locking 3-point latch with Ethernet capable PLC, operator interface (18-bit color, touch screen, 640 x 480 resolution minimum) and SCADA modem. Also, setpoint controllers, power distribution, Ethernet switch, 24 VDC power supply control relays,

and terminal strips. Door mounted devices shall be mounted on an interior door. "Operator-In-Trouble" mushroom head maintained contact (detented) pushbutton on exterior bottom of panel. See Section 5.7 for additional requirements.

11. UPS shall be provided, sized to power communications for 1 hour. Backup battery shall be provided for 24V DC Controls for 1 hour.

12. District shall determine the communication technology to be used depending the site location during initial design. Options include: cellular, DSL, and radio.

13. Provide spare conduits as determined by the District.

14. Provide electrical single-line diagram as part of the design showing all components and control between pedestal, lift station and generator with wire and conduit sizes.

15. The District shall be provided with a complete reproducible set of as-constructed plans and details showing final location of all equipment, conduit and wire.

4.13 GENERATOR

4.13.1 General

Standby power generation equipment shall be provided at the lift station site that will operate the lift station in the event of a commercial power outage. Permanent generators shall be located a minimum of 10 feet from the property line.

The generator set shall be diesel fueled, 60 Hertz, 1,800 rpm, 3-phase, 277/480 volt unless approved by the District.

It is essential that the standby system be designed with capacity and rating to carry safely the entire connected lift station load, including all pumps starting across the line and ancillary loads unless otherwise approved by the District.

4.13.2 Manufacturer

The generator shall be manufactured by Cummins/Onan or equal as approved by the District.

4.13.3 Engine

Single phase, 1,500-watt coolant heater (115 Vac).

4.13.4 Appurtenances

The standby power unit shall be complete in every respect and shall include, but not be limited to, the following:

- Generator, control panel, main circuit breaker and load bank circuit breaker.
- Vibration isolators (pad-mounted).
- Engine, radiator and exhaust system with exhaust silencer.
- Fuel tank with automatic fuel level sensor for remote monitoring and tank leak alarm.
- Generator set enclosure, lockable, and sound attenuating.
- Automatic transfer switch.
- Block Heater.
- Battery and rack.
- Battery charger (plug-in style).
- Conduit, wire and piping.

Provide the following dry contacts in the generator control panel for PLC Control: Generator Running, ATS in Emergency Position, Generator Fault, ATS Fault, Low Fuel, and Generator Fuel Level.

4.13.5 Seismic Calculations

Provide factory-supplied seismic calculations. Calculations shall meet the current version of the IBC.

4.13.6 Noise/Enclosure Requirements

External generators shall include a Quiet Site Level II sound attenuating enclosure as manufactured by Cummins/Onan, or equal. Generators within a building shall meet the requirement of 70 dB within 23 feet

(7 meters) unless more stringent sound levels are required by the permitting agency.

4.13.7 Fueling Requirements

Onsite fuel storage shall be provided for fuel to allow for 7 days of generator run time at 25 percent load. All fuel piping shall be black iron, except for flexible vibration isolation connections at pipe ends. Diesel tank shall be a dual-wall subbase tank with leak detection. External fuel tank may be considered per District approval.

4.13.8 Generator Pad

Generator mounting pad shall be reinforced concrete to carry the weight of the unit and shall extend a minimum of 3 inches beyond generator housing and 4 inches above the surrounding finish grade. Chamfer all edges 3/4 inch.

4.14 ENVIRONMENTAL REQUIREMENTS

Ventilation, coating, and electrical code requirements shall be based on the classification of the space as defined in NFPA 820. For example, wet wells and areas in contact with sewage gasses shall be treated as Class 1 Div. 1. .Dry pits shall be treated as Class 1 Div. 2 unless continuous ventilation is provided to declassify the space.

4.15 SPARE PARTS

All manufacturer's recommendations of number of parts and quantities of spare parts shall be provided to the District and labeled with part numbers.

4.16 FACTORY-BUILT (PACKAGE) SUBMERSIBLE LIFT STATION STANDARDS

In lieu of custom-built lift stations, factory-built package lift stations may be used for Temporary, Interim, and Mini lift station applications. Package lift stations shall meet all the same requirements as custom-built stations for electrical requirements, sizing, capacity, redundancy, and equipment.

4.17 MOTOR STARTERS

Motor Starters shall match the manufacturer of the PLC, Siemens, for benefits of single unit responsibility and integrated diagnostics with the automation system. The following make/model of Siemens motor starters shall be used.

- VFDs: Siemens
- RVSS: Siemens
- Direct: Siemens
- Motor Overloads: Siemens
- Motor Control Centers: Siemens

Motor Starters shall be oversized to next size up to reduce the threat of over-current tripping and enable operation at higher temperatures. VFDs shall be sized according to the Constant Torque (CT) ratings only, and no oversizing is required when using CT ratings.

Motor starters shall be network connected to the PLC control panel via Profinet connection. Profinet cabling shall be 600V rated and Cat5 or better. All motor starter connections shall be directly connected to the PLC control panel's network switch. Daisy chaining is not allowed.

A motor starter's internal logic blocks must be programmed to enable the motor to operate in accordance with the projects control narratives, without the use of a PLC. Motor starters may be required to sense external process conditions to safely start/stop process control functionality (depending upon control narrative).

The rules of these motor starters apply any motors that meet one of the following conditions: (1) motor uses 3-phase power; (2) greater than 2 hp, or the motor starter supplies data to the PLC for inferred process measurements.

SECTION 5

STARTUP, TESTING, COMMISSIONING, AND WARRANTY

5.1 MANUFACTURERS SERVICES

The sewage pump station shall be installed in accordance with the manufacturers' recommendations. A manufacturer's rep will be required to be on-site for startup and testing of key equipment. Required representatives include:

- Pump Supplier
- Generator Supplier
- Electrician
- SCADA/Integrator
- Control and Pump Panel Supplier

5.2 PUMP FACTORY TESTING

All pumps shall be factory tested following pump station assembly to ensure that vibration is within the current Hydraulic Institute Standards. Rotating assemblies shall be spin balanced by the pump manufacturer prior to vibration testing. Factory test results shall be provided to the District and approved prior to shipment.

Following installation of the pumps at the site and prior to startup, the pumps shall be retested for vibration and all characteristics by the pump manufacturer. Copies of all test results shall be included in the maintenance and operation information.

5.3 GENERATOR TESTING

Generator installation shall be checked by the supplier after installation to determine that the installation is correct. Written confirmation shall be provided to the District. Generator supplier shall perform a full load test for 2 hours after installation is complete. Provide resistive load bank for this test. Provide copy of the test results to the District.

Generator shall be broken-in sufficiently to permit application of full load immediately upon installation.

Generator supplier shall provide all tools for the generator set as recommended and required by the manufacturer.

5.4 LIFT STATION STARTUP AND TESTING

The Developer shall perform, as a minimum, the following tests and provide the District written documentation of the date performed and results obtained. Pump tests shall meet or exceed specified capacity. The District shall be informed of the testing schedule 72 hours prior to the test and shall be present during testing. Testing shall not be scheduled with District until the site is fully functional and all equipment installed. All tests shall be supervised by the manufacturer's representative for the applicable equipment, and documentation shall be provided of satisfactory installation of the factory-built pump station and associated control systems, the generator and transfer switch, and the electrical system, at the conclusion of the testing.

1. Demonstrate proper station operation under normal operating and individual alarm conditions.

2. Pump capacity by drawdown test, for each pump operating alone and each combination of multiple pump operation. Record amperes and furnish pressure gauge to record static head and total dynamic head for each condition at one specific wet well level. Compare with measured flow from the magnetic flow meter.

3. Control/telemetry panel operation. Float switch operation.

4. Generator load test.

5. Automatic transfer to and from auxiliary power.

6. Control and telemetry to terminal strip.

7. Sewage pump vibration test.

Fill water for testing shall be obtained in accordance with the cross-connection policies of the District.

Documentation of satisfactory installation shall be provided for the pump station and the generator. Documentation of satisfactory installation shall be in the form of a notarized manufacturer's affidavit submitted by the manufacturer or an authorized representative, certifying that:

1. The equipment has been properly installed and lubricated;

2. The equipment is in accurate alignment;

3. The manufacturer was present when the equipment was placed into operation;

4. The manufacturer has checked, inspected, and adjusted the equipment as necessary;

5. The equipment is free from any undue stress imposed by connecting piping or anchor bolts;

6. The equipment is not imposing any undue stress on any connecting members;

7. The equipment has been operated satisfactorily under full load conditions;

8. The manufacturer has inspected his equipment during the operational demonstrations and system validation tests to the extent specified, and the equipment is fully covered under the terms of the guarantee.

5.5 TRAINING

The following on-site training and follow-up service shall be provided at the Developer's expense, by the manufacturer's representative, and shall be in addition to any testing and inspection services required for installation and startup. Startup and on-site training shall not occur until approved O&M materials have been provided to the District. On-site training shall occur after the onsite testing and startup for the entire lift station facility is complete. On-Site training shall be coordinated with training for the other lift station components. On-site Training shall not occur on the same day as site testing and/or startup for any of the lift station components. Training and follow-up inspections shall be scheduled in advance with the District.

5.6 MAINTENANCE OF OPERATIONS MATERIALS

The equipment manufacturer shall provide three complete copies of maintenance and operation material to the District as described elsewhere in this specification. Maintenance and operation material shall include a complete discussion of pump control strategy in narrative form, including operational troubleshooting procedures, startup and reset procedures, and calibration, setting and testing of level set points, gauges and alarms.

Record (as-constructed) information for the lift station shall be incorporated into the record drawings for the developer extension. In addition, the Developer shall submit operations and maintenance information for the lift station equipment.

The following information shall be furnished for all items of equipment installed on the project requiring operational and/or maintenance procedures, and for any additional items indicated by the District.

- Lubrication Information: This shall consist of the manufacturer's recommendations regarding the lubricants to be used and the lubrication schedule to be followed.

- Drawings and Diagrams: Drawings shall include record (as-constructed) version of dimensional outline drawings. Diagrams shall record (as-constructed) version of schematic electrical and connection diagrams, showing points of connection, numbers of circuits, size and number of conduits and conductors. Provide electronic copies in AutoCAD format.

- Control Panel Programming: electronic copies of programs for PLC and HMI.

- Startup Procedures: These instructions shall consist of equipment manufacturer's recommendations for installation, adjustment, calibration, and troubleshooting.

- Operating Procedures: These instructions shall consist of the equipment manufacturer's recommended step-by-step procedures for starting, operating, and stopping the equipment under specified modes of operation.

- Preventive Maintenance Procedures: These instructions shall consist of the equipment manufacturer's recommended steps and schedules for maintaining the equipment.

- Overhaul Instructions: These instructions shall consist of the manufacturer's directions for the disassembly, repair and reassembly of the equipment and any safety precautions that must be observed while performing the work.

- Parts List: This list shall consist of the generic title and identification number of each component part of the equipment. Component equipment items provided by other manufacturers shall be identified with the manufacturer's name, part description, and part number. This information shall be provided in a spreadsheet so that it can be incorporated into the District's asset management system.

- Spare Parts List: This list shall consist of the manufacturer's recommendations of number of parts and quantities that should be stored by the Owner and any special storage precautions that may be required. Note spares provided.

- Exploded View: Exploded or cut views of equipment shall be provided if available as a standard item of the manufacturer's information. When exploded or cut views are not available, plan and section views shall be provided with detailed callouts.

- Copies of factory test results, startup check lists, manufacturer's affidavits of proper installation, initial equipment set points and related documentation.

- Maintenance Information Summaries: as specified herein.

- Listing of failure modes: List of failure for critical lift station components.

- CAD files: Electronic CAD files for as-builts, programming and controls drawings.

Two preliminary review copies and electronic files of the manufacturer's equipment O&M manuals shall be submitted to the District for review at the time of equipment delivery and not later than 7 days prior to product training. All manuals except one return copy with comments will be retained by the District.

Two hard and electronic files copies of the final acceptable operational and maintenance materials shall be submitted to the District prior to project acceptance.

5.6.1 Maintenance Information Summaries

Maintenance Information Summaries (MIS) shall be provided for the following component equipment items, within the appropriate section of the equipment manuals, prepared according to the format specified herein:

- Non-clog pumps
- Sump pumps
- Heating and ventilation equipment
- Standby generator
- Valves (larger than 1 inch in size)
- Control Panel
- Motor starters
- Magnetic Flow Meter
- Level Transducers
- Surge Relief Valves
- Air/Vacuum Relief Valves
- Package Lift Stations

Maintenance information summaries shall be furnished on 8-1/2" x 11" paper and electronically in a District -approved format. The MIS shall contain the following information compiled from manufacturer's recommendations in the order shown.

1. Description or name of item of equipment.

2. Manufacturer.

3. Name, address, and telephone number of local manufacturer's representative.

4. Serial number (where applicable).

5. Equipment nameplate data including model number.

6. List of failure modes.

7. Manufacturer estimated useful life.

8. Recommended maintenance procedures:

   - Description of procedures.
   - Maintenance frequency required.
   - Lubricant(s) or other materials required (where applicable), including type of lubricant, lubricant manufacturer, and specific compound.
   - Additional information as required for proper maintenance.

9. Spare parts provided (where applicable).

All operation and maintenance information shall be comprehensive and detailed, and shall contain information adequately covering all normal operation and maintenance procedures. The information shall be organized in high quality D-style 3-ring binders. The binders shall be provided with spine labels, cover inserts, a table of contents and tab sheets to permit easy location of desired information. Each volume shall contain an index for the entire set. Sheets shall be 3-hole punched, and not otherwise punched for comb binding or spiral binding.

All information shall be specifically for items of equipment installed in the Project. Material not directly applicable shall be removed, neatly lined out, or omitted from catalogs or other printed information.

Lubricants shall be described in detail, including type, recommended manufacturer, and manufacturer's specific compound to be used.

If a manufacturer's standard brochures and manuals are used to describe operating and maintenance procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

5.7 CONTROL PANEL AND INSTRUMENTATION INSTALLATION REQUIREMENTS

The control panel will be shop tested and witnessed by the District prior to delivery to the site, or onsite if allowed by the District. Motor starter integration shall also be shop tested and witnessed by the District prior to delivery to jobsite. The witness test will review process control functionality, HMI touch screen development, motor starter HAND and AUTO operation, communication system

diagnostics, and backup float system pumping. The District will identify required control panel programming in coordination with the District's Integrator. The District may require the Developer and Contractor to attend a control panel pre-construction meeting with the District's Integrator to communicate and coordinate the requirements prior to design or fabrication of the control panel.

Smart motor starters shall be used for all wet well pumps and/or fans used to declassify areas. Smart motor starters are defined by three key attributes: (1) network connection to the PLC for data exchange and control capabilities; (2) power profile of the motor is sent to the PLC; and (3) the use of internal logic blocks to safely start or stop the motor based upon process conditions – even if the connection to the PLC is lost. Smart motor starters shall be from the same manufacturer as the PLC, Siemens, so to gain the benefit of single unit responsibility from the manufacturer.

Control and instrument system plans shall thoroughly and completely depict system design. The plans, in conjunction with the specifications, shall define the type of control system, the type of components in the system, the set points and the interface between the instrumentation and control system and the mechanical components. To accomplish this, the control and instrument plan(s) shall include, as a minimum, the following:

- Control and instrumentation system legend and general notes.
- Control, instrumentation and distribution block diagram(s) with notes for associated process control functionality
- Network Diagram (station LAN, and system WAN)
- Control Panel 2D and/or 3D layouts with permissible conduit penetration areas defined
- MCC or MSP 2D and/or 3D layouts with permissible conduit penetration areas defined
- Plans showing location of all control, instrument, and distribution system equipment and components, both electrical and pneumatic.
- All equipment and installation details.

The power, control and instrumentation systems shall be designed with both operational reliability and maintainability. Use standard products wherever possible.

All components within the lift station system, including both internally and face-mounted instruments and devices, shall be clearly identified with phenolic nameplates with white letters on black background.

All wiring between cabinet, equipment and components shall be marked/numbered and multiple color coded where applicable.

All conduits shall be tagged at each end.

Pumps shall normally be operated on a lead/lag basis based on wet well level as determined by a single submersible level transducer. The level transducer's output signal will be connected with the PLC as the set point controller and producing a 4 to 20 mA signal proportional to the wet well level. The SCADA PLC (Siemens as applicable) shall be programmed to generate pump calls via Profinet connection to the motor starters within the motor starter panel (MSP) or motor control center (MCC). The Profinet connection will include diagnostic, motor power profile, alarm, and event information.

The wet well level as determined by the transducer shall also be displayed on the HMI screen.

High water alarm contacts from the high and high-high level float switches, can also be used to activate the redundant PUMP NO. 1 call and redundant PUMP NO. 2 call that is directly powered/connected to the pump starter's control circuit.

The system enters "Float Mode" operation if the high level float switch is tripped when the level transducer is producing a level signal. The PLC control system is programmed to assume that the electronic level probe is non-functional and produce a "High-Float" alarm. The PLC also produces an alarm for analog control disabled and subsequently ignores the level detector until the alarm is reset locally – as to force an operator to investigate the issue on-site. In this mode the PLC controls pump operation in the following manner:

> The PLC will call the lead pump to run for a pre-set time period (XXX seconds or XX minutes). The PLC expects the High Float alarm to clear during the timed pump down. Pumps will shut off when the pre-set time expires and the PLC will alternate the lead pump (if the alternator function is enabled). If the High level float does not clear, the Lag pump is called assist in the pump-down.

"BACKUP FLOAT MODE" is activated if the High-High float is tripped. In this mode of operation, the PLC switches control over to the backup mechanical timer system as the PLC functionality must be inspected for process control functionality. This mode operates an independent backup relay control system that immediately starts Pump 1. The relays and timer for operation are located in the Intrinsically Safe Relay (ISR) enclosure in the control panel and the timer setting must be adjusted for the amount of time needed for the first pump to

pump down the wet well to clear the high float. If the wet well remains above the high float for more than the time set on the timing relay, Pump 2 will start and run with Pump 1 until the wet well level drops below the high float. If the PLC is failed (dark, non-functional), the backup float system will continue to perform timed pump-downs each time the high float is tripped. The backup float system is designed to operate above the low float and below the high until the PLC is restored to functionality.

The wet well control elevations shall be indicated on the plans, i.e., for duplex station: HIGH HIGH FLOAT ALARM/LAG PUMP ON (float switch), HIGH FLOAT ALARM/LEAD PUMP ON (float switch), HIGH LEVEL ALARM (pressure transducer), LAG PUMP ON (pressure transducer), LEAD PUMP ON (pressure transducer), LAG PUMP OFF (pressure transducer), LEAD PUMP OFF (pressure transducer), and LOW LEVEL ALARM (pressure transducer).

The intrusion/operator access limit switch shall be connected to the pump control panel and used to monitor intrusion into the control panel in conjunction with an amber light located on the panel door and a time delay relay that delays the alarm signal for an adjustable interval on deactivation. Reactivation shall not occur until the limit switch is reset.

A complete set of spare fuses shall be provided for all fused equipment.

The HMI touch panel of the control panels shall feature several key features to improve the long-term O&M functions for the District including: PDF copy of drawings, PDF copy of control narratives, interactive list of pre-start conditions required for a motor to start, interactive list of conditions which are process safety interlocks and will inhibit automatic operation, diagnostics page for PLC, and diagnostics page for communication.

The station may need to sequence its pumping with nearby stations in an effort to minimize over-pumping to the main. Therefore, the PLC's application software shall feature the ability to enable pump sequencing with other stations. Enabling this feature is site-specific.

The Control Panel and associated motor starter panel/motor control center shall be capable of being commanded remotely by the SCADA computer visualization system. Both units shall feature capabilities for remote service, application software modifications, and system diagnostics by the District's Integrator.

Control Panel programming shall be based off sample program provided by the District and modified as required for the specific lift station. Provide programming to District for review during design.