TEXAS WATER COMPANY

February 2026

TEXAS WATER COMPANY

Pump Station and Ground Storage Tank Design Criteria

Table of Contents

Part 1 – Introduction and Purpose

A. Application of Design Standards
   i. These design criteria establish the process and standards to be followed for the engineering design and the preparation of construction plans and specifications for potable water pump stations with a 300-gpm to 2,000-gpm firm pumping capacity for Texas Water Company (TWC). Coordinate with TWC directly for design criteria for pump stations with a firm pumping capacity higher than 2,000 gpm.

B. Adherence to Design Standards
   i. The Design Engineer shall refer to the Engineering Design Criteria in addition to this document. Shall there be any contradictions, this document takes precedence. It is the responsibility of the user of these documents to reference and/or utilize industry standards for items not otherwise directly referenced within this document.

C. TWC Approval Requirements
   i. The Design Engineer may not deviate from the criteria presented in this document without prior written approval of TWC.

D. Design Purpose
   i. The purpose of these design criteria is as follows:
      1. Provide adequate service capacity to meet all customer needs (firm capacity).
      2. Provide maximum service reliability for customers.
      3. Provide adequate working space and safe working conditions for maintenance personnel.
      4. Provide maximum operating efficiency.
      5. Provide durable, low maintenance, long-lasting equipment and facilities.
      6. Provide neighbor-friendly site development and building architecture.

E. Code Requirements
   i. The Design Engineer shall observe all applicable codes and other requirements adopted by local permitting agencies. The current version of these documents effective at Notice to Proceed of the design phase shall be used as a reference for design purposes. In case of conflict between the requirements of these reference documents and any code adopted by a local permitting agency, the code requirements prevail.
   ii. Site safety guidelines shall be provided by TWC as requested by the Design Engineer.

F. Design/Sizing Criteria
   i. Coordinate with TWC modeling department to confirm pump capacity requirements.
   ii. Facilities shall meet or exceed the requirements of 30 Texas Administrative Code (TAC) Chapter 290.
   iii. During max day demand, the minimum pressure at the highest elevation to be served in the affected pressure zone must not be less than 45 psi.

G. Construction Sequencing
    i. It is TWC's preference that all existing facilities (if applicable) remain functionally in service while construction occurs. In some cases, this preference is mandatory.

H. Electrical Power
    i. Engineer is responsible for coordinating the extension of primary power to the pump station site if required. Power shall be the responsibility of the Contractor until the site is substantially accepted by TWC.
    ii. Provide 480Y/277V three-phase power with a 120/240V single-phase step down transformer, unless otherwise approved by TWC.
    iii. Coordinate with TWC during power application process. TWC will submit payment for utility fees directly to utility company.

Part 2 – Plan Preparation

All water distribution systems, water main extensions, and all appurtenant items shall be designed in accordance with these standards, TWC Standard Details and TCEQ Title 30 Chapter 290 Standards, whichever is most stringent. Consult TWC for clarification of specific items.

The TWC water distribution facility or any portion thereof, which is to become the property and sole responsibility of TWC, shall be designed by a Registered Professional Engineer and constructed within a TWC-owned lot and/or easement.

Please consult the TWC website for specific plan preparation guideline, standard notes that must be included in all sets of plans, and standard details.

The list of recommended sheets and specifications below is a suggestion, but the Engineer of Record must determine which sheets are required for submittal.

A. Plan Review
    i. After plans are approved and construction is complete, the Engineer of Record will stamp the plans as "Record Drawings" for submission to TWC. One full-size paper copy of the As-built drawings shall be submitted along with one copy in .pdf format file submitted to the Engineering Manager. Compliance with this submittal requirement is not complete until final review and approval by TWC.

B. Recommended Plans
    i. Erosion Control Plan
    ii. Grading & Drainage Plan
    iii. Site Plan
    iv. Yard Piping Plan
        1. Profiles required for pipe 12" and larger
    v. Tank Plans
    vi. Building Piping Plan
    vii. Chlorine Room Plan
    viii. Architectural Sheets

ix. Structural Sheets
x. Electrical Sheets

C. Recommended Specifications
i. General Requirements
ii. Facility Startup
iii. Site Work Section
iv. Ductile Iron Pipe and Fittings
v. Resilient Seated Gate Valves
vi. Control Valves
vii. Air Release Valves
viii. Electromagnetic Meters
ix. Check Valves
x. Tank Mixer
xi. Tank
xii. Painting (Facility & Tank)
xiii. Pump and Motors
xiv. Chlorine Analyzer
xv. Chlorine Generation/Injection System
xvi. Architectural
xvii. Electrical
xviii. Structural

D. Additional Documents
i. 30% Design Report and Conceptual Site Layout
ii. 60% Submittal Plans and Specifications

E. Records Request
i. Upon request, TWC may provide plans, as-builts, etc., on a case-by-case basis.
ii. Email request/correspondence shall include TWC Project Names and Project Numbers, if applicable and/or known. Direct email to the following TWC members:
1. Monica Thygerson - Monica.Thygerson@txwaterco.com
2. Betty Pera - Betty.Pera@txwaterco.com
3. Nancy Turner - Nancy.Turner@txwaterco.com
4. Heath Woods (CC) - Heath.Woods@txwaterco.com
iii. Timeline is dependent on sensitivity of the record request. Information is typically delivered within 2 weeks to 30 days.

Part 3 –Site Design

This section is intended to describe design requirements of a facility including site layout, site access, ground cover requirements, and site appurtenance requirements.

A. Site Layout and Sizing
   i. Provide 20’ minimum clear space around all buildings, tanks, etc. Provide widths and slopes to allow vehicle access around and between structures. Additional space may be required for project-specific access and/or maintenance, such as crane positions for vertical turbine pump removal, spacing for concrete tank erection, etc.
   ii. For sites larger than proposed fenced area, maintain a 15’ minimum separation from tree trunks to the outside of the fence. No tree branches shall be within 5’ of the fence.
   iii. All third-party utility infrastructure to be located outside the perimeter of the site. If access within the site is required, a main access gate must be provided. A separate TWC access gate shall be provided to access the TWC facility. Unless required, external utilities shall not have access to the interior of the TWC facility.
   iv. Additional space for future facility expansion may be required at TWC’s discretion.

B. Driveway and Access
   i. Provide a 20’-wide concrete driveway connected to the existing road with a concrete header. The minimum section requirements for the driveway are 8” concrete supported by a 6” compacted sub-base compacted to 98% standard proctor, unless otherwise recommended in a geotechnical report signed and sealed by a Professional Engineer licensed in the state of Texas.
   ii. Access drives shall have a longitudinal slope not to exceed 10%, a transverse slope not to exceed 5%, no vertical grade breaks greater than 10%, no vertical curve with grade change greater than 1% per horizontal foot. Where the transverse slope of a driveway exceeds 3%, a raised curb shall be installed on the side with the higher elevation.
   iii. The concrete driveway shall lead to the overhead door of the pump station building. The Design Engineer shall include means to turn a vehicle around as part of the site layout (i.e. hammerhead, looped access, etc.).
   iv. Provide space adjacent to the pump station building for a boom truck to remove pumps and motors.
   v. Provide expansion and contraction joints as required in TxDOT driveway details.

C. Site Cover
   i. It is TWC’s general guidelines to provide 8” flexible base in site areas to be accessed by vehicle for periodic maintenance.
   ii. Provide 6” of compacted Grade 57 Rock above a geotextile fabric (Mirafi 1004M) on the remaining areas of the site.
   iii. For sites smaller than approximately 0.1 acre or as directed by TWC, entire site shall be concrete paved at the discretion of TWC.

D. Site Grading
   i. Around all concrete slabs and structures, provide a minimum of 4 horizontal feet of grade with a 2% maximum slope away from all concrete slabs and structures.
   ii. Finished grades shall not exceed 10% slope in areas to be accessed by vehicle.
   iii. Finished grades shall not exceed 25% slope in all other areas on the site.

iv. Provide 3-4" rock on site slopes between 10-25%.
v. Provide 6-12" rip rap/bull rock on site slopes greater than 25%.
vi. Retaining walls shall be installed when finished grades exceed 10% slope in areas to be accessed by vehicles and 25% in all other areas on the site.
    1. Where retaining walls are provided around structures (building, tanks, etc.), provide an aluminum OSHA-compliant handrail on top of the retaining wall.
vii. Install large rip rap in areas with concentrated water flow and on slopes greater than listed above. Rip rap to be sized by Engineer.

E. Tank Overflow
    i. Provide a concrete overflow splash pad with rip-rap channel to edge of fenced area. Engineer to size rip-rap and confirm adequate size and lengths of swale and/or overflow splash pad.
    ii. At TWC's discretion and dependent on the overflow water path due to site slopes, if an overflow pad is not feasible, provide a 4'x4', or larger, grate inlet centered at overflow pipe discharge. Inlet and grate shall be designed for H20 traffic loading.
        1. Provide a 2' concrete apron around all edges of the inlet. Slope apron at a grade of 2% toward the inlet.
    iii. Engineer shall be responsible for confirming the trajectory and arc length of the tank overflow water path to ensure proper alignment with splash pad or grate.
    iv. When concentrated flows (including flow from tank overflow, periodic tank draining, etc.) are directed onto adjacent properties, provisions and considerations shall be made to return flow to sheet flow or provide easements across adjacent tracts when left as concentrated flow.

F. Drainage Retention/Detention
    i. Refer to Local Jurisdiction (City/County) and TCEQ (Edwards Aquifer, etc.) drainage code for retention/detention requirements.

G. Gate and Fence
    i. Provide an 8' tall fence (with no barb wire) with an 18"-wide reinforced, concrete mow-strip base around the entire site. Fence fabric and all members, posts, ties, etc. shall be green vinyl coated. The bottom of the fence fabric shall be flush with the top of the mow strip. Include 1-5/8" bottom rail on fence and gate. Provide maximum 4" gap between fabric / rails and posts. All fabric ends shall be triple twisted selvage. Gate catch and other related mechanisms to be per SAWS standards.
        1. For sites larger than approximately one acre, TWC may allow king ranch fencing on the site property line, and chain link fencing within the site area.
    ii. Pump stations, well sites, and tank sites shall have a minimum 20' wide double-swing gate with lock. WWTPs and other manned stations shall have a cantilever gate.
    iii. Provide a 3.5' lockable personnel gate to the left of the vehicle gate.

iv. Additional gates may be required in areas where additional site access/maintenance is required.
v. The Contractor shall be responsible for providing a temporary combination lock until station is accepted by TWC. Upon acceptance of station, TWC will furnish their standard lock.

Part 4 – Building Design

This section is intended to describe design requirements of a pump station facility building including building layout, building access, and mechanical and plumbing requirements.

A. Space and Function Preferences
   i. Provide adequate room within the building for equipment loading and unloading using the overhead roll up door.
   ii. Allow for sufficient floor space around piping and equipment so that dollies may be used where overhead crane access is not available.
   iii. All equipment shall be accessible without the need for ladders or climbing over pipes or other equipment.
   iv. Allow for a minimum 4-foot clearance between pump piping and appurtenances and away from all pumping station walls, stairways, ladders, etc.
   v. When using vertical turbine pumps, provide interior lockable hatches on roof of pump station building centered above pumps and cans. Hatches shall be sized to allow a minimum 3" clearance on all sides of the largest piece of equipment (i.e. pump head, can flange, piping, etc.) or provide 36" hatches, whichever is most stringent. Hatch throat to be clear of any hinges, hold-open mechanisms, etc. Include OSHA-compliant tie-off points on roof at each hatch.
   vi. Allow for sufficient space for air compressor within the pump room.
   vii. Reference other TWC standards for building layout and electrical room requirements.

B. Access/Doors
   i. Electrical Room, Pump Room, and Chemical Room (if applicable) shall be separate rooms.
   ii. All doors on electrical, chemical and pump rooms shall have interior push bar panic exit devices.
   iii. An interior door shall be provided for access between the Electrical Room and Pump Room.
   iv. Provide exterior double doors at outside entrance to Electrical Room and Chemical Room.
   v. All doors shall have a tan or white factory painted finish with color to be selected by TWC.
   vi. If the chemical room and pump station are separate buildings, exterior fiberglass double doors shall be installed for access to the chemical building. If the chemical room is integrated within the pump station building, exterior steel double doors shall be acceptable.

vii. Pump Room
   1. Provide a 10’ minimum width exterior overhead roll-up door for maintenance and/or truck access. Engineer to confirm exact door size. Avoid locating the maintenance/truck access over the inlet and discharge penetrations into the station to prevent pipe shear loadings at these locations.
   2. Provide a single exterior personnel door for access.
   3. Contractor to furnish and install door cylinders which can be changed out by TWC at a later date.

C. Building Composition and Painting
   i. Reference other TWC standards for building composition and painting requirements.

D. Ventilation/HVAC and Heaters
   i. Reference other TWC standards for ventilation/HVAC and heater requirements.

E. Building Drain System
   i. Provide 4” floor drains in the Chlorine Room and Pump Room. Floors of the pump station building shall be reinforced concrete, sloped to area drains.
   ii. Install stub-ups from drain line along walls in Chlorine room to direct any excess water from equipment to drain.
   iii. Floor of the electrical room shall be elevated at least 4-inches to mitigate flood damage in the event of a pipe failure.

F. Sidewalk and Landings
   i. Provide 4’ sidewalk for building access at doors.
   ii. Provide a retaining wall with an aluminum OSHA-compliant handrail along the sidewalk for any vertical drops exceeding 12”.
   iii. Provide adequate 4’ clearance around HVAC equipment.

G. Building Utilities
   i. A 1-inch water service and hose bibb shall be connected to the pump discharge a minimum of 24” above finished floor and placed inside the pumping station building for water sampling and cleaning the building. A pressure reducing valve shall be placed in an accessible area, installed upstream of the hose bibb. All hose bibbs shall be equipped with a vacuum breaker. All wall penetrations shall be sleeved through the walls.
   ii. Isolation kits must be placed between connections of brass and ferrous piping and between any other pipes made of dissimilar metals.

Part 5 – Ground Storage Tank Design

This section is intended to describe design requirements of ground storage tanks including tank type, piping, and tank accessories/appurtenances. Ground storage tanks and all piping that comes into contact with water shall be domestic.

A. Ground storage tank types for Various Sizes
    i. Tanks up to 500,000-gallon capacity shall be welded steel meeting the requirements of AWWA D100.
        1. Welded steel tanks under 26’ diameter shall have a self-supported dome roof.
        2. Reference *TWC Standard Tank Coating Specification* for coating of welded steel tanks.
        3. Cathodic protection is not required for newly constructed welded steel tanks.
        4. Engineer is responsible for spacing inlet and outlet and all other tank appurtenances in accordance with TCEQ requirements.
    ii. 500,000-gallon capacity tanks and over shall be prestressed concrete in accordance with AWWA D110.

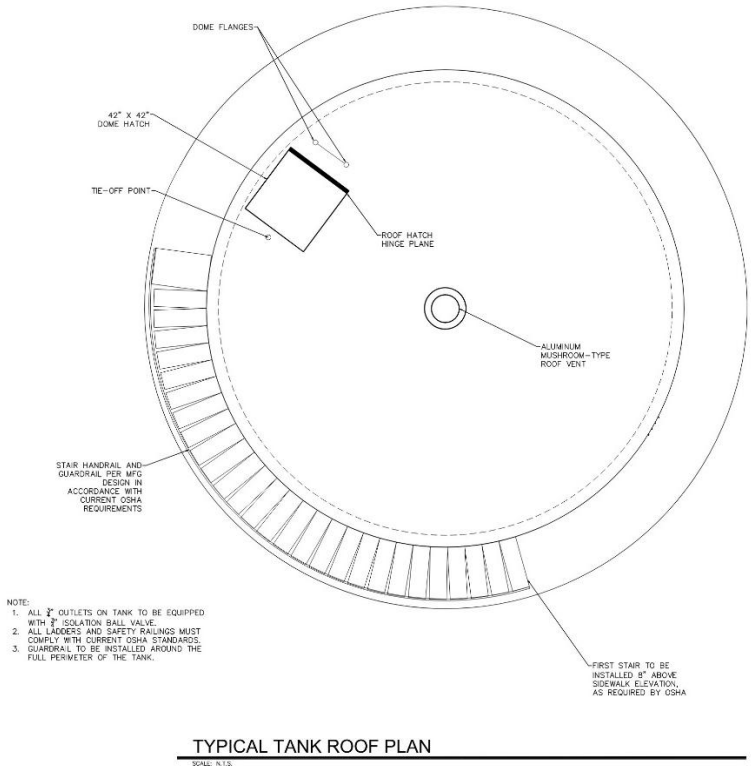
B. Inlet Piping Design
    i. Inlet piping shall have an air gap in accordance with 30 TAC Chapter 290.
    ii. TWC standard is for the tank inlet to follow the exterior of the tank, with penetration through the side of the tank wall, as close to the inlet elevation as possible. Exceptions may be made on a case-by-case basis. Gate valve on inlet pipe to be buried.
    iii. To allow for adequate tank mixing, the inlet pipe shall have a 90-degree bend parallel to tank wall.
    iv. For sites with on-site chlorine injection, install a hose bibb with vacuum breaker approximately 3’ above-grade connected to the tank inlet piping near the exterior of the tank for chlorine sampling.

C. Outlet Piping Design
    i. Provide outlet pipe penetration through bottom of tank. Extend top of outlet pipe appropriately above the tank FFE to allow room for settlement within tank.

D. Overflow Piping Design
    i. Provide an appropriately sized overflow pipe designed to 1.5x the maximum tank inlet flow or the current version of AWWA standard, whichever is greater.

E. Accessories/Appurtenances
    i. Shell Manways
        1. Provide one 36” shell manway on the side of the tank closest to the driveway. Provide a second 36” shell manway for tanks larger than 30’ diameter. Place the second shell manway 180-degrees from the first or as requested by TWC, and any additional shell manways at locations requested by TWC.
    ii. Roof Hatch
        1. Roof Hatch shall be adequately sized to install and remove tank mixer and associated equipment, or 42”x42”, whichever is greater.
        2. Install exterior lock per 30 TAC Chapter 290 requirements on roof hatch.
        3. Roof hatch shall be aluminum or as approved by TWC.
    iii. Roof Hatch Layout

1. Roof hatch shall be located approximately 180 degrees from tank outlet but not above tank inlet, or as approved by TWC.
2. Roof hatch shall be designed for access from tank exterior to interior.
3. Hatch shall be placed to the left side of the top stair landing, allowing for adequate spacing on the roof for servicing access. Hatch to open towards dome flanges.
4. See Figure below for general layout/spacing requirements for a tank roof plan.



TYPICAL TANK ROOF PLAN

SCALE: N.T.S.

iv. Interior and Exterior Access

1. For all tanks smaller than 15’ diameter, provide OSHA-compliant ladder for roof access and ladder gate. Include safety climbing rail at the direction of TWC. For tanks larger than 15’ diameter, provide OSHA-compliant stairs with separate handrail and guardrail around tank for roof access. Exterior ladder to be 316 stainless steel or aluminum.
   (a) For tanks with exterior ladder, electrical conduit must be installed onto the tank with conduit clamps. Conduit clamps attached to any part of the ladder is not allowed.
2. For all tanks, provide OSHA-compliant guardrail around full perimeter of tank roof.
3. Provide a 3’ sidewalk around the entire tank foundation.

4. A tank interior ladder is not required, unless determined to be required by TWC. When required, interior ladders and safety climbing rail shall be 316 stainless steel with safety ladder-up or grab bars for tank access through the roof hatch. Interior ladders shall be bolted or welded to tank.
5. Provide one OSHA-compliant tie-off point near the roof hatch.

v. Tank Vent
1. Tank vent shall be appropriately sized for the maximum inlet and outlet flow, or 24" diameter, whichever results in a larger vent size. The Engineer must specify the number of vents required per tank.
2. Provide four (4) hand holds on vent housing for lifting and removal of vent.
3. Tank vent shall be centered on the tank roof unless otherwise specified by Engineer.
4. Tank vent shall be aluminum.
5. Vent screen to be 316 stainless steel, with opening size meeting TCEQ requirements.

vi. Shell Couplings
1. Provide one (1) ¾" outlet with isolation valve for pressure transducer and a TCEQ-compliant pressure gauge as close to the tank floor as possible per AWWA requirements. Enclose transducer, gauge, piping, etc. in a NEMA-compliant enclosure.
2. If applicable, provide one (1) ¾" outlet with isolation valve for Chlorine Analyzer test line.
3. Provide one (1) spare ¾" outlet per tank with isolation ball valve.
4. Provide one (1) ¾" outlet with isolation ball valve and hose bib for sampling.

vii. Nameplate
1. A permanently attached nameplate shall be provided for each tank. The nameplate shall include the following:
   (a) Nominal Tank Diameter
   (b) Nominal Tank Height
   (c) Overflow Height
   (d) Finished Floor Elevation
   (e) Nominal Tank Capacity
   (f) Tank Type (e.g. AWWA D100-11, Section 14)
   (g) Year Constructed
   (h) Name of Contractor
   (i) Contract Number
2. Place nameplate near manway closest to driveway at readable height.

viii. Tank Mixer
1. An active tank mixer shall be provided as requested by TWC and/or Texas Commission on Environmental Quality (TCEQ).

ix. Dome Penetrations
1. Provide appropriately sized dome flanges for tank mixer and/or any other tank penetrations. All tank penetrations shall be sealed using ductile iron blind flanges

during and, if unused, after construction. Flanges shall be coated with the same protective coating system specified for the tank.

2. Dome flanges to be placed between handrail and hatch.

x. Tank Drain Line
   1. Tank drain line to be appropriately sized for tank capacity and drain rate.
   2. Tank drain line shall be adequately spaced adjacent to tank overflow pipe so that water exiting the tank drain line will flow into the grate inlet per the Tank Overflow Storm Drain Section of this document.
   3. Provide gate valve with blind flange and a 2-inch female iron pipe thread (FIPT) connection. Provide a 2" cap over the penetration.

xi. Sump
   1. For steel and concrete tanks, provide one (1) 24" diameter sump near the 36" shell manway closest to the driveway.

xii. Tank Level Control
   1. Tank Levels shall be controlled by a calibrated pressure transducer.

Part 6 – Hydro-pneumatic Tank Design

This section is intended to describe design requirements of hydro-pneumatic tanks including tank functionality, piping design, and tank accessories/appurtenances.

A. Design Requirements
   i. The tank shall meet all ASME Boiler and Pressure Tank Vessel Codes and be in compliance with all paint and primer codes (AWWA standards). Tanks must withstand and exceed all design pressures and be rated for full vacuum.
   ii. All hydro-pneumatic tanks shall be installed outside and clear of overhead obstructions.
   iii. Concrete tank pedestal to be 2' tall maximum measured from the finished grade elevation to the bottom of the tank.
   iv. Hydro-pneumatic tank, valves, and all appurtenances to be domestic in manufacture, and sized and provided by the same supplier. This same supplier shall also size and provide the air compressor.

B. Accessories/Appurtenances
   i. Nameplate
      1. A permanently attached nameplate shall be placed below or adjacent to the manway on each tank at readable height. The nameplate shall include the following:
         (a) Tank Dimensions
         (b) Bottom Tank Elevation
         (c) Nominal Tank Capacity
         (d) Design Pressure
         (e) Tank Type
         (f) Year Constructed
         (g) Name of Contractor

(h) Contract Number

ii. Pressure Relief Valve
   1. On top of hydro-pneumatic tank, provide a pressure relief valve with 90-degree bend down and screen. If ball valve is required, provide ball valve that locks in the open position.
   2. Pressure relief valve to be 2” minimum size, unless otherwise directed by Engineer. Engineer to select design pressure.
   3. Pressure relief valve to be lead-free and/or safe for use in potable water systems.
   4. Pressure relief valve to include external cap, not lever.

iii. Vacuum Relief Valve
   1. On top of hydro-pneumatic tank, provide vacuum relief valve with 90-degree bend down and screen. If ball valve is required, provide ball valve that locks in the open position.
   2. Vacuum relief valve to be 2” minimum size, unless otherwise directed by Engineer. Engineer to select design pressure.
   3. Pressure relief valve to be lead-free and/or safe for use in potable water systems.
   4. Pressure relief valve to include external cap, not lever.

iv. Drain Line
   1. Provide 2” NPT ball valve centered at bottom of tank. Larger drain size may be required dependent on pump capacity, demand, etc.

v. Air Supply Line
   1. Buried air supply line to be as short of a run as possible.
   2. Buried air supply piping shall be PEX installed within a larger 4” PVC sleeve. Once above ground, air line shall transition to domestic galvanized steel piping through a meter box.

3. Air supply line shall be provided per detail below and sized per chart below.

PIPE SIZE SELECTION FOR COMPRESSED AIR LINES								
FREE AIR C.F.M	EQUIVALENT LENGTH OF PIPE LINES IN FEET							
	25	50	75	100	150	200	250	300
1	½	½	½	½	½	½	½	½
2	½	½	½	½	½	½	½	½
3	½	½	½	½	½	½	½	½
5	½	½	½	½	½	½	½	½
10	½	½	½	¾	¾	¾	¾	¾
15	½	¾	¾	¾	¾	¾	¾	¾
20	¾	¾	¾	¾	¾	¾	¾	¾
25	¾	¾	¾	¾	¾	1	1	1
30	¾	¾	¾	¾	1	1	1	1
35	¾	¾	1	1	1	1	1	1
40	¾	1	1	1	1	1	1	1
50	1	1	1	1	1	1	1	1
60	1	1	1	1	1-1/4	1-1/4	1-1/4	1-1/4
70	1	1	1	1	1-1/4	1-1/4	1-1/4	1-1/4
80	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	1-1/2
100	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	1-1/2
125	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	1-1/2
150	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	1-1/2
175	1-1/2	1-1/2	1-1/2	1-1/2	2	2	2	2
200	1-1/2	1-1/2	1-1/2	1-1/2	2	2	2	2
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250	2	2	2	2	2	2	2	2
275	2	2	2	2	2	2	2-1/2	2-1/2
300	2	2	2	2	2	2	2-1/2	2-1/2
350	2	2	2	2	2-1/2	2-1/2	2-1/2	2-1/2
400	2	2	2	2	2-1/2	2-1/2	2-1/2	2-1/2
450	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	3	3
500	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	2-1/2	3	3
550	2-1/2	2-1/2	2-1/2	2-1/2	3	3	3	3
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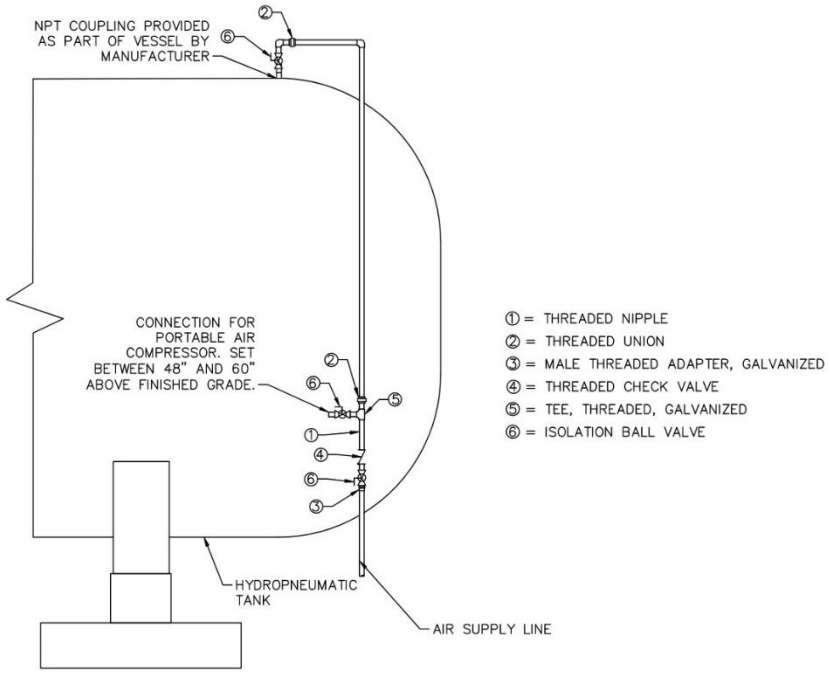


AIR LINE INSTALLATION DETAIL

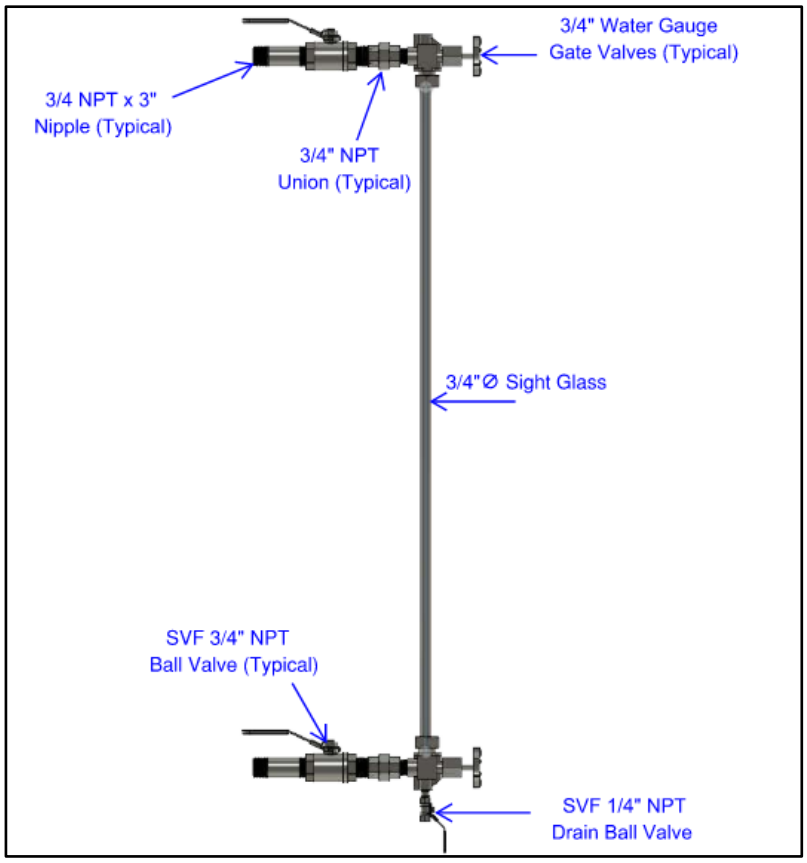
SCALE: N.T.S.

vi. Air Compressor

1. Provide 240V air compressor for air supply line. Air compressor shall be oil lubricated and have an air-water separator.
2. Air compressor tank shall be sized to meet the air and pressure requirements of the hydro-pneumatic tank.
3. Air compressor shall be installed in the pump room within the pump station building.
4. Air compressor shall have an automatic drain valve.

vii. Sight Glass

1. Couplings for sight glass shall penetrate from side, not top, of hydro-pneumatic tank.
2. Hydro-tank and all tank appurtenances to be provided by the same manufacturer.
3. Provide a sight glass with heat tracing within a steel enclosure at the hydro-pneumatic tank per detail below.



Part 7 – Pump, Piping, and Appurtenance Design

This section is intended to describe design requirements of pump station piping, valves, appurtenances, and additional gauges.

A. Pipe and Fittings for Pump Station and Yard Piping
   i. These guidelines shall not take precedence over TWC Design Criteria guidelines for piping, or TWC standard technical specifications.
   ii. Size requirements
      1. All yard piping (excluding pump suction lines) and above-ground piping shall be sized such that the water velocity at the firm pumping rate is a maximum of 5 ft/s.
      2. Pump suction lines shall be sized such that the water velocity at the firm pumping rate does not exceed 4 ft/s or the latest version of the Hydraulic Institute standards, whichever is most stringent.
   iii. All pumping station suction and discharge piping shall be ductile iron or engineered shop fabricated steel or as directed by TWC.
   iv. Restraint Requirements
      1. All pipe, valves, and fittings installed above-ground or located in a structure shall have flanged ends.
      2. All buried fittings installed below-ground shall be mechanical joint restrained with retainer glands.
      3. All buried pipe installed below-ground shall be push-on pipe restrained with exterior bell restraints or an interference type joint method integrated into the pipe bell (i.e. American CIPC Flex-Ring, U.S. Pipe HDSS or TR Flex).
   v. All fittings/appurtenances (exterior, buried) shall have adequately designed thrust blocking at all changes of direction. Thrust block shall be per TWC standard details.
   vi. Minimum Pressure Class Requirements
      1. Engineer is responsible for selecting appropriate pipe pressure class for project-specific system pressures. System pressures not included in the pressures below shall be evaluated on a case-by-case basis.
      2. All pump station and yard piping shall be ductile Iron. All pipe penetrations through walls shall be via cast-in-place wall sleeves.
   vii. Flexible type fittings or joints with restraining devices shall be provided when transitioning from structures (pump stations, tanks, vaults, etc.) to buried piping to allow for differential settlement.
   viii. See *TWC Design Criteria* guidelines for piping and TWC standard technical specifications for acceptable linings and coatings of station piping.
   ix. Minimum cover shall meet TWC standard detail for all buried piping.

B. Pump and Motors
   i. Pump and Motor Requirements

1. Pumps shall be sized appropriately to meet the Engineer's specified duty point. Pumps shall be designed in accordance with the latest requirements of the Hydraulic Institute.
2. When selecting a pump, Design Engineer shall consider the following:
   (a) Select a pump operating curve where the required operating point is greater than the minimum and slightly to the right of the maximum efficiency point of the pump curve.
      (i) The pump shall move closer to its maximum efficiency point as the system ages to minimize total life cycle operational cost
   (b) Avoid pumps with "flat" pump operating curves where a small change in total dynamic head (TDH) results in a large change in pump flow.
3. Engineer shall note the following information on the plans:
   (a) Pump manufacturer and selected pump model
   (b) Pump and motor horsepower
   (c) Pump maximum and minimum speeds
   (d) Pump maximum and minimum pressures
   (e) Design Flow
   (f) Design Head
   (g) Pump and motor power requirement
   (h) Pump Curve
4. Pumps and motors shall be short set vertical turbine. Horizontal split-case type pumps, depending upon conditions, may be accepted on a case-by-case basis.
   (a) Vertical Turbine Pumps
      (i) Vertical Turbine Pumps shall have vertical turbine motor or submersible motor.
      (ii) Pump impeller and bearings shall be Nickel-Aluminum-Bronze.
      (iii) Vertical Turbine Pumps with vertical turbine motor shall have packing seals, and TWC may require mechanical seals on a case-by-case basis.
   (b) Horizontal Split-Case Pumps
      (i) Pump impeller and bearings shall be Nickel-Aluminum-Bronze.
      (ii) Coordinate with TWC for seal requirements when using horizontal split-case pumps.
5. Vertical Turbine Pump Cans, when applicable:
   (a) Pump can shall terminate above-ground within the pump station building and have a flange connection.
   (b) Provide watertight electrical coupling for all electrical connections.
   (c) Pump can flanges shall be equipped with a ¼" ball valve for pressure/water release.
   (d) Install a pump can vent on the top of the can using a ball valve with a 90-degree downward bend.
6. Motors

(a) Motors shall be inverter duty rated.
(b) Motors shall be suitable for installation, i.e. WP1 type for outdoor vertical installation.
(c) Pumps and motors shall operate on VFDs.
(d) Provide premium efficiency motors for non-submersible installations.
(e) Pumps and motors shall be 1800 RPM.
(f) A minimum of 2 Resistance Temperature Detectors (RTD) shall be installed in each motor less than 25 hp. Additional RTDs may be required in each motor greater than 25 hp.

ii. Pump On/Off Control
1. Pumping systems are normally controlled by a level control from an elevated storage tank or a closed zone system (where a set pressure is maintained using hydro-pneumatic tanks).

C. Gate Valves
i. Gate valves shall be per TWC standards.
ii. Gate valves shall be installed before and after each pump for isolation. Above-grade valves shall be installed with a handwheel. Buried valves shall be installed with a valve nut and gate valve box.

D. Check Valves
i. Check valves shall be installed on each pump discharge.

E. Air Release Valves
i. Provide air relief valves when high points are unavoidable. Interior air relief shall be screened with a 90-degree bend down.
ii. Air release valves shall be combination air/vacuum valves on pump discharge piping.
iii. Install air release valves with appropriately sized service saddle.

F. Dismantling Joints
i. Provide sufficient dismantling joints adjacent to meters, control valves, etc. for maintenance and repair of flanged piping.

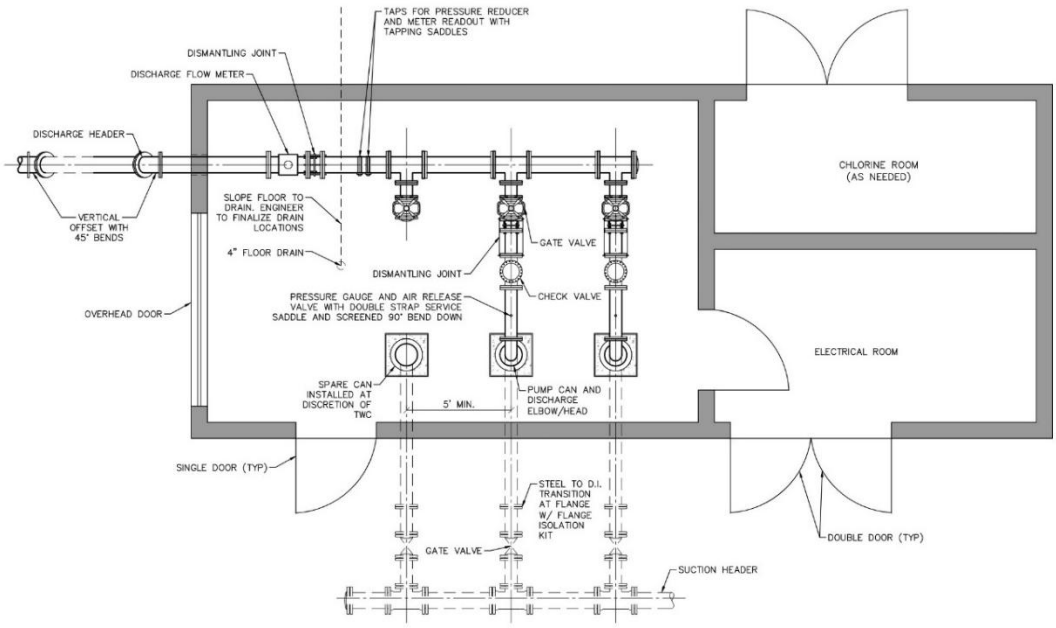
G. Pipe Supports
i. Provide sufficient concrete and adjustable flange piping supports for pumps, valves, and piping.

H. Pressure Gauges
i. Provide a 2” liquid-filled pressure gauge on each pump discharge piping. Gauges shall be 0-300 psi range unless otherwise required due to project-specific pressures.
ii. Provide a pressure transducer at the discharge header.

I. Flow Meter
i. Provide a flow meter on the discharge header.
ii. Flow Meter Requirements – See Magnetic Meters Section of this document.

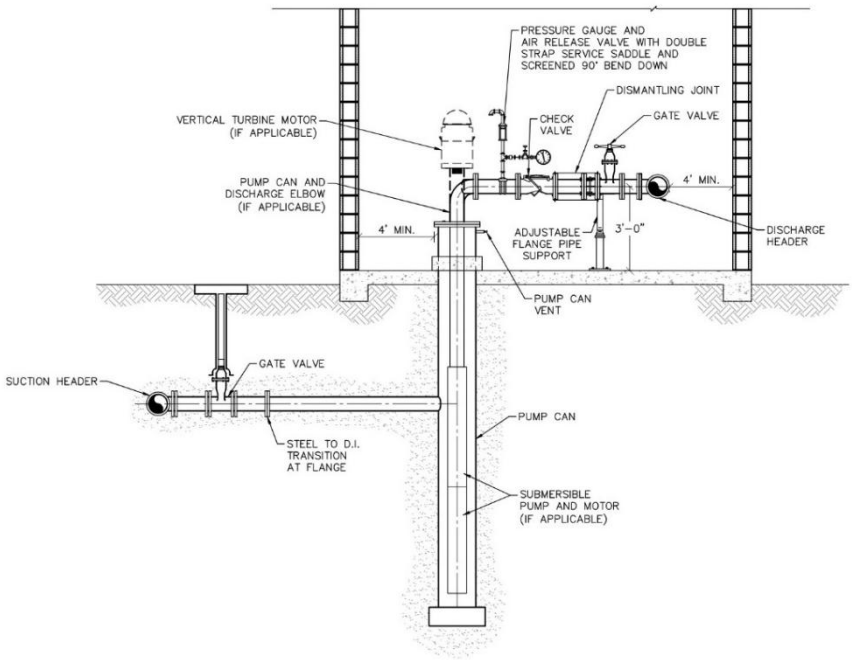
J. Configuration and Layout

i. See Figure below for general layout/spacing requirements for a vertical turbine pump with submersible motor or above-ground motor configuration.



TYPICAL (VERTICAL TURBINE) PUMP STATION LAYOUT PLAN

SCALE: N.T.S.



TYPICAL (VERTICAL TURBINE) PUMP STATION LAYOUT SECTION

SCALE: N.T.S.

K. Tank Control Valves

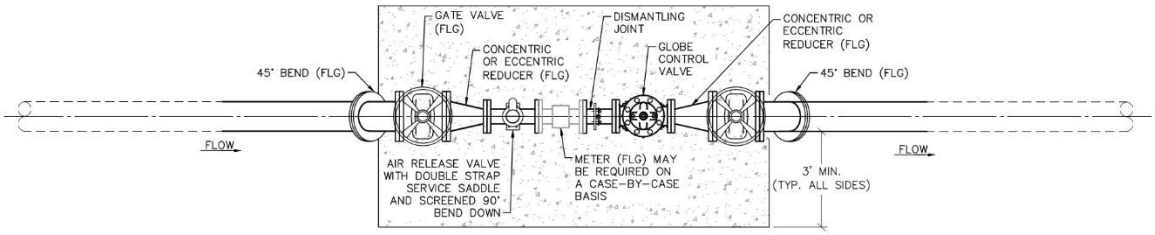
i. Globe style control valves shall be in accordance with TWC standard specification.

ii. Tank Control Valve Functions and Features:
   1. Open and close based on tank level
   2. Valve to close upon power failure
   3. Remote open/close function (solenoid)
   4. Pressure sustaining feature will be required on all tank control valves that fill from a system serving customers.

iii. Control valves shall be above-grade, unless site specific conditions do not allow. See the figures below for a general above-grade tank control valve piping layout.

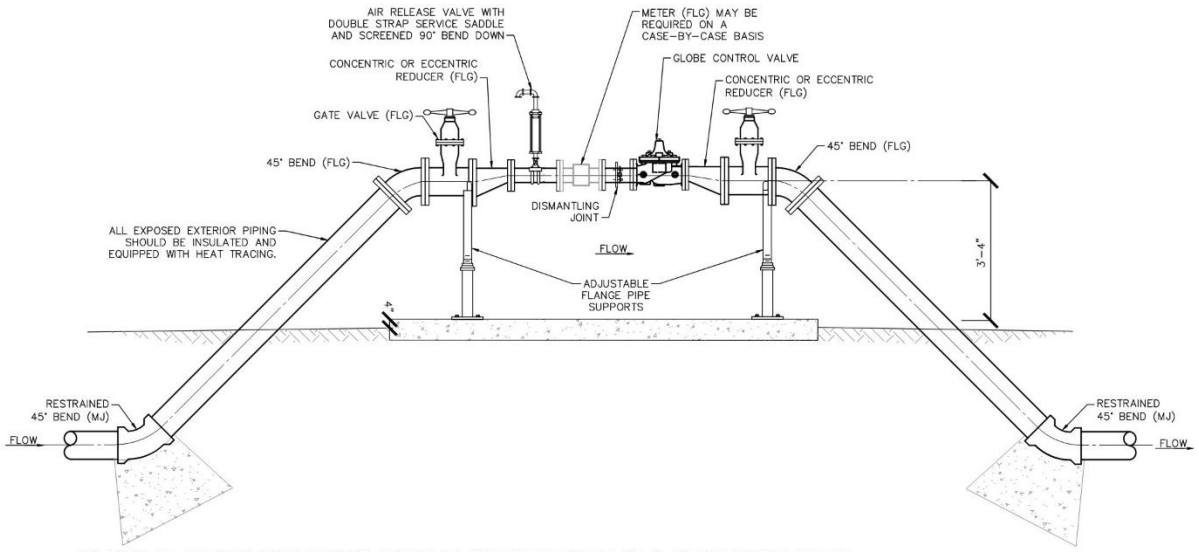
L. Freeze Protection

i. Provide aluminum jacketed insulation and heat tracing for all above-ground piping at control valve. For control valve, provide bag with open bottom for freeze protection.



TYPICAL TANK CONTROL VALVE (ABOVE GRADE) PLAN VIEW

SCALE: N.T.S.



TYPICAL TANK CONTROL VALVE (ABOVE GRADE) SECTION VIEW

SCALE: N.T.S.

Part 8 – Special Pump Station Requirements

Before the design of any pump station begins, the TWC staff shall determine which Special Pump Station Requirements, if any, are required in the project design. Special Pump Station Requirements will be evaluated on a case-by-case basis and may not be required for all pump stations. Special Pump Stations Requirements are typically for pump station designs with high lift or high flow pumps, special environmental concerns, or other special design requirements as determined by TWC.

A. Pump Control Valves, Surge Tanks, and Surge Relief Valves
    i. Coordinate with TWC to determine if pump control valves, surge tanks, and/or surge relief valves are required due to special cases such as high-pressure discharge.

B. Overhead Crane and Hoist
    i. Overhead bridge crane and hoists will be analyzed on a case-by-case basis for larger capacity pump stations and/or pump stations with a larger building.
    ii. Crane and hoist shall be entirely manual.
    iii. Crane and hoist shall be appropriately sized to carry the weight of the heaviest piece of equipment in the pump station.
    iv. Cranes shall be capable of lifting each item of equipment (including valves and electrical equipment) above and over all other equipment (with 1’ minimum clearance) without removing any other equipment

Part 9 – Water Well Design

This section is intended to describe design requirements for water wells with 50 – 300 gpm pumping capacity. Coordinate with TWC directly for design criteria for water wells with a pumping capacity exceeding 300 gpm.

A. Site Design Considerations
    i. Well Maintenance Laydown Area
        1. Allow a 40’ X 20’ clear space 180-degrees from the well head to lay the well column piping for maintenance

B. Column Piping
    ii. Column piping shall be appropriately sized for the design conditions.
    iii. Column piping shall be threaded and coupled galvanized steel pipe. Engineer is responsible for confirming pressure ratings. Other types of column piping will be accepted on a case-by-case basis dependent upon well capacity, TDH, and/or well depth.

C. Casing Pipe
    i. Casing Pipe Requirements
        1. Casing piping shall be appropriately sized steel casing with cement filing per TCEQ requirements.
        2. All TCEQ permitting procedures shall be adhered to for any water well modifications and/or installations.

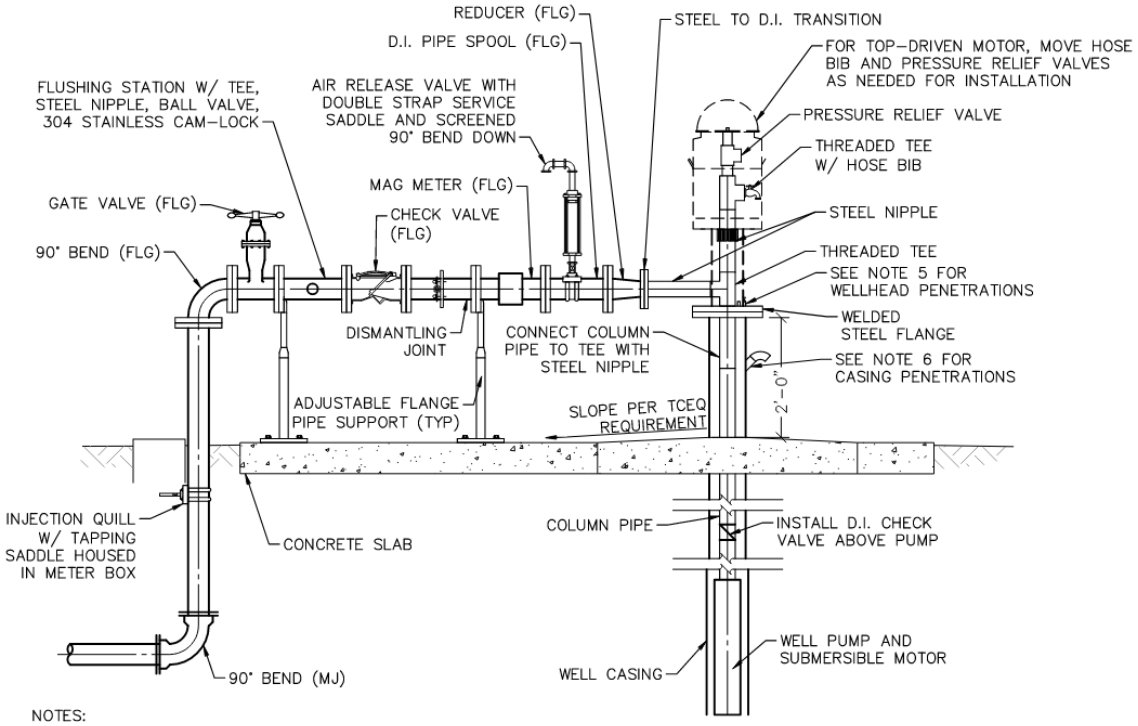
ii. Well Head Casing Penetrations
    1. Casing shall be equipped with one (1) 1-1/2" or appropriately-sized nipple cut at 45-degrees and welded to casing. Install 90-degree bend down with TCEQ-compliant screen onto welded nipple.

D. Well Pump
    i. Well Pump Requirements
        1. Well pumps shall be sized appropriately to meet the Design Engineer's specified duty point.
        2. Well pumps and motors shall be of submersible type. Vertical turbine pumps and motors may be accepted on a case-by-case basis.
        3. Well pumps and motors shall operate on VFDs.
        4. Well pumps and motors shall be 1800 RPM.
            (i) 3600 RPM may be accepted on a case-by-case basis.

E. Discharge Flow Meter
    i. Discharge Flow Meter Requirements – See Magnetic Meters Section of this document
        1. The flow meter readout shall be in the electrical room only.

F. Flushing and Sampling Point
    i. Flushing Point Requirements
        1. Well shall be installed with a minimum 2" flushing/sampling point.
        2. For larger wells, size of flushing/sampling point is to match well discharge piping size and Camlock is to be replaced with a gate valve and blind flange with a 2" tap.

G. Configuration and Layout
    i. See Figure below for general layout/spacing requirements. Each site configuration will vary dependent on site conditions or at TWC discretion.

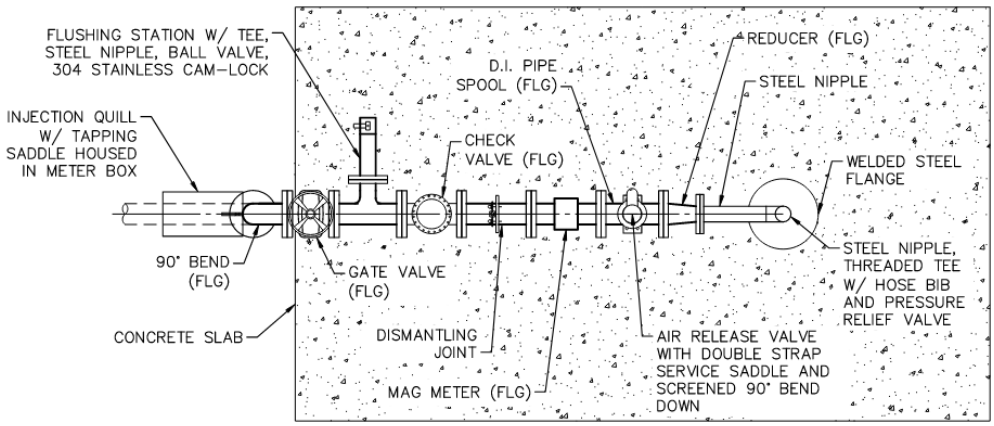


NOTES:

1. ALL STEEL PIPE JOINTS SHALL BE THREADED GALVANIZED SCH 40.
2. EXPOSED CASING PIPE SHOULD BE PAINTED SAFETY BLUE.
3. PROVIDE PIPE INSULATION AND HEAT TRACING FOR ALL EXPOSED PIPING.
4. WELLHEAD FLANGE TO BE EQUIPPED WITH THE FOLLOWING PENETRATIONS:
   4.1. PENETRATION FOR STAINLESS STEEL AIR LINE
   4.2. BLACK STEEL COUPLING WELDED TO WELLHEAD PLATE FOR PUMP AND MOTOR SUBMERSIBLE CABLE
5. CASING PENETRATIONS SHOULD INCLUDE THE FOLLOWING:
   5.1. BLACK STEEL COUPLING CUT AT A 45° ANGLE AND WELDED TO CASING FOR PUMP CAN VENT AND CHLORINATION AS NEEDED. INSTALL TCEQ-COMPLIANT STAINLESS STEEL MESH SCREEN AND HOSE CLAMP ONTO COUPLING.

TYPICAL WELL LAYOUT SECTION

SCALE: N.T.S.



TYPICAL WELL LAYOUT PLAN

SCALE: N.T.S.

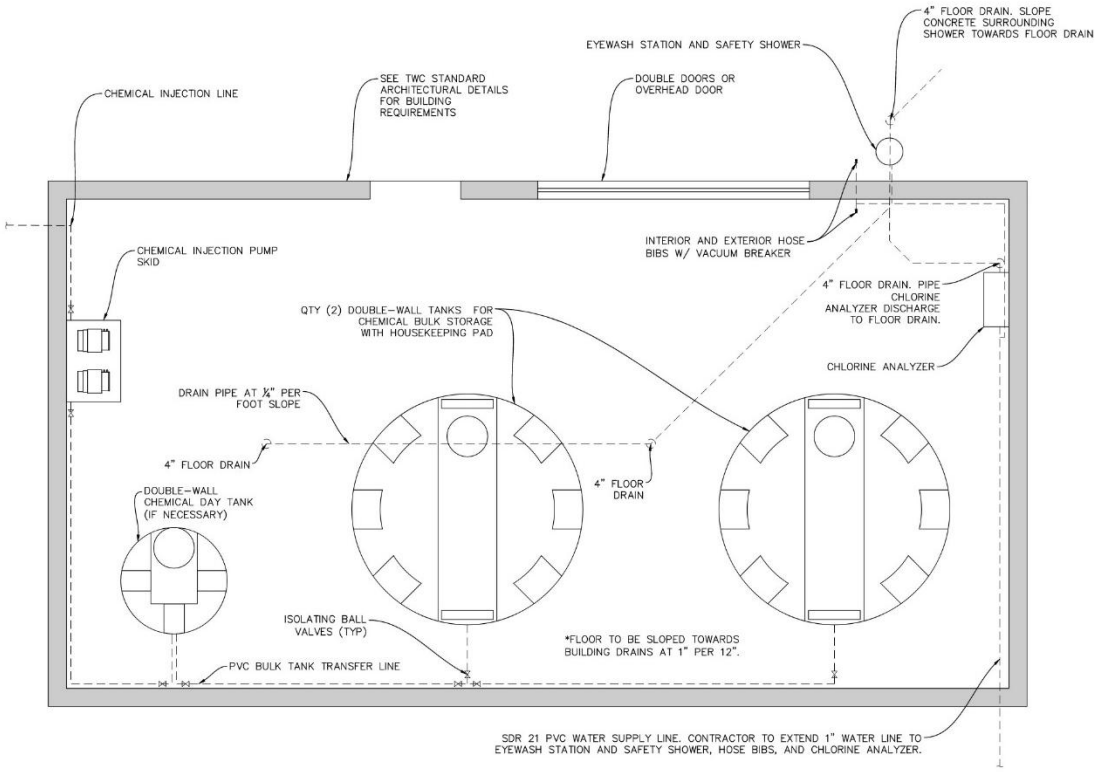
Part 10 – Water Disinfection Design

This section is intended to describe disinfection design requirements for water wells and well pumps, chlorine boosting, and chlorine monitoring.

A. Chlorine Analyzer Requirements
   i. A reagentless Chlorine Analyzer shall test water from the ground storage tank.
   ii. All equipment and materials in contact with water shall be NSF61-compliant.

B. Disinfection System
   i. Disinfection System
      1. Chlorine disinfection shall be appropriately sized sodium hypochlorite injection system. On-site generation system may be accepted on a case-by-case basis.
      2. Contractor to provide 12.5% sodium hypochlorite filled to full capacity of tanks prior to startup.
      3. Containment shall be provided for chemicals by means of double-wall tanks or spill watch container (i.e. spill pallet or floor depression and grating).
      4. Proper ventilation is required for all enclosed on-site generation chlorine rooms per manufacturer's requirements.
      5. Chlorine injection point shall be installed at the exterior tank inlet, located 1.5 feet below grade along the vertical piping run.
      6. Chlorine injection line to be appropriately-sized polyethylene tubing encased in larger polyethylene tubing. Provide tracer wire on chlorine injection line.
      7. System shall be controlled and monitored via SCADA.

C. Chemical Room Design
   i. Engineer to confirm capacity, permitting, and design of the disinfection system per TCEQ requirements.
   ii. Provide exhaust fan and light on the same exterior mounted switch on the Chemical Room building exterior.
   iii. Fan and lower vent shall be located to provide means of cross-ventilation.
   iv. When feasible within chemical room, use poly tubing encased in a larger PVC pipe to allow for easier maintenance.



TYPICAL CHEMICAL ROOM LAYOUT

SCALE: N.T.S.

Part 11 – Safety, Security Equipment, and Labeling

This section is intended to describe general site safety requirements for pump station sites.

A. Eyewash and Shower Station
   i. Provide an eyewash station on the building exterior, near the exterior doors of any chemical room or building. Provide hose bib near eyewash station.
   ii. Eyewash station shall be per OSHA 29 CFR 1910.151C.

B. Labeling and Placards
   i. Electrical equipment
      1. Reference other TWC Standards for labeling of electrical equipment.
   ii. Pipe
      1. Provide painted arrows or pipe labels every 6 feet indicating direction of flow for all above ground water pipe.
      2. Pipe shall be color-coded in accordance with AWWA:
         (i) Chemical lines shall be white in color.
         (ii) Water lines shall be blue in color.
         (iii) Drain lines shall be grey in color.

(iv) Sewer lines (if applicable) shall be green in color.

iii. Facility Sign
   1. Facility sign to be provided by Contractor.
   2. Locate sign near the entrance of the facility
   3. Minimum sign size: 24" X 24"
   4. Facility sign labeling:
      (a) Owner Name & Logo
      (b) Phone Number
      (c) Facility Name
      (d) Address
      (e) PWS
   5. Warning sign will be provided by Contractor. TWC to provide warning sign template. Additional coordination with Fire Marshal may be required on a cas-by-case basis.

C. Security Design
   i. Coordinate with TWC for security design requirements.

D. Accessories and Spare Parts
   i. Install a wall-mounted 30" wide NEMA 4/12 cabinet in pump room for operation and maintenance manuals. Install a self-standing 42" (minimum) wide shelf for storage of accessories, spare parts, etc.
      1. Adequate space shall be provided in front of the cabinet for access.
      2. Cabinet shall have locking doors.

Part 12 – Electrical Coordination Design

This section is intended to describe emergency power provisions, electrical design requirements, and instrumentation and control requirements for pump stations and water well pumps.

A. Primary Electric
   i. Provide utility coordination and extension of utility power to pump station site.
   ii. 120V, 240V, and 480V panels shall be placed in separate cabinets.
   iii. 480Y/277V, three-phase is standard for pump station facilities.

B. P&ID
   i. Provide a Piping & Instrumentation Diagram for each pump station and tank site.

C. Instrumentation and Control Requirements
   i. All sites shall have SCADA for monitoring and control.
   ii. All electrical equipment shall be installed in the Electrical Room.
   iii. See *TWC Electrical Standards* for the following:
      1. Grounding

(a) Grounding grids shall be provided for all buildings and tanks per TWC Electrical Standards.

2. PLC
3. HMI
4. Pump monitoring points
5. SCADA Requirements
6. Pressure Transducers
7. MCC
8. VFDs
   (a) All pumps shall be provided with appropriately sized VFDs. VFD manufacturer and model shall be per TWC Electrical Standards.

ii. Magnetic Flow Meters

1. For 2" and larger discharge header piping, provide a magnetic flow meter on the discharge header within the pump station.
2. Magnetic flow meter shall operate with 0.5% tolerance.
3. Magnetic flow meter shall be provided with RS485 port for Modbus.
4. Maintain upstream and downstream lay length requirements per manufacturer's specifications.
5. Provide a flow meter readout at the meter location.
6. All magnetic flow meters shall be properly grounded.

iii. Tank Control Valves

1. Provide ability to remotely open/close.
2. Provide SCADA valve status (open/close).

D. Lighting

i. Lighting Requirements

1. Site
   (a) See *TWC Electrical Standards* for fixture requirements.
   (b) Where sites are located in Dark Sky Communities, the Dark Sky Community requirements shall govern.
2. Facility
   (a) See TWC Electrical Standards for fixture requirements.

E. Emergency Power

i. Emergency Power requirements

1. An emergency diesel generator is required at pump station facilities. Generator shall have adequate amount of fuel storage per latest version of 30 TAC Chapter 290.
2. An automatic transfer switch is required at all pump station sites. See TWC Electrical Standards for additional design information.