DRAFT
City of Mesa
Engineering

# Star Valley Lift Station & Sulfide Control Station

**Design Concept Report**
**November 5, 2024**

**City of Mesa**
**Project No. CP0958LS01**

Registered Professional Engineer (Civil)
CERTIFICATE NO.
43850
KARL R.
TOBIN
11/05/2024
Date Signed
ARIZONA U.S.A.

mesa·az

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# 1. Introduction

The existing City of Mesa Star Valley Lift Station (LS) and Sulfide Control Station (SCS) is located at 3820 N. Shenandoah, northwest of the intersection of Thomas Road and Recker Road. The original lift station was constructed in 1985 and then rehabilitated in 2005. The lift station discharges through a 10” PVC force main to discharge manhole MH16358 at the intersection of Recker Road and Virginia Street. The new 133-acre Reserve at Redrock residential development is being constructed around the lift station and will be served by the lift station as well.

Existing LS components include:

- 20-ft deep, 8-ft diameter wet well
- Two 800 gpm submersible pumps
- 6,000-gallon ferrous chloride storage tank
- Chemical fill station
- Metering pump building with two 10 gph metering pumps
- Natural gas emergency generator

The purpose of this project is to rehabilitate the LS and SCS and to increase wet well and emergency storage capacity for the ultimate build-out flows resulting from the Reserve at Red Rock development. The City does not anticipate any other additional flows at ultimate build-out. Figures 1 and 2 below show the overall site location and LS service area respectively.

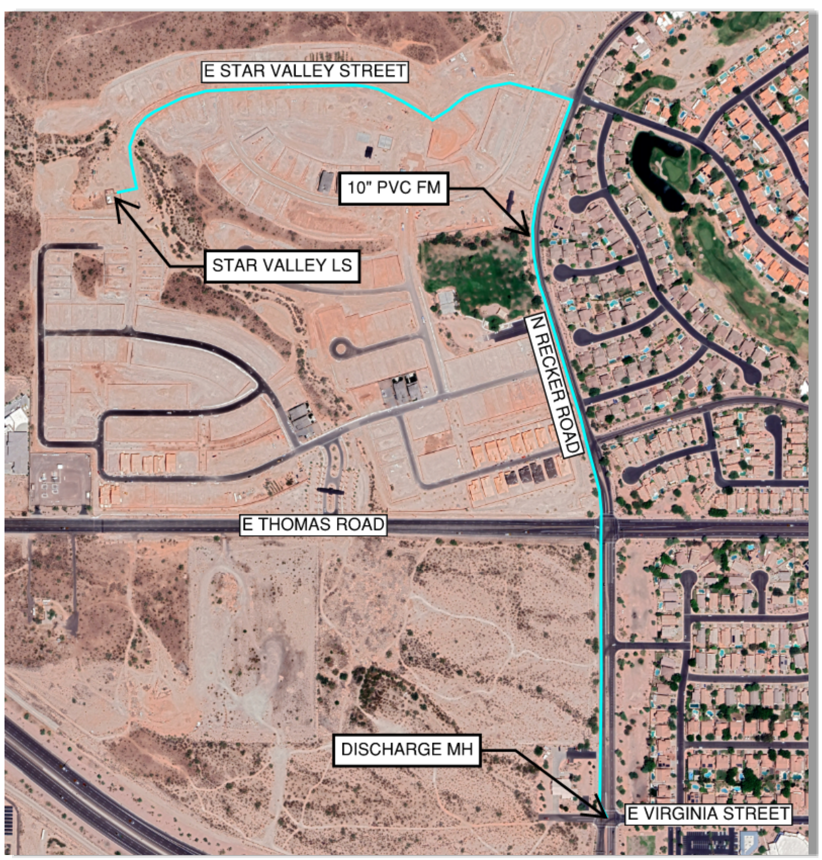



**Figure 1 – Overall Site Location**

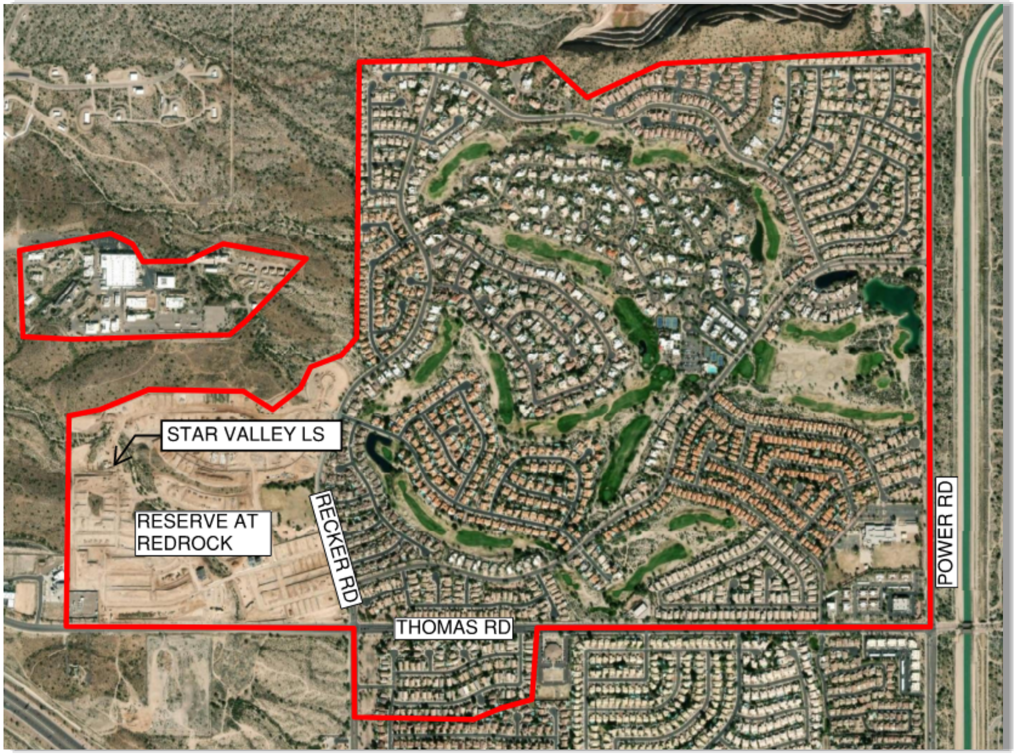



**Figure 2 – Star Valley LS Service Area**

# 2. Project Scope

Rehabilitation improvements will include the following:

**Lift Station**

- Install a new 12-ft diameter wet well with two (2) new submersible pumps, and one additional pump for the shelf.
- New above ground discharge piping with swing check valves, plug valves, pressure gauges, air relief valves, ultrasonic flow meter, and emergency pump bypass cam-lock fitting.
- Recoat and utilize the existing 8-ft diameter wet well for emergency storage overflow with a new drain line and valve back to new wet well.
- Evaluate maintenance of plant operation (MOPO) for temporary bypass pumping during construction.
- New Wet Well Wizard

**Odor Control**

- Add a biofilter.
- Install a new chemical fill station.
- Replace 6,000-gallon ferrous chloride tank, skid mounted metering pumps, and eyewashes.
- Replace steel doors on pump room with louvre panels.
- Repaint pump room walls, paint handrails, coat pump room floor, re-coat chemical containment area.
- Evaluate the feasibility of providing a dissolved oxygen odor control system in place of chemical injection.

**Site**

- Replace the existing ¾” water service with a 2” service.
- Replace site walls and gates and expand site footprint to parcel limits.
- Install chemical truck delivery and maintenance vehicle access within the site.
- Rehabilitate the influent manhole.

**Force Main**

- Perform surge analysis.
- Evaluate air valve locations along existing 10-inch force main.
- Rehabilitate discharge manhole.

**Electrical**

- Move service entrance sections outside of the site walls and re-work the wall so the transformer is located outside of the site.
- Replace the MCC.
- Reinstall recently upgraded Modicon M340 PLC in new MCC.
- Provide new electrical cabinets.
- Integrate pressure transmitter and flow meter readings into SCADA.
- Replace automatic transfer switch.
- Replace site lights with LED lights. Provide lighting near wet well that can be turned on when needed.
- Replace existing generator and gas service.
- Create air gap terminations for the pumps.
- Replace tank level transducer, wet well float switch, and wet well level transducer.
- Replace antenna with base mounted antenna.
- Delineate Division 1 and Division 2 classifications at the time of detailed design.

# 3. Design

The following sections provide the design methodology utilized to develop the conceptual design plans provided in Appendix A.

## 3.1 Design Flows

The existing Star Valley LS flows are 285 gpm (average) and 428 gpm (peak) based on the 2020 flow study performed by the City. Build-out flows incorporate an additional average day flow of 50 gpm for the Reserve at Redrock residential subdivision based on the Basis of Design Report included in Appendix B. The newly constructed American Leadership Academy charter school located at the intersection of Thomas Road and Recker Road is being served temporarily by the Star Valley LS for the next several years while the Thomas Road Sewer is being designed and constructed. Once the Thomas Road Sewer has been constructed and is operational, it will permanently serve the charter school. The Star Valley LS design flows include ultimate build out of the Reserve at Redrock subdivision and does not include the charter school since the school’s flows are temporary.

The City’s standard peaking factor for new development wastewater flow is 3.0. However, the City flow study indicates that the actual peaking factor for the Star Valley LS is much less than 3.0 at 1.5. The City has agreed to a peaking factor of 2.0 in designing for the build-out peak flow. The ultimate build-out design flow is 670 gpm and the proposed pumps have a capacity of 800 gpm each. Table 3.1 below summarizes the design flows:

**Table 3.1 Design Flows**

| Condition | Average Day (gpm) | Peaking Factor | Peak Hour (gpm) |
|---|---|---|---|
| Existing | 285 | 1.5 | 428 |
| Reserve at Redrock | 50 | - | - |
| Build-Out Design | 335 | 2.0 | 670 |

## 3.2 Submersible Pump Sizing

There are two existing pumps installed at the LS, Flygt model NP3171 HT 454 rated for 800 gpm at 90'. The existing pump data sheet and pump curve is included in Appendix C. The City operates the pumps in lead, lag operation and cycles the lead pump between each start. The existing capacity of a single pump exceeds the current peak hour flow and meets the City Lift Station Standard of meeting peak flow with a redundant pump on standby. The existing pump capacity is also adequate to meet the build-out peak hour flow of 670 gpm with a redundant pump on standby. The new pumps will cycle between lead and lag pump to ensure both pumps are regularly operated. GHD prepared a system curve and head loss calculation in the force main to validate the existing pump model as shown in Figures 3 & 4 below.

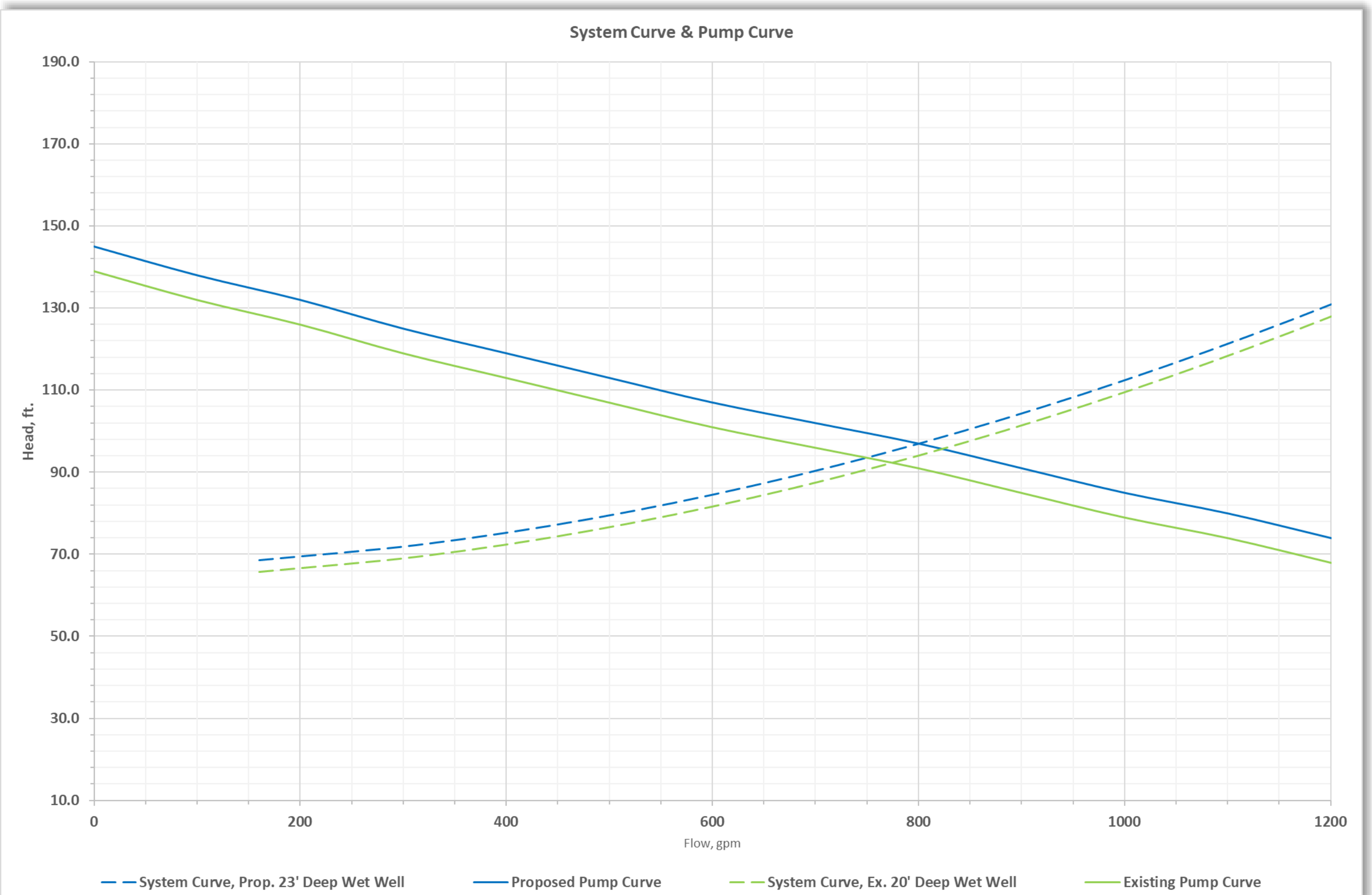



**Figure 3 – System Curve**

Design Flow, gpm = 800 | Pump Off Elevation, ft = 1,382.00
DIP C-Value = 130 | Elevation of Highest Point in FM, ft= 1,449.14
PVC C-Value = 150

**Headloss Calculations:**

| Pipe Dia, in | Length, ft | Flow, gal/min | System Component | No. of Comp. | Equivalent Comp. Length, | Equivalent Length, ft | Velocity, ft/s | $V^2/2g$ | C | $h_L$ per 100 ft | Actual $h_L$ | Cumm. Head |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | | 800 | 90° Bend | 1 | 10.1 | 10.1 | 20.43 | 6.48 | 130 | 34.51 | 3.49 | 3.5 |
| 4 | | 800 | 4"->8" Reducer | 1 | k = 0.325 | | 20.43 | 6.48 | - | - | 2.11 | 5.6 |
| 8 | 72 | 800 | 8" DIP | 1 | 72 | 72 | 5.11 | 0.40 | 130 | 1.18 | 0.85 | 6.4 |
| 8 | | 800 | 90° Bend | 1 | 20 | 20 | 5.11 | 0.40 | 130 | 1.18 | 0.24 | 6.7 |
| 8 | | 800 | Swing Check Valve | 1 | 33.3 | 33.3 | 5.11 | 0.40 | 130 | 1.18 | 0.39 | 7.1 |
| 8 | | 800 | Plug Valve (Thru) | 1 | k = 1.26 | | 5.11 | 0.40 | - | - | 0.51 | 7.6 |
| 8 | | 800 | Tee Branch | 1 | 39.9 | 39.9 | 5.11 | 0.40 | 130 | 1.18 | 0.47 | 8.1 |
| 8 | | 800 | Tee Thru | 2 | 13.3 | 26.6 | 5.11 | 0.40 | 130 | 1.18 | 0.31 | 8.4 |
| 8 | | 800 | Flow Meter | 1 | 13.3 | 13.3 | 5.11 | 0.40 | 130 | 1.18 | 0.16 | 8.5 |
| 8 | | 800 | Plug Valve (Thru) | 1 | k = 1.26 | | 5.11 | 0.40 | - | - | 0.51 | 9.0 |
| 8 | | 800 | 45° Bend | 3 | 10.06 | 30.18 | 5.11 | 0.40 | 130 | 1.18 | 0.36 | 9.4 |
| 8 | | 800 | Plug Valve (Thru) | 1 | k = 1.26 | | 5.11 | 0.40 | - | - | 0.51 | 9.9 |
| 8 | | 800 | 8" Wye | 1 | 39.9 | 39.9 | 5.11 | 0.40 | 130 | 1.18 | 0.47 | 10.4 |
| 8 | | 800 | 8"->10" Reducer | 1 | k = 0.05 | | 5.11 | 0.40 | - | - | 0.02 | 10.4 |
| 10 | 5807 | 800 | 10" PVC | 1 | 5807 | 5807 | 3.27 | 0.17 | 150 | 0.30 | 17.44 | 27.8 |
| 10 | | 800 | 90° Bend | 2 | 25.1 | 50.2 | 3.27 | 0.17 | 150 | 0.30 | 0.15 | 28.0 |
| 10 | | 800 | 45° Bend | 42 | 13.4 | 562.8 | 3.27 | 0.17 | 150 | 0.30 | 1.69 | 29.7 |
| 10 | | 800 | Pipe Exit | 1 | k = 1 | | 3.27 | 0.17 | - | - | 0.17 | 29.8 |
| | | | | | | | | | Total Headloss (Rounded), ft = | | | 29.8 |
| | | | | | | | | | Pump Off Elevation, ft = | | | 1382.00 |
| | | | | | | | | | Elevation of Highest Point in FM, ft= | | | 1449.14 |
| | | | | | | | | | Static Head, ft = | | | 67.1 |
| | | | | | | | | | TDH (Rounded), ft = | | | 97.0 |

Design Flow, gpm = 775 | Pump Off Elevation, ft = 1,385.00
DIP C-Value = 130 | Elevation of Highest Point in FM, ft= 1,449.14
PVC C-Value = 150

**Headloss Calculations: Ex. 20' Deep Wet Well**

| Pipe Dia, in | Length, ft | Flow, gal/min | System Component | No. of Comp. | Equivalent Comp. Length, ft | Equivalent Length, ft | Velocity, ft/s | $V^2/2g$ | C | $h_L$ per 100 ft | Actual $h_L$ | Cumm. Head |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | | 775 | 90º Bend | 1 | 10.1 | 10.1 | 19.79 | 6.08 | 130 | 32.54 | 3.29 | 3.3 |
| 4 | | 775 | 4"->8" Reducer | 1 | k = 0.325 | | 19.79 | 6.08 | - | - | 1.98 | 5.3 |
| 8 | 72 | 775 | 8" DIP | 1 | 72 | 72 | 4.95 | 0.38 | 130 | 1.12 | 0.80 | 6.1 |
| 8 | | 775 | 90º Bend | 1 | 20 | 20 | 4.95 | 0.38 | 130 | 1.12 | 0.22 | 6.3 |
| 8 | | 775 | Swing Check Valve | 1 | 33.3 | 33.3 | 4.95 | 0.38 | 130 | 1.12 | 0.37 | 6.7 |
| 8 | | 775 | Plug Valve (Thru) | 1 | k = 1.26 | | 4.95 | 0.38 | - | - | 0.48 | 7.1 |
| 8 | | 775 | Tee Branch | 1 | 39.9 | 39.9 | 4.95 | 0.38 | 130 | 1.12 | 0.45 | 7.6 |
| 8 | | 775 | Tee Thru | 2 | 13.3 | 26.6 | 4.95 | 0.38 | 130 | 1.12 | 0.30 | 7.9 |
| 8 | | 775 | Flow Meter | 1 | 13.3 | 13.3 | 4.95 | 0.38 | 130 | 1.12 | 0.15 | 8.0 |
| 8 | | 775 | Plug Valve (Thru) | 1 | k = 1.26 | | 4.95 | 0.38 | - | - | 0.48 | 8.5 |
| 8 | | 775 | 45º Bend | 3 | 10.06 | 30.18 | 4.95 | 0.38 | 130 | 1.12 | 0.34 | 8.8 |
| 8 | | 775 | Plug Valve (Thru) | 1 | k = 1.26 | | 4.95 | 0.38 | - | - | 0.48 | 9.3 |
| 8 | | 775 | 8" Wye | 1 | 39.9 | 39.9 | 4.95 | 0.38 | 130 | 1.12 | 0.45 | 9.8 |
| 8 | | 775 | 8"->10" Reducer | 1 | k = 0.05 | | 4.95 | 0.38 | - | - | 0.02 | 9.8 |
| 10 | 5807 | 775 | 10" PVC | 1 | 5807 | 5807 | 3.17 | 0.16 | 150 | 0.28 | 16.44 | 26.2 |
| 10 | | 775 | 90º Bend | 2 | 25.1 | 50.2 | 3.17 | 0.16 | 150 | 0.28 | 0.14 | 26.4 |
| 10 | | 775 | 45º Bend | 42 | 13.4 | 562.8 | 3.17 | 0.16 | 150 | 0.28 | 1.59 | 28.0 |
| 10 | | 775 | Pipe Exit | 1 | k = 1 | | 3.17 | 0.16 | - | - | 0.16 | 28.1 |
| | | | | | | | | | Total Headloss (Rounded), ft = | | | 28.1 |
| | | | | | | | | | Pump Off Elevation, ft = | | | 1385.00 |
| | | | | | | | | | Elevation of Highest Point in FM, ft= | | | 1449.14 |
| | | | | | | | | | Static Head, ft = | | | 64.1 |
| | | | | | | | | | TDH (Rounded), ft = | | | 92.3 |

**Figure 4 – Head Loss Calculations**

Based on the system curve results the existing pumps are operating close to their design point at approximately 775 gpm with the existing 20-ft deep wet well shown in green on Figure 3 above. The City would like to install a deeper 23-ft wet well with these improvements to provide additional emergency storage per Sections 3.4 and 3.5 below. A larger impeller can be provided on the same pump model to obtain a pumping rate of 800 gpm with the new deeper wet well as shown in blue on Figure 3 above. The proposed pumps will be rated for 800 gpm at 97-ft TDH each.

## 3.3 Pipe Sizing

The pump discharge piping, valves, and fittings will match the existing 8” epoxy lined ductile iron where it will tie into the existing below ground 10” PVC force main. At 800 gpm, the 8” discharge pipe velocity is 5.1 ft/s and the 10” force main velocity is 3.3 ft/s. Both pipe sizes meet the City Force Main Standard of 3 – 7 ft/s. The discharge piping is sized for a single 800 gpm pump since a single pump exceeds the future buildout flow of 670 gpm.

## 3.4 Wet Well Sizing

The existing 8-ft diameter wet well is not large enough to fit three pumps and does not meet the City Lift Station Standard for minimum volume relating to time between successive starts. A minimum 23-ft deep, 12-ft diameter wet well is required to allow for the installation of the pumps and meet the City Standard for minimum volume as shown below. Wet well level settings are provided on the wet well cross section provided in Appendix A:

- Minimum Volume: V = (t x q) / 4
  - V = Volume between 1$^{st}$ pump start level and pump stop level
  - t = minimum time between successive pump start (15 min)
  - q = single pump capacity at the design point
  - V = (15 min x 800 gpm) / 4 = 3,000 gal (401 ft$^3$)
- 12-ft diameter wet well cross sectional area = 113.1 ft$^2$
- Pumping depth: 401 ft$^3$ / 78.5 ft$^2$ = 3.5 ft
- Lead Pump On (2-ft below influent invert) = 15.5 ft
- Pumps off (1-ft above motor) = 4.0 ft
- Wet well depth: 3.5 + 15.5 + 4.0 = 23 ft

Retention time is 15 minutes which meets the City maximum allowable retention time of 30 minutes.

## 3.5 Emergency Storage

The City would like to increase the emergency surcharge storage volume in the upstream collection system in the event of a lift station failure or power/generator outage. The surcharge elevation is limited to the lowest lateral invert elevation to prevent sewage backup into individual service connections, which is 1393.37-ft. Based on observations from City staff, the existing system currently only has 15 minutes of emergency storage. The following emergency storage is incorporate into the design as calculated not to exceed the lowest lateral invert elevation:

- Existing upstream gravity collections system = 4,831.9 gal
- New 23-ft deep,12-ft diameter wet well = 13,003.3 gal
- Convert existing 8-ft diameter wet well to surcharge overflow manhole = 4,651.3 gal
- Total surcharge volume = 22,486.50 gal
- Emergency storage time = surcharge volume / build-out average day flow
  - 22,486.50 gal / 335 gpm = 67 min (1.1 hr)

The City also considered upsizing the existing influent line from 12” to either 36”, 48” or 60”. GHD noted that the pipe will only run between 3% and 6% full with the upsized pipe and provides a risk of solids settling out, which may require routine maintenance. The upsizing would provide between 4 and 12 minute of additional storage. The City determined that the potential maintenance risk is not worth the small amount of additional storage time and elected to keep the existing 12” influent line size. The City is also comfortable with the 67 minute emergency storage time and does not require the wet well to be deeper than 23-ft to increase storage time. The 67 minute emergency storage time is calculated using ultimate build-out average day flow. Emergency storage time will actually be much greater during the nighttime low flow hours.

## 3.6 Bio Filter Sizing

The new bio filter sizing is based on the detailed Bohn budgetary proposal included in Appendix D, as summarized below.

- 99% hydrogen sulfide removal
- Current average day flow = 285 gpm
- Build-out average day flow = 335 gpm
- Wet well dimensions = 34-ft deep, 10-ft diameter
- Includes 8-ft diameter old wet well/surcharge manhole
- Includes 12” influent piping and existing influent manhole
- Air changes per hour = 12
- Air flow = 1,300 CFM
- Media volume = 2,000 $ft^3$
- Sized for ultimate build-out, no changes required between current and build-out
- Average summer water demand = 7 gpm x 30 min x 16 times/month = 3,360 gal/month

There are three configurations available for the bio filter. All have similar footprints and performance. The pricing in Bohn quote provided in Appendix D does not include excavation, concrete basin, or handrail costs. The approximate cost for each option is provided below:

- In-ground perforated pipes (no concrete basin required) - $276,000
- In-ground raised floor (requires a buried concrete basin - $313,000
- Above ground raised floor (requires concrete basin, stairs, and handrail) - $320,000

The City has selected the In-ground raised floor option, which is included in the cost estimate provide in Appendix E.

## 3.7 Ferrous Chloride Injection Sizing

The new ferrous chloride injection system will match the sizes of the existing equipment as follows:

- Ferrous chloride storage tank = 6,000 gal
- Metering pumps = 2 each, 10 gph

The City has confirmed that this sizing will be adequate for ultimate build-out.

## 3.8 Surge Analysis

GHD prepared a surge analysis on the existing 10” force main utilizing HAMMER CONNECT software by Bentley. The model simulates a power failure at the Star Valley LS to evaluate the surge wave that travels through the force main after a power loss and sudden stop of the pump. Figure 4 below provides the high and low pressures resulting from the surge wave. Although a single pump has the capacity to meet ultimate buildout flow, the surge analysis was performed with both pumps running as a conservative measure. GHD also ran the model with vacuum valves spaced every 1,000-ft along the force main to determine if additional vacuum valves would eliminate the negative pressure. The pipeline still experiences negative pressures, even with vacuum valves every 1,000-ft. Therefore, the model only includes the air/vacuum valves located at the lift station discharge piping and the two air/vacuum valves located along the force main as discussed in Section 3.9 below.

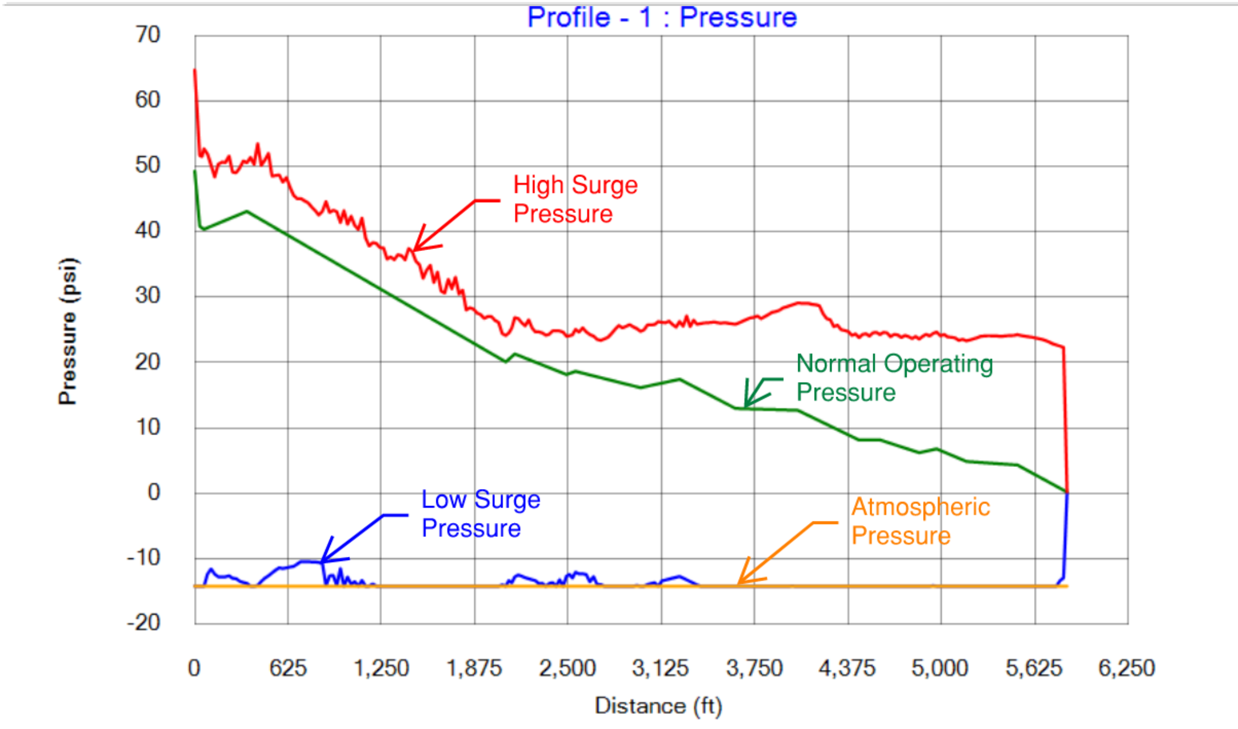



**Figure 5 – Surge Pressures**

Additional surge mitigation measures are not recommended since the PVC and ductile iron pipe are rated significantly beyond than the maximum surge pressure and lowest surge wave pressure/buckling force.

The highest surge pressure is 65 psi. Based on project as-builts, the PVC force main is rated for 165 psi operating pressure which provides a safety factor of 2.5 for the high surge pressure. Ductile iron fittings are rated for 250 psi operating pressure, which provides a safety factor of 3.8 for the high pressure.

The lowest surge wave pressure is negative 13 psi, which is equal to one atmospheric pressure at the site elevation. Vacuum pressure can never go below one atmosphere pressure, which is shown as the orang line on Figure 4. Negative pressures are also described as buckling pressures. Therefore, a pressure of negative 13 psi equates to a buckling pressure of 13 psi. Buckling pressure capacities were calculated using JM Eagles Technical Bulletin for PVC pipe and using Ductile Iron Pipe Research Association (DIPRA) Technical Bulletin for Ductile Iron Pipe with equations provided in Figures 5 and 6 below. A water temperature of 120 degrees Fahrenheit was used in the calculations as a conservative measure.

Buried 10” class 165 C900 PVC pipe can withstand a buckling pressure of 375 psi which provides a safety factor of 28.8 for the low surge pressure. The 8” above ground ductile iron pipe can withstand a buckling pressure of 601 psi, which provides a safety factor of 46.2 for the low surge pressure. The Ductile Iron Pipe Research Association (DIPRA) only publishes calculations for above ground pipe, but notes that buried piping can withstand even higher buckling pressures since the pipe is supported by the surrounding soil.

Above ground 10” ductile iron pipe can withstand a buckling pressure of 321 psi, which provides a safety factor of 24.7 for the low surge pressure. The buried 10” ductile iron fittings can withstand even greater great forces according to DIPRA and will have a safety factor greater than 24.7 for the low surge pressure.

C900 PVC gaskets are vacuum tested to one atmosphere per ASTM D3139. In addition, this test is performed on above ground pipe with no restraints. The PVC force main is buried and restrained, which increases the gaskets resistance to buckling forces above the ASTM test.

$$Pcr = \frac{2E}{0.856\,(DR-1)^3}$$

Where:

**Pcr** = Critical Pressure (lbs/in$^2$)

**Dr** = Dimension Ratio of PVC Pipe
= Average OD/Minimum Wall

**E** = Modulus of Elasticity for PVC Pipe material (lbs/in$^2$)

At 73°F, **E** has the following values:

PVC Cell Class 12454: 400,000 (lbs/in$^2$)
PVC Cell Class 12364: 440,000 (lbs/in$^2$)

| | | | |
|---|---|---|---|
| E @ 73 F = | 400000 | psi | |
| E @ 120 F = | 316000 | psi | |
| DR = | 25 | *Class 165 C900 | |
| Pcr = | 53.4084 | psi | |
| E' = | 2000 | | |
| C = | 1 | | |
| Pb = | 375.8527 | psi | |
| **Corrected Pb =** | **375.8527** | **psi** | *10" PVC |

## Case 2: Buried Pipe With Soil Support

Proper soil support will improve a PVC pipe's resistance to buckling. Use the following equation for buried PVC pipes:

## Equation 3:

$$Pb = 1.15\sqrt{Pcr \times E'}$$

Where:

**Pb** = Buckling Pressure of buried PVC pipe (lbs/in2)

**Pcr** = Critical Pressure for PVC pipe (found from Equation 1 or Equation 2)

**E'** = Modulus of Soil Reaction (Table 2 below)

**Table 2**

AVERAGE VALUES OF MODULUS OF SOIL REACTION, E'

| Soil type-pipe bedding material (Unified Classification System[a]) (1) | E' for Degree of Compaction of Bedding, in pounds per square inch | | | |
|---|---|---|---|---|
| | Dumped (2) | Slight < 85% Proctor, < 40% relative density (4) | Moderate 85%-95% Proctor, 40%-70% relative density (4) | High > 95% Proctor, > 70% relative density (5) |
| Fine-grained Soils (LL>50)[b] Soils with medium to high plasticity CH, MH, CH-MH | No data available; consult a competent soils engineer; Otherwise use E'=0 | | | |
| Fine-grained Soils (LL<50) Soils with medium to no plasticity CL, ML, ML-CL, with less than 25% coarsegrained particles | 50 | 200 | 400 | 1,000 |
| Fine-grained Soils (LL<50) Soils with medium to no plasticity CL, ML, ML-CL, with less than 25% coursegrained particles. Coarse-grained soils with Fines GM, GC, SM SC[c] contains more than 12% fines | 100 | 400 | 1,000 | 2,000 |
| Coarse-grained Soils with Little or No Fines GW, GP, SW, SPc contains less than 12% fines | 200 | 1,000 | 2,000 | 3,000 |
| Crushed Rock | 1,000 | 3,000 | 3,000 | 3,000 |

[a] ASTM Designation D 2487, USBR Designation E-3
[b] LL = Liquid limit
[c] Or any borderline soil beginning with one of these symbols (i.e. GM-GC,GC-SC)

**Figure 6 – PVC Buckling Force Capacity**

$$P_{CR} = \frac{2E}{(1-\gamma^2)} \left(\frac{t_1}{D_M}\right)^3 \quad (Eq.1)$$

where:

| | | |
|---|---|---|
| $P_{CR}$ | = | Critical buckling pressure (psi) |
| E | = | Modulus of elasticity of the pipe material ($24 \times 10^6$ psi for ductile iron) |
| $\gamma$ | = | Poisson's ratio for the pipe material (0.28 for ductile iron) |
| $D_M$ | = | Mean diameter of the pipe |
| $t_1$ | = | Minimum manufacturing thickness of the pipe (inch) |

DIPRA Critical Buckling Pressure.pdf (ctfassets.net)

| | | | |
|---|---|---|---|
| E = | 24000000 | psi | |
| y = | 0.28 | | |
| Casting Tolerance = | 0.05 | in | 'DIPRA, 8" Table 2 |
| Pipe Thickness = | 0.25 | in | *DIPRA, 8" Table 1 |
| t1 = | 0.2 | in | |
| Pipe OD = | 9.05 | in | *DIPRA, 8" Table 1 |
| Dm = | 8.85 | in | |
| **Pcr =** | **601.12** | **psi** | *8" DIP |
| | | | |
| E = | 24000000 | psi | |
| y = | 0.28 | | |
| Casting Tolerance = | 0.06 | in | 'DIPRA, 8" Table 2 |
| Pipe Thickness = | 0.26 | in | *DIPRA, 8" Table 1 |
| t1 = | 0.2 | in | |
| Pipe OD = | 11.1 | in | *DIPRA, 8" Table 1 |
| Dm = | 10.9 | in | |
| **Pcr =** | **321.74** | **psi** | *10" DIP |

**Figure 7 – DIP Buckling Force Capacity**

## 3.9 Air Release Valve Locations

Historically, there have been no ARVs installed along the Star Valley LS force main. The City installed several cleanouts along the force main in 2022, which included an ARV at the main high point at the intersection of Star Valley Road and Recker Road, shown in blue on Figure 7 below. At the time of installation, GHD recommended an additional ARV be installed at second significant high point in the line as shown near MH 5 on Figure 7. The second ARV was recommended to release air at a high point created by an existing vertical realignment in the force main. The ARV drain lines can be plumbed to the nearby gravity sewer manholes to control odor an provide unrestricted air flow in a vacuum event.

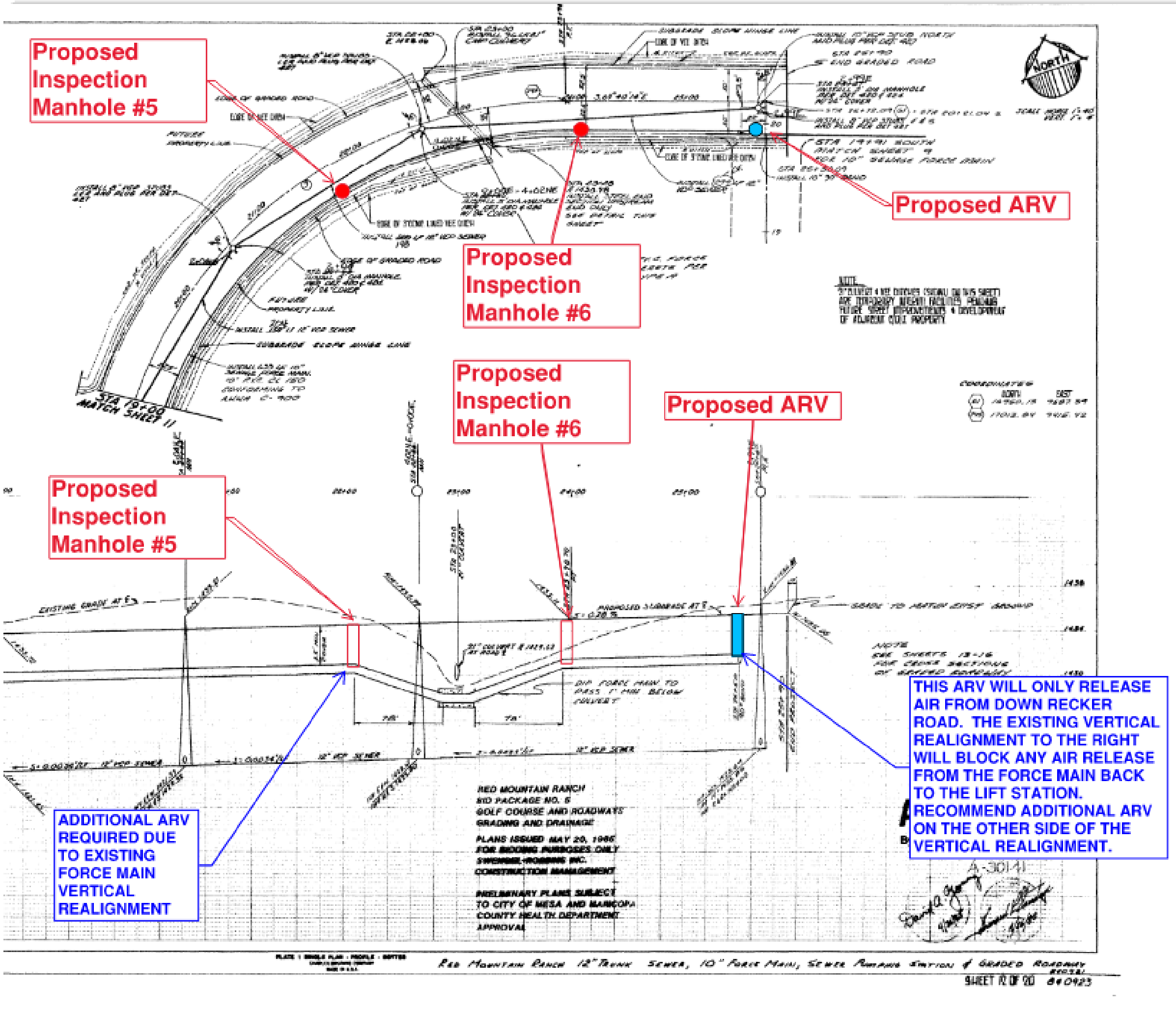



**Figure 8 –Proposed ARV Location**

# 4. Maintenance of Plant Operation (MOPO)

The following draft MOPO was prepared with the intent to maintain LS operations during construction while minimizing temporary bypass pumping duration. Temporary pump controls will be installed as described in Section 5.6 to allow for the new electrical gear to be installed in the same location as the existing gear without bypass pumping. This will allow for most of the improvements to be installed without the need for bypass pumping. The proposed bypass pumping route for the remainder of the improvements follows the same route and connection point used for the 2022 force main cleanout installation project as shown on Figure 9 below. This is the most economical route for the City and takes advantage of the open space track, uses the same FM connection point that was already installed in 2022, reduces pipe length, keeps the line out the roadways, and doesn't block any driveways or intersections. HOA approval will be required to utilize the open track, but this route provides the least impact to residents and allows improvements to the lift station that serves the development.

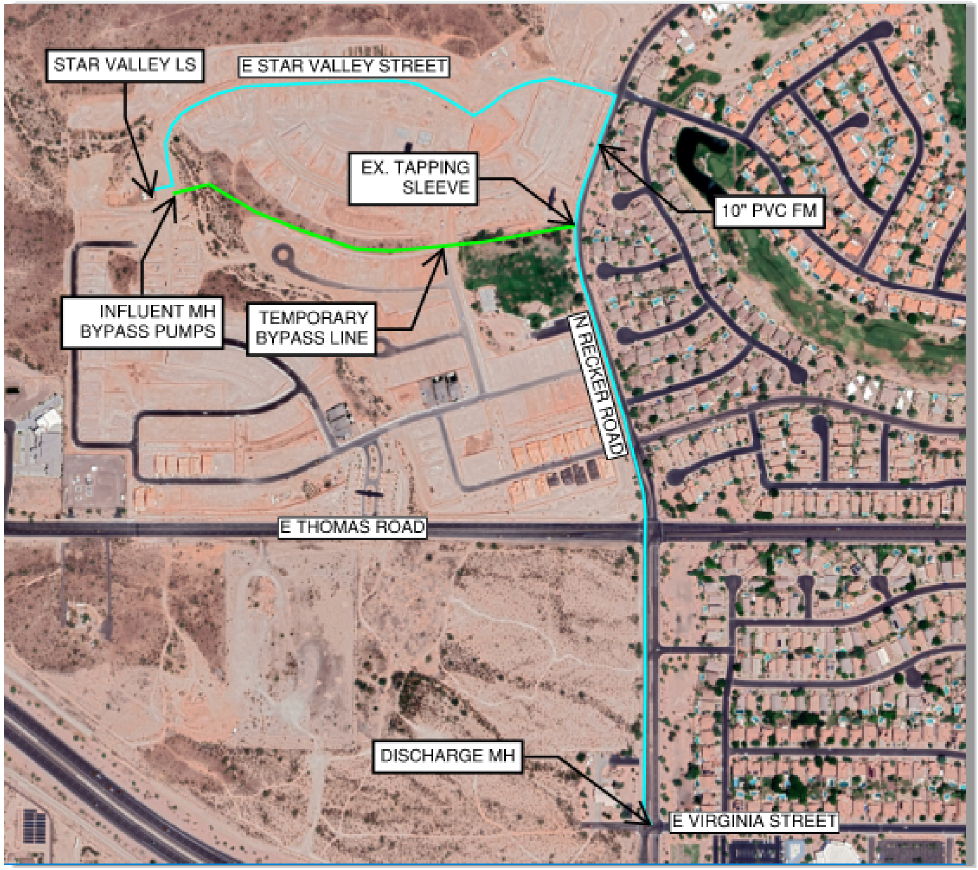



**Figure 9 – Bypass Route**

This site is existing and needs to operate during construction. Temporary power will need to feed the existing wet well pumps during Steps 1 and 2 below. The existing MCC can be relocated temporarily and reused to control and power the lift pumps. Temporary power cords can be used to connect the existing pumps to the relocated MCC. All existing electrical equipment will need to be removed. All new electrical equipment will need to be installed and connected to the new wet well pumps before removal of the existing wet well pumps and the temporary power. The existing generator will be utilized for backup power for Steps 1 and 2 below, except for when the new generator is installed. The contractor shall provide a temporary portable backup generator during the new generator installation. The bypass pumping contractor will provide backup power during Step 3 through the use of standby diesel powered pumps.

**MOPO Steps:**

1. Operate existing LS and install:
   - Biofilter
   - $FeCl_2$ tank, metering pumps, doors, eyewashes, & fill station
   - New water service
   - Temporary pump controls
2. Switch to operating existing LS with temporary controls and install:
   - Pump controls & ATS
   - Generator (provide portable temporary backup generator during new generator installation)

- SES
- Install temporary bypass pumps and line
- Excavate for new wet well down to existing influent line

3. Shut down LS, operate temporary bypass, and install:

   - Wet well
   - 60” gravity sewer
   - Submersible pumps
   - Discharge piping and force main connection
   - Start up new LS
   - Obtain provisional Maricopa County Environmental Services Department (MCESD) Approval of Construction (AOC)

4. Operate new LS, remove bypass equipment, and install:

   - Site walls and gate
   - Access driveways
   - Obtain final MCESD AOC

# 5. Site Improvements

## 5.1 Site Walls

The City would like to expand the site walls to encompass the entire City parcel. A 25-ft offset from the street back of curb will be provide to allow for maintenance trucks to pull off the road prior to entering the site. The site walls will be 8-ft CMU with security posts and domes grouted caps to prevent moisture intake. The walls will also be painted with graffiti resistant paint.

## 5.2 Site Access

Two 30-ft wide commercial driveways with 25-ft rolling gates will be installed on each side of the site to allow for chemical delivery trucks to pull through the site. The drive will be asphalt pavement with a concrete containment pad and drain for chemical truck fill parking.

GHD contacted the City’s chemical suppliers, Pencco and Kemira, to determine the standard chemical deliver truck dimensions for the new site access. Both suppliers confirmed that their tanker trailer is always 42’ long and is paired with a standard cab tractor 90% of the time, for a total truck length of 55’. Both suppliers mentioned that a rare double cab tractor would result in a total truck length of up to 65’. The City requested that the new chemical truck access match the Las Sendas SCS site, which does not have any issues with chemical deliveries.

GHD utilized AutoTURN software to confirm the standard 55’ truck can navigate the example Las Sendas SCS site. AutoTURN software is an attachment to AutoCAD, where different vehicle parameters can be entered and the vehicles driving patch can be traced over a site layout. GHD also checked the rare, longer 65’ truck length using AutoTURN at the Las Sendas SCS site and noted that the 65’ truck would not stay on the access path at Las Sendas. The AutoTURN software is conservative when it comes to tractor trailers since it cannot model all the maneuvers a truck driver can perform.

The City confirmed they are comfortable moving forward with matching the Las Sendas SCS, 50-ft radius, 25-ft wide access path and using the standard 55' truck in AutoTURN, since the City has not had any issues with chemical delivery access at the Las Sendas SCS. Appendix A contain a site layout with the AutoTURN truck path overlay for the 55' truck.

## 5.3 Grading and Drainage

In general, the site grading will follow the existing topography, which slopes down at approximately 2.0% from the southeast to northwest. Improvements will avoid the adjacent wash. A retention basin will be provided at the northwest corner of the site for onsite retention. It is anticipated that stormwater disposal will be through direct percolation and that a drywell will not be required. The use of direct percolation will be confirmed during design when the geotechnical evaluation is performed. Approximate retention basin volume is provide in Table 5.1 below per the 2022 City of Mesa Engineering and Design Standards.

**Table 5.1 Design Flows**

| Total Area (ac) | Impervious Area (ac) | Impervious Coefficient | Pervious Area (ac) | Pervious Coefficient | Weighted Coefficient | P (in) | Volume Req. (ac-ft) | Volume Req. (cf) |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 0.4 | 0.95 | 0.6 | 0.5 | 0.68 | 2.2 | 0.12 | 5,430 |

# 6. Electrical

The Star Valley Lift Station LS9 and Sulfide Control Station SS8 is located at 3820 E. Shenandoah in Mesa Arizona. This site is currently fed from a 200 amp, 480/277VAC three phase pad mounted service from Salt River Project. This site requires all electrical equipment to be replaced.

## 6.1 Power

The service meter, ATS, generator and motor control center are past its useful life and needs to be replaced. The service meter will be located on the outside wall of the site or within a separate fenced off area that only SRP can access. SRP will not have access to the main site. The new ATS, generator, motor control center, and all other electrical gear will be located inside the main site.

**Figure 10 SES, ATS and Motor Control Center**

The site is fed from a pad mounted utility transformer providing 200 amps of 480VAC three phase power. The pad mounted utility transformer is located within the main site, making servicing this transformer difficult. This transformer will remain in place and a new exterior wall will be built behind the transformer so the transformer will be outside of the exterior. The new load on the service is based on both lift station pumps operating at the same time and can also be powered from a 200 amp service.

**Figure 11 Utility Transformer**

A new backup generator will be installed on site. The generator will be sized to run the entire site on backup power. Natural gas service is existing on site and the generator will be fueled by natural gas. Scot Sherwood with the City has confirmed that the existing ½" gas service line is adequate for the new generator.

## 6.2 Lift Station LS9

The current lift station is equipped with two 30HP pumps. The pumps are fed from a motor control center (MCC). A solid-state soft starter with a bypass contactor controls the pumps. The pump power conductors and wet well instrument conductors are routed through a junction box with conduit seal offs which then route into the wet well. This can be seen below in figure 11.

**Figure 12 Existing Wet Well**

The motor control center (MCC) will need to be replaced. The wet well will be moved and the two existing pumps will be replaced with two new pumps. The new pumps will be driven by new starters located in the new MCC. These motors will alternate between Lead and Lag. This will be done through interlocks in the motor starters which, will communicate with the PLC.
The new conduits will be fed through a junction box placed outside of the hazardous wet well boundary. The conductors entering the wet well at the junction box will be installed with air gaps at this location and not with conduit seal offs.

**Figure 13 Existing MCC**

The new MCC will provide power distribution to the entire site. There will be one low voltage distribution and transformer located within the MCC for site lighting and the sulfide control station. With the relocation of equipment, new conduit and conductors will need to be installed.

## 6.3 Sulfide Control Station SS8

There are 2 chemical feed pumps which will be replaced by a new skid mounted system. The system will be powered out of the low voltage power panel LPA located within the MCC. It is anticipated the size of the pumps and motors will be similar to the existing size. Each pump will be driven by variable speed drives (VFDs). The VFDs will be controlled through a pump control panel. The new pump control panel will communicate with the main PLC panel for SCADA monitoring. The pump control panel will come equipped with a HMI for local operator control.  The existing HMI is obsolete and will be replaced with the Graphite Series G15C.

**Figure 14 Chemical Room**

The existing tank will be replaced. The new tank will require a level sensor. The new level transmitter will be a Pulsar. The level sensor that connects to the Pulsar will be mounted to the top of the tank and will be a radar sensor.

## 6.4 Bio Filter

A new Biofilter is to be installed and is equipped with a 5HP fan. This will be powered from a size 1 starter in the new MCC and controlled from the PLC.

## 6.5 RTU Panel

The existing PLC is located in the MCC lineup. The PLC has recently been upgraded to a Modicon M340. The MCC will be removed and replaced. The existing PLC will be installed in the new separate RTU control panel enclosure separate from the MCC. This site is located in a new housing development and the current PLC communicated by radio. A new radio path study may need to be conducted to determine the new height of the communications pole. There is no fiber on site, and it anticipated no future fiber will be installed near or at the site.

Below is a list of anticipated signals to be sent to SCADA for monitoring:

- Wet Well Level
- Wet Well High Level
- Lift Pump Remote Mode (2)
- Lift Pump Running (2)
- Lift Pump Fault (2)
- Lift Station Pump Discharge Pressure
- Lift Station Pump Discharge Flow
- Intrusion Alarms (MCC, RTU & Site)
- Generator Running
- Generator Alarm
- Utility Power On
- Standby Power On
- Chemical Tank Level
- Chemical Feed Pump Speed (2)
- Chemical Feed Pump Speed Command (2)
- Chemical Feed Pump Run Command (2)
- Chemical Feed Pump Fault Alarm (2)
- SCS Intrusion Alarm

These signals will be typical for two lift station pumps, two chemical feed pumps, a chemical storage tank and flow, discharge pressure and Discharge flow. The existing discharge flow meter is a magnetic flow meter. This will be replaced with an ultrasonic flow meter. The containment area will have a sump and a receptacle for a plug-in sump pump. The sump will be operated manually based on visual inspections of City personnel. The containment area will not be equipped with a level sensor for flood indication, as these are proving to be a nuisance. A rate of drop alarm can be programmed into the PLC to indicate a significant leak in the chemical tank for safety.

## 6.6 MOPO During Construction

This site is existing and needs to operate during construction. Temporary power will need to feed the existing wet well pumps. The existing MCC can be relocated temporarily and reused to control and power the lift pumps. Temporary power cords can be used to connect the existing pumps to the relocated MCC. All existing electrical equipment will need to be removed. All new electrical equipment will need to be installed and connected to the new wet well pumps before removal of the existing wet well pumps and the temporary power.

# 7. Opinion of Probable Cost

The preliminary Opinion of Probable Cost is included in Appendix E and is summarized in Table 7.1 below. A 10% project contingency has been included along with a 15% market escalation factor to reflect recent market volatility and potential material and labor price increase at the time of construction.

**Table 7.1 Preliminary Opinion of Cost Summary**

| Description | Cost |
|---|---|
| Materials & Labor | $2,525,707 |
| 10% Project Contingency | $252,571 |
| 15% Market Escalation Factor | $378,856 |
| 15% Overhead & Profit | $473,570 |
| 3% Bond & Insurance | $94,714 |
| **TOTAL** | **$3,725,417** |

# 8. Dissolved Oxygen Odor Control Feasibility

## 8.1 Background

The City requested GHD to evaluate the feasibility of converting multiple LS and SCS facilities from their current ferrous chloride ($FeCl_2$) injection to the Eco Oxygen Technologies, $ECO_2$ dissolved oxygen system. The sites initially considered for the $ECO_2$ dissolved oxygen system included:

- Star Valley LS & SCS
- Noche De Paz LS & SCS
- Alma School LS & SCS
- Horne SCS
- Hermosa Vista LS & SCS

Upon initial investigation, it was determined that Star Valley LS & SCS is the only potentially feasible site for the dissolved oxygen odor control system evaluation. This is because Star Valley is the only site with a significant length of force main. The $ECO_2$ system relies on a side stream of wastewater from a pressurize force main to dissolve the oxygen and requires a long enough force main to provide a contact time of approximately 30 minutes within the force main to be effective. The $ECO_2$ product information states the system can be installed on a gravity sewer line. However, the manufacturer indicated that there are challenges with performance and reaching the required oxygen saturation level when operating on a gravity line and does not recommend installing their system on a gravity line for this application. The standalone SCS sites are not feasible because they are not located near a force main and the other LS sites do not have long enough force mains to provide the required contact time. Therefore, the Star Valley LS and SCS was chosen for the evaluation.

GHD coordinated with Oxygen Technologies to size the required $ECO_2$ system, prepared a preliminary layout for the required improvements, and developed a life cycle cost comparison with $FeCl_2$ injection to determine the feasibility of installing the $ECO_2$ system at Star Valley.

## 8.2 $ECO_2$ Odor & Corrosion Control

Sulfides are produced by sulfate reducing bacteria only under anaerobic conditions in wastewater. The $ECO_2$ oxygen injection system satisfies the dissolved oxygen (DO) demand of the wastewater and maintains aerobic conditions which prevents the formation of sulfides and hydrogen sulfide gas ($H_2S$).

When H2S gas reaches the surface of sewer infrastructure, thiobacillus thiooxidans bacteria oxide the $H_2S$ to sulfuric acid ($H_2S0_4$), which corrodes concrete and steel.  In addition to controlling odor, preventing the formation of $H_2S$ also prevents the formation of $H_2S0_4$ and controls corrosion of the sewer infrastructure.

## 8.3 ECO$_2$ Components

The ECO$_2$ system components are illustrated on Figure 15 and described below.

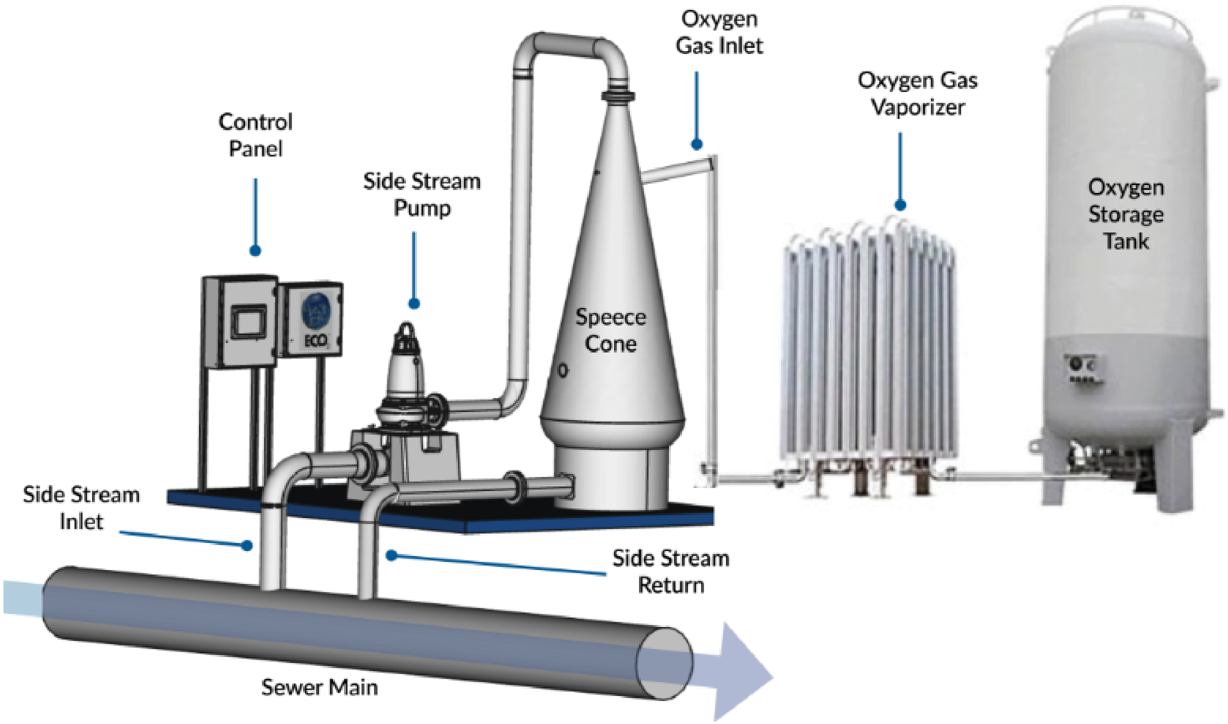



**Figure 15 ECO$_2$ Components**

A small 5 hp Flygt side stream pump is connected to the sewer force main down stream of the lift station discharge flow meter. The side stream is pumped through the hollow stainless steel Speece Cone.  The Speece Cone has no nozzles, baffles, or moving parts.  The Speece Cone serves as a contactor to provide enough time for oxygen gas to dissolve into the wastewater side stream without bubbles or undissolved oxygen gas. The system is designed to supper saturate the wastewater stream since higher saturation levels can be achieved within a pressurized FM line.

The oxygen gas is provided by a micro bulk liquid oxygen (LOX) tank and vaporizer.  The LOX tank and vaporizer are leased from a supplier such as Air Products, which currently provides LOX to the City for the Signal Butte Water Treatment Plant.  The ECO$_2$ system has an option where an oxygen gas generator can be purchased to generate oxygen gas onsite.  Hower, oxygen gas generators are only economical at very large sites with high oxygen demands.  In addition, oxygen gas generators have challenges operating in high ambient temperature environments such as Mesa.  Control panels are included to operate the side stream pump when the LS pumps are operating and to regulate the amount of oxygen delivered to the Speece Cone bases on the LS flow meter readings.

The dissolved oxygen is then returned to the main FM flow by the side stream pump.  The super oxygenation in the wastewater then oxidizes the dissolved sulfides during the approximate 30-minute contact time within the force main, which prevents the formation of gases at the discharge manhole and continuation through the collection system.

## 8.4 $ECO_2$ Sizing

Table 8.1 below provided by Eco Oxygen Technologies details the design parameter and system sizing for the Star Valley $ECO_2$ system.

**Table 8.1 $ECO_2$ Sizing**

| Force Main Parameters | Location #1 |
|---|---|
| Name of Pump Station (FM starting pt) | Star Valley |
| Force Main Discharge (FM end point) | Downstream MH |
| Lift Station Pump Operation (flow pattern) | Fill/Draw (x8/hr - |
| **Diameter of Force Main** | 10" PVC |
| **Length of Force Main** | 5280' |
| **Dynamic Pressure** | 115.5 psi |
| **Static Pressure** | 50 psi |
| **FM Flow, Average Daily** | .3 MGD |
| **Station Pump Flowrate - Instantaneous** | 800 gpm |
| | |
| Existing Dissolved Sulfides @ FM Start | 2mg/L |
| Max Temperature of Sewage | 27c |
| BOD (typ. 250mg/L) | 250 |
| Oxygen Uptake Rate (typ. 10mg/L/hr) | 10mg/L |
| | |
| **Objective (DS prevention or removal)** | **Both** |
| **HRT (maximum at low flow)** | **4 hrs** |
| **DO Demand (maximum)** | **49 mg/L** |
| ***Technical Fit / Saturation Check*** | ***Yes*** |
| **O2 Flowrate, Instantaneous Max.** | **520** |
| **O2 Use, Daily Average** | **70** |
| | |
| **ECO2 System Size** | **3-ft Diameter** |
| **Side stream Pump Size** | **5 HP** |
| **Side stream Flowrate** | **550 gpm** |
| **Side-stream Pipe Size** | **4-in** |

## 8.5 $ECO_2$ Layout

Appendix F includes the preliminary layout for the $ECO_2$ system within the Star Valley site. Below is an image of an example site with a similar sized $ECO_2$ system.


**Figure 16 Example $ECO_2$ Site**

The Speece Cone itself is 12-ft tall with an additional 2-ft of height for the inlet piping. Due to the overall 14-ft height of the Speece Cone and nearby residents, GHD proposes placing the Speece Cone inside the existing chemical containment sump to reduce visibility from outside of the site. The oxygen tank is then place next to the roadway loop to allow for LOX deliveries. Four-inch diameter ductile iron pipe and isolation valves are also provided downstream of the discharge flow meter to feed the side stream to the Speece Cone.

## 8.6 Life Cycle Cost Comparison

Appendix G provides a 30-year life cycle cost comparison between replacing the existing $FeCl_2$ odor control equipment and installing the $ECO_2$ system. The life cycle cost includes capital costs, annual operating costs, and an assumed annual inflation rate of 2.5% for each option. Costs are also included for two different oxygen tank sizes. The first size of 1,500L was recommended by the oxygen supplier as the most economical option but requires approximately 7 deliveries a year. The City also requested the option for a larger 3,000L tank to limit deliveries to approximately 3 time per year since the site is within a gated community and the City must escort the oxygen supplier into the site for each delivery. Operating cost for $FeCl_2$ are based on the City provided usage of 11,000 gallons of $FeCl_2$ per year at a current cost of $1.63 per wet gallon. Operating costs for $ECO_2$ are based on the Eco Oxygen Technologies calculated oxygen usage of 70 lb/day and quote from Air Products for the oxygen tank lease, deliveries, and oxygen chemical costs shown in Appendix G.

**Table 8.2 Life Cycle Cost Comparison**

| Option | Capital Cost | Year 1 Operating Cost | 30-Yr Life Cycle Cost |
|---|---|---|---|
| Replace $FeCl_2$ | $194,177 | $18,354 | $999,950 |
| $ECO_2$ with 1,500L Tank | $539,644 | $14,480 | $1,175,350 |
| $ECO_2$ with 3,000L Tank | $539,644 | $17,978 | $1,328,935 |

## 8.7 $ECO_2$ Evaluation

The operational advantages to the $ECO_2$ system include effective odor/corrosion reduction and reduced iron loading in the downstream collection system. The operational disadvantage is that the $ECO_2$ system does not control odor at the LS wet well. The existing $FeCl_2$ system injects at the wet well to assist with odor control at the LS. If the $ECO_2$ system is installed, the proposed biofilter improvement would be solely relied on to control odor at the LS.

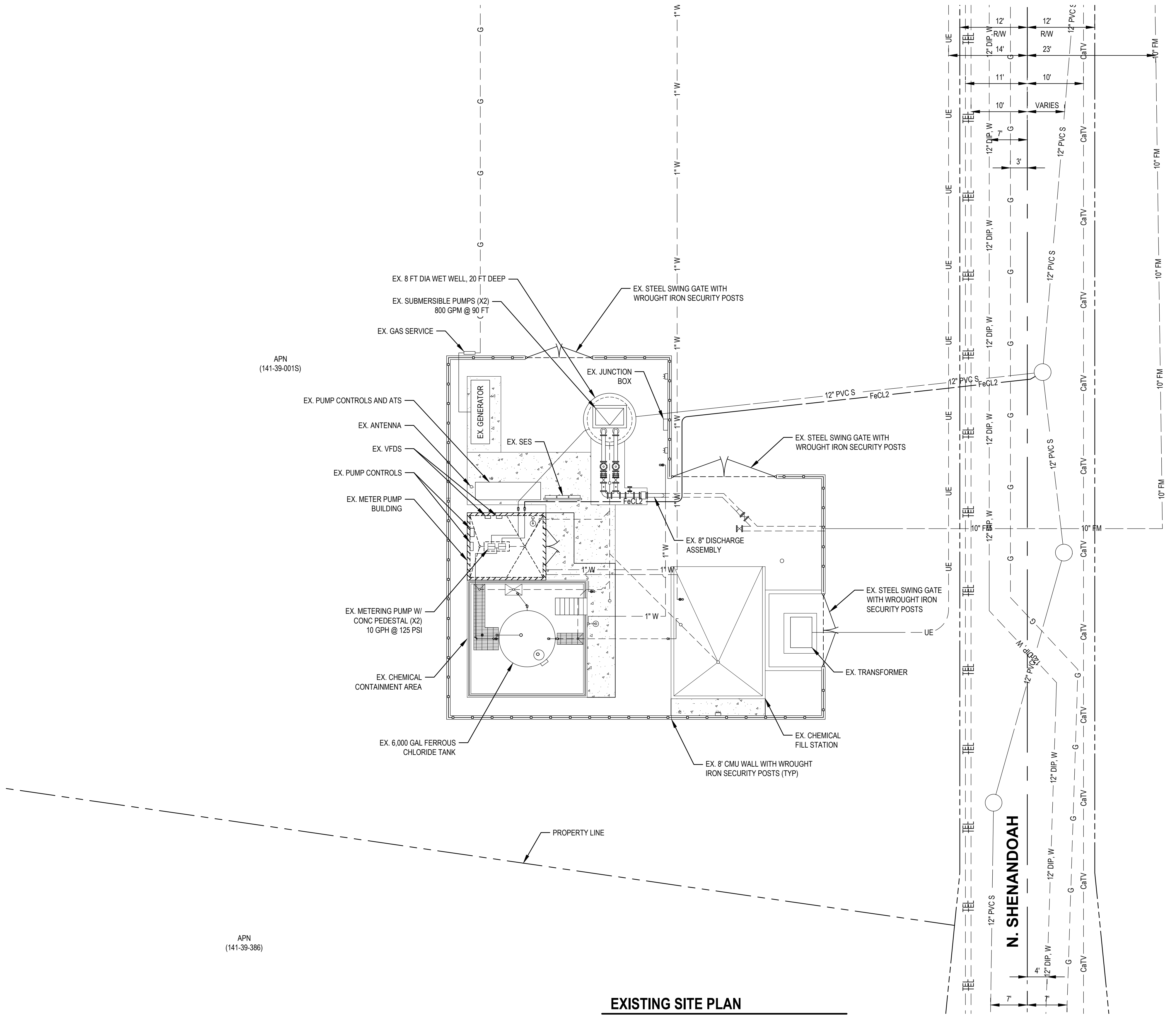
Economically the $ECO_2$ system has a much higher capital cost than replacing the $FeCl_2$ system. The $ECO_2$ system normally relies on the significantly lower oxygen chemical cost over $FeCl_2$ to recover the higher capital cost within approximately 5 years of operation. However, this requires a site with a much higher $FeCl_2$ demand to recover the capital cost that quickly. The $FeCl_2$ demand at Star Valley would need to be approximately 4 times higher to recover the capital cost within 5 year. The higher the $FeCl_2$ demand, the faster the $ECO_2$ capital cost is recovered. The $FeCl_2$ demand at Star Valley is so low that the higher capital cost of the $ECO_2$ system is not recovered within the 30-year operational life.

In conclusion, the $ECO_2$ system does not appear feasible for the Star Valley LS based on the following:

- The 30-year life cycle cost of replacing the $FeCl_2$ system is lower than the $ECO_2$ system due to the very low $FeCl_2$ demand at the site.
- The $FeCl_2$ system provides the added benefit of controlling odor at the LS wet well.
- The City is not experiencing any odor control performance issues with the existing $FeCl_2$ system.
- The $FeCl_2$ demand at Star Valley is so low that downstream iron loading is not a concern for the City.

# Appendix A

# Conceptual Plans




## EXISTING SITE PLAN

SCALE: 1" = 10'


CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

EXISTING SITE PLAN

Project No. 12577360
Report No. N/A
Date OCTOBER 2024

C1

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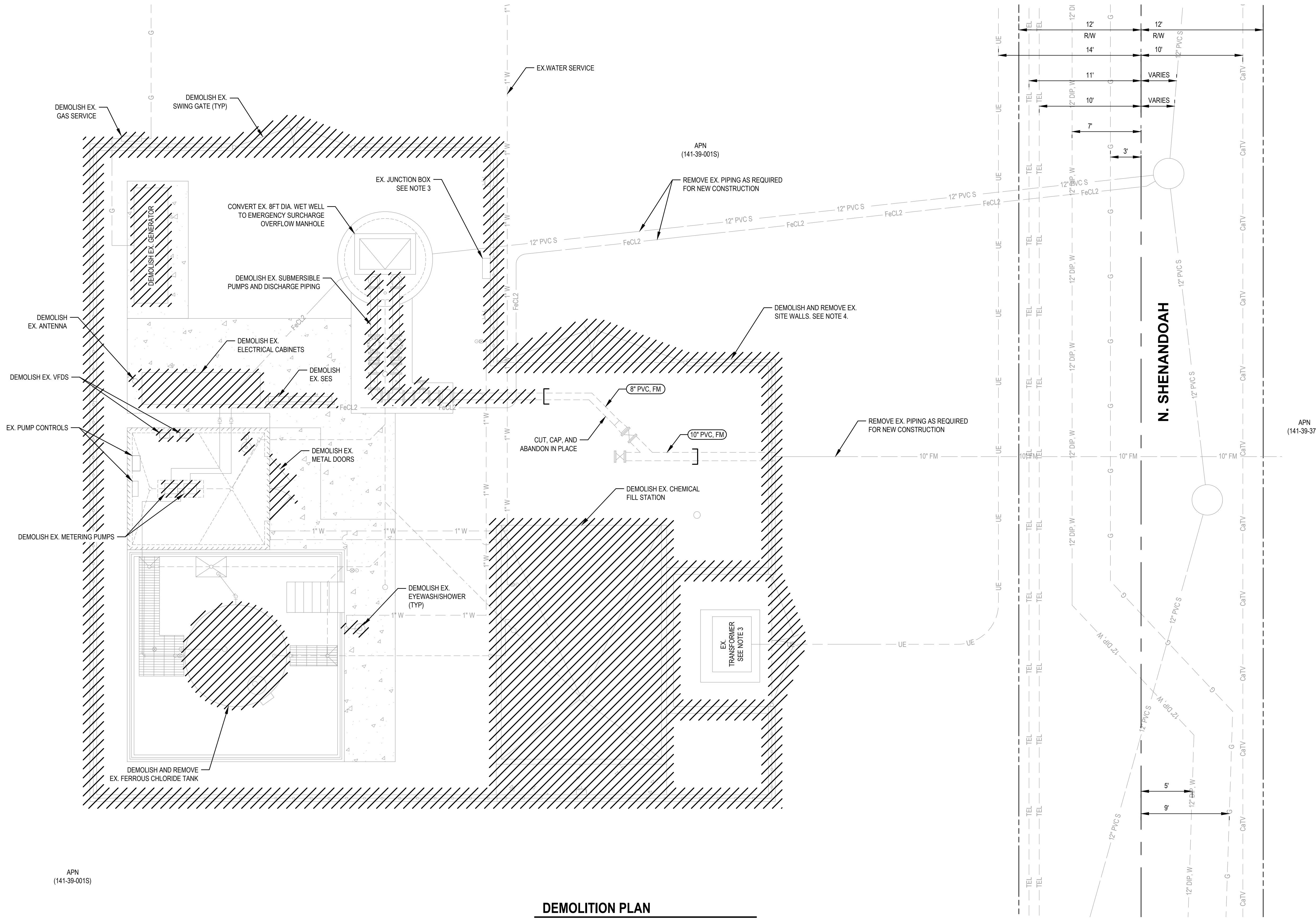


## DEMOLITION PLAN

SCALE: 1" = 5'

## LEGEND

DEMOLITION AND REMOVALS

N

0 5' 10'

CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

DEMOLITION PLAN

Project No. 12577360
Report No. N/A
Date OCTOBER 2024

C2

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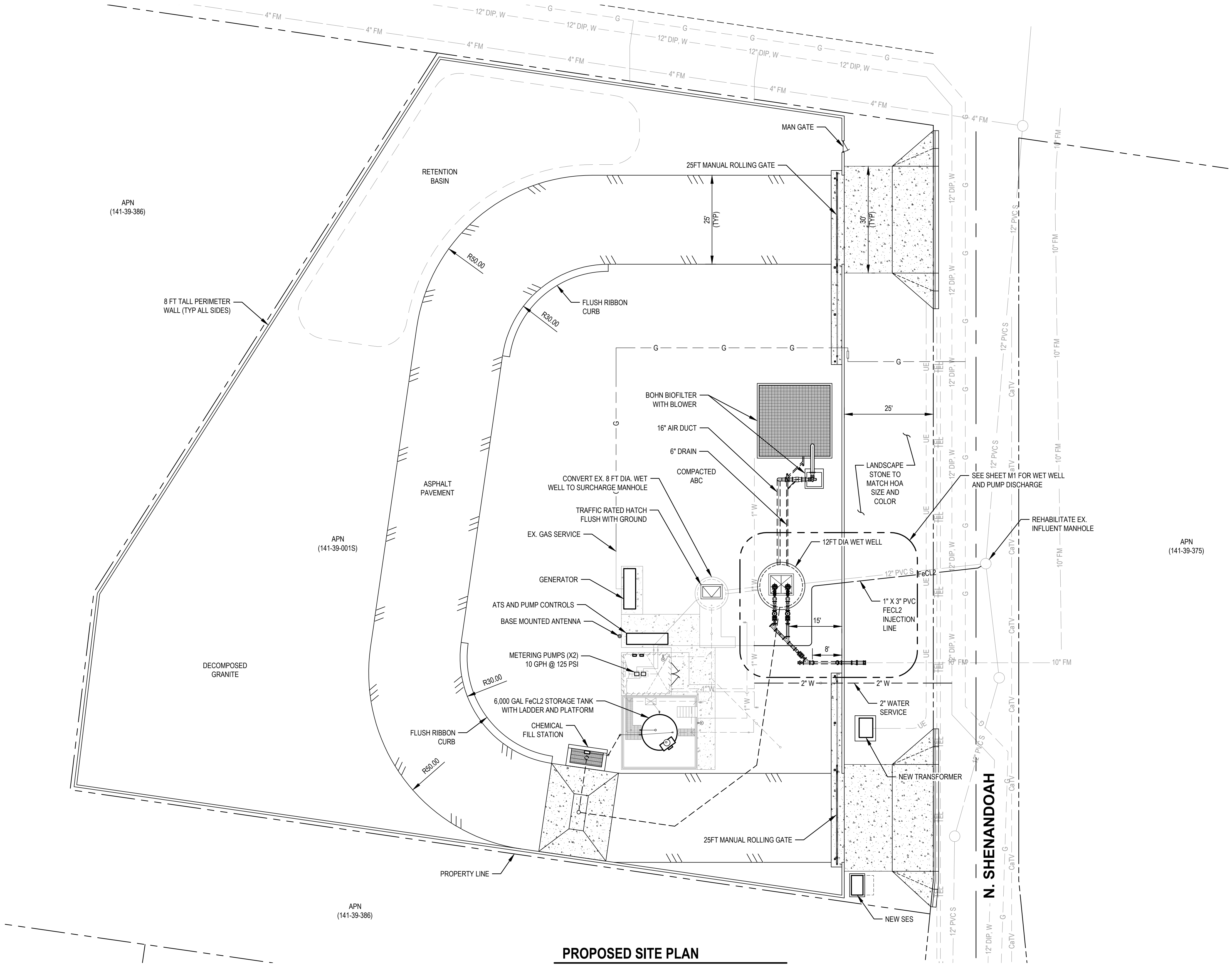


## PROPOSED SITE PLAN

SCALE: 1" = 15'

N

0 15' 30'

CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

PROPOSED SITE PLAN

Project No. 12577360
Report No. N/A
Date OCTOBER 2024

C3

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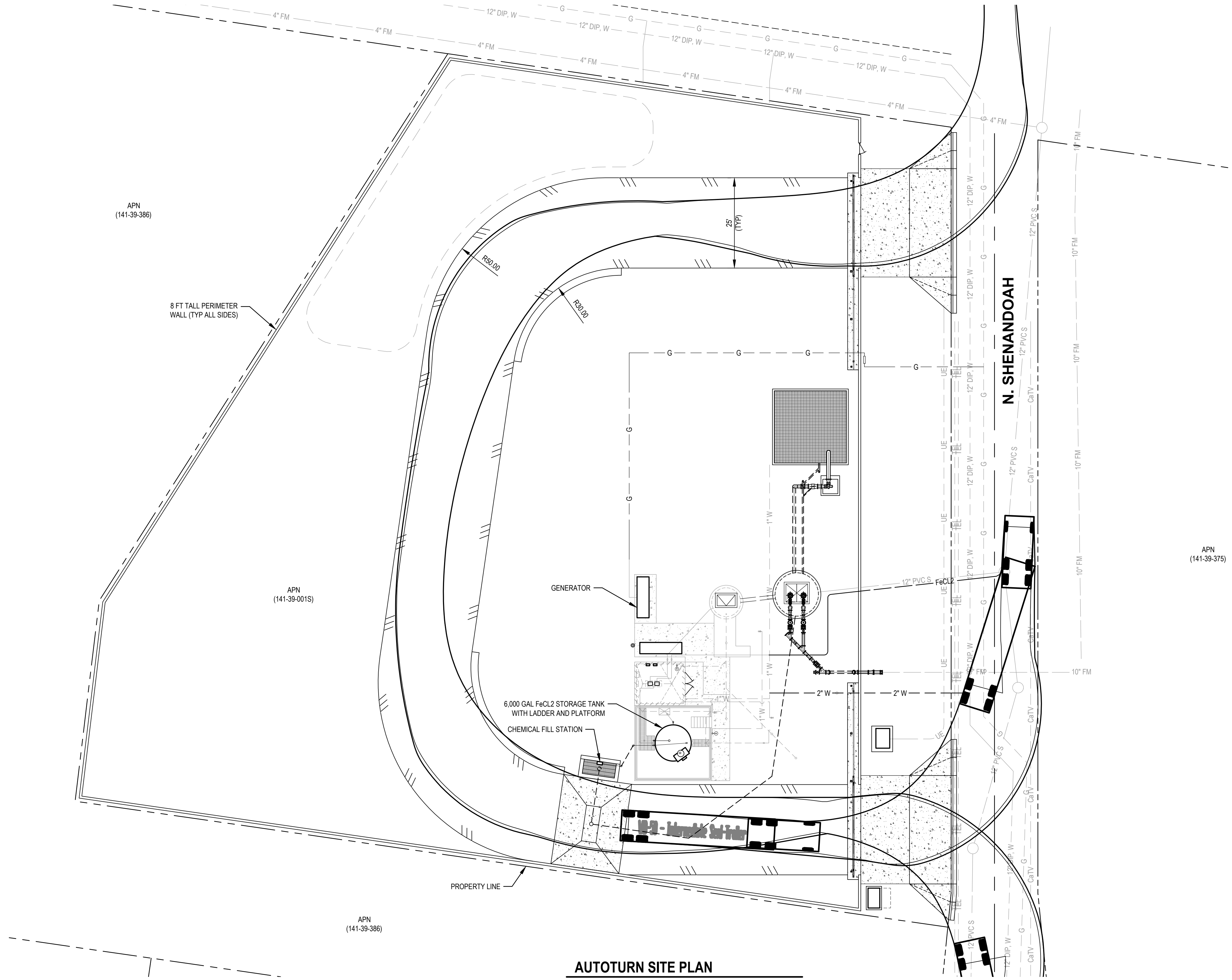


## AUTOTURN SITE PLAN

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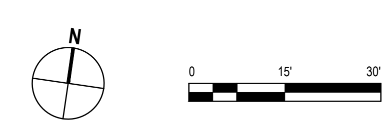


CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

AUTOTURN SITE PLAN

Project No. 12577360
Report No. N/A
Date OCTOBER 2024

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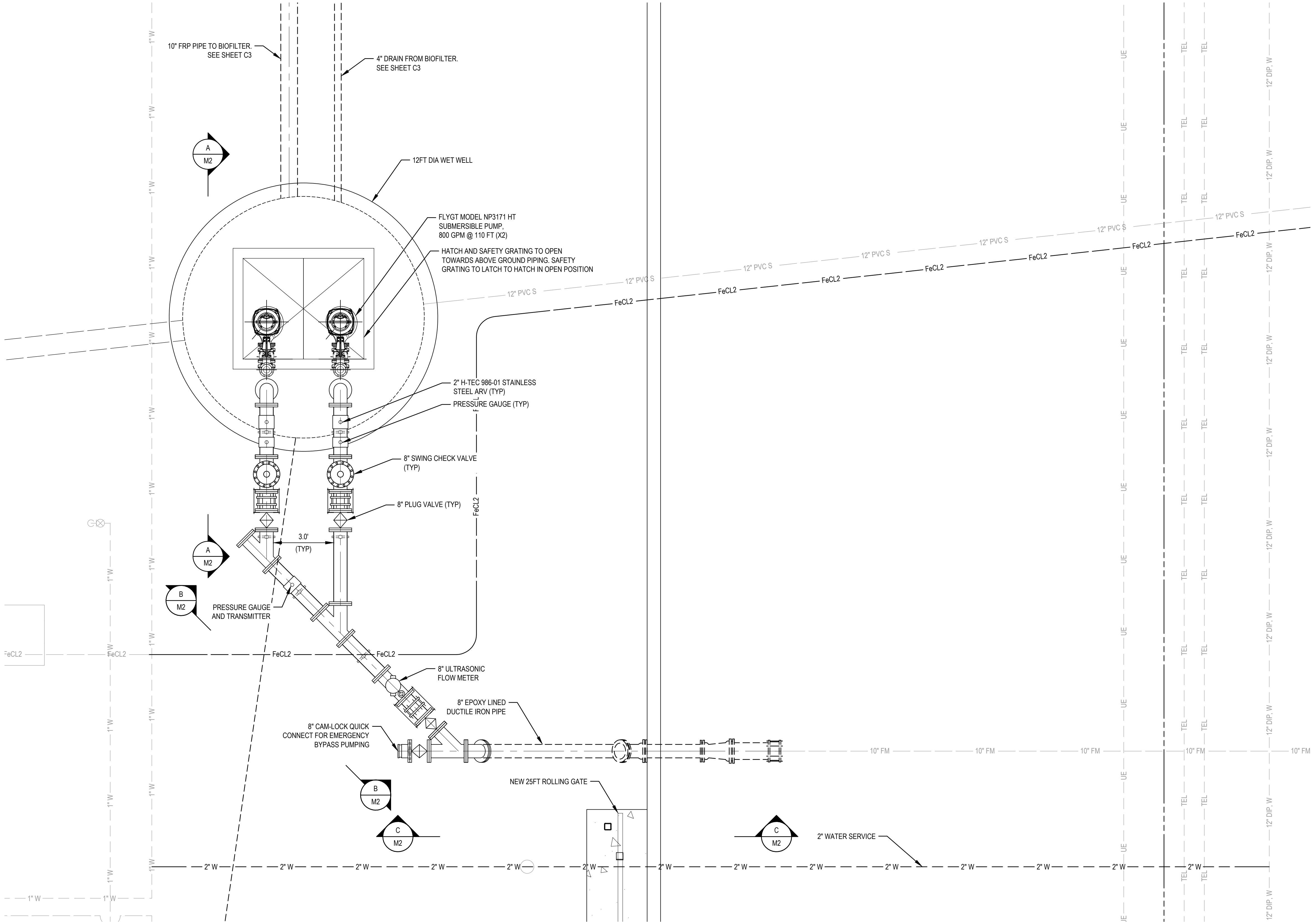


## PROPOSED LIFT STATION PLAN

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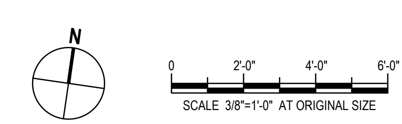


CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

PROPOSED LIFT STATION PLAN

Project No. 12577360
Report No. N/A
Date OCTOBER 2024

M1

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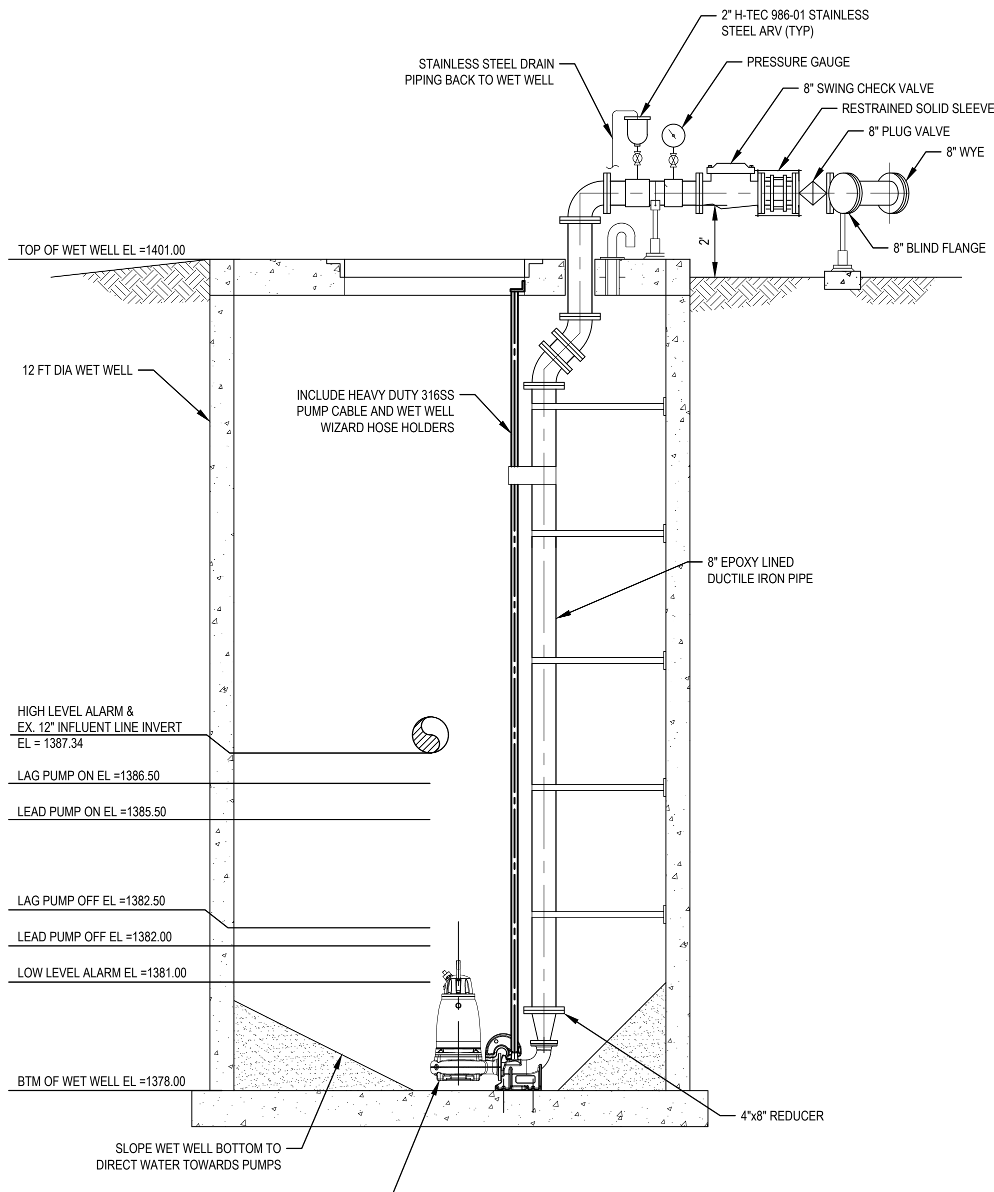
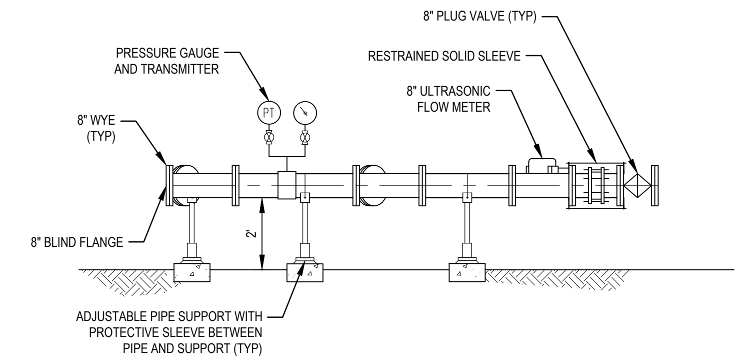



A / M1 **SECTION**
SCALE: 3/8" = 1'-0"

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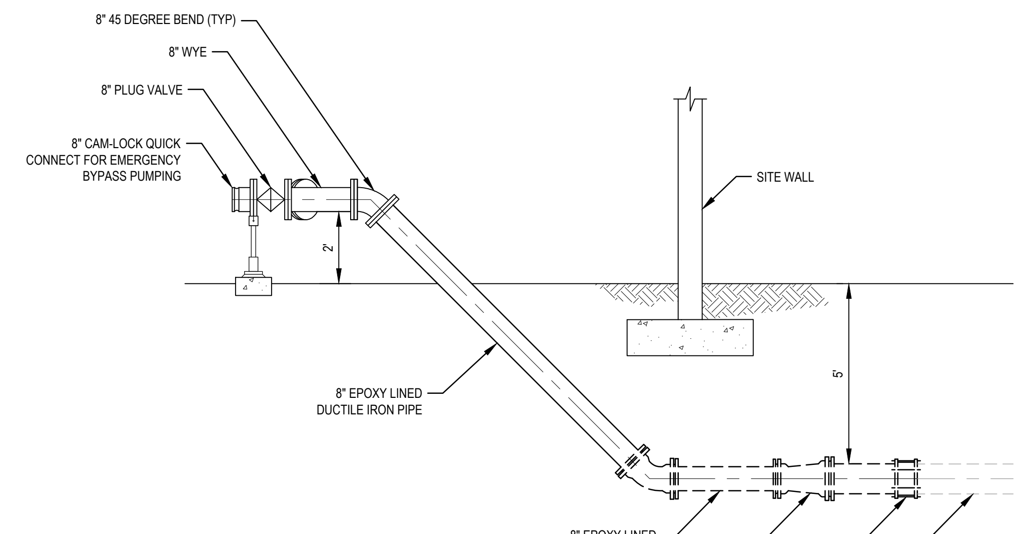


C / M1 **SECTION**
SCALE: 3/8" = 1'-0"

N

0 2'-0" 4'-0" 6'-0"
SCALE 3/8"=1'-0" AT ORIGINAL SIZE

GHD

**CITY OF MESA**
**LIFT STATION IMPROVEMENTS**
**STAR VALLEY**

**SECTIONS**

Project No. **12577360**
Report No. **N/A**
Date **OCTOBER 2024**

**M2**

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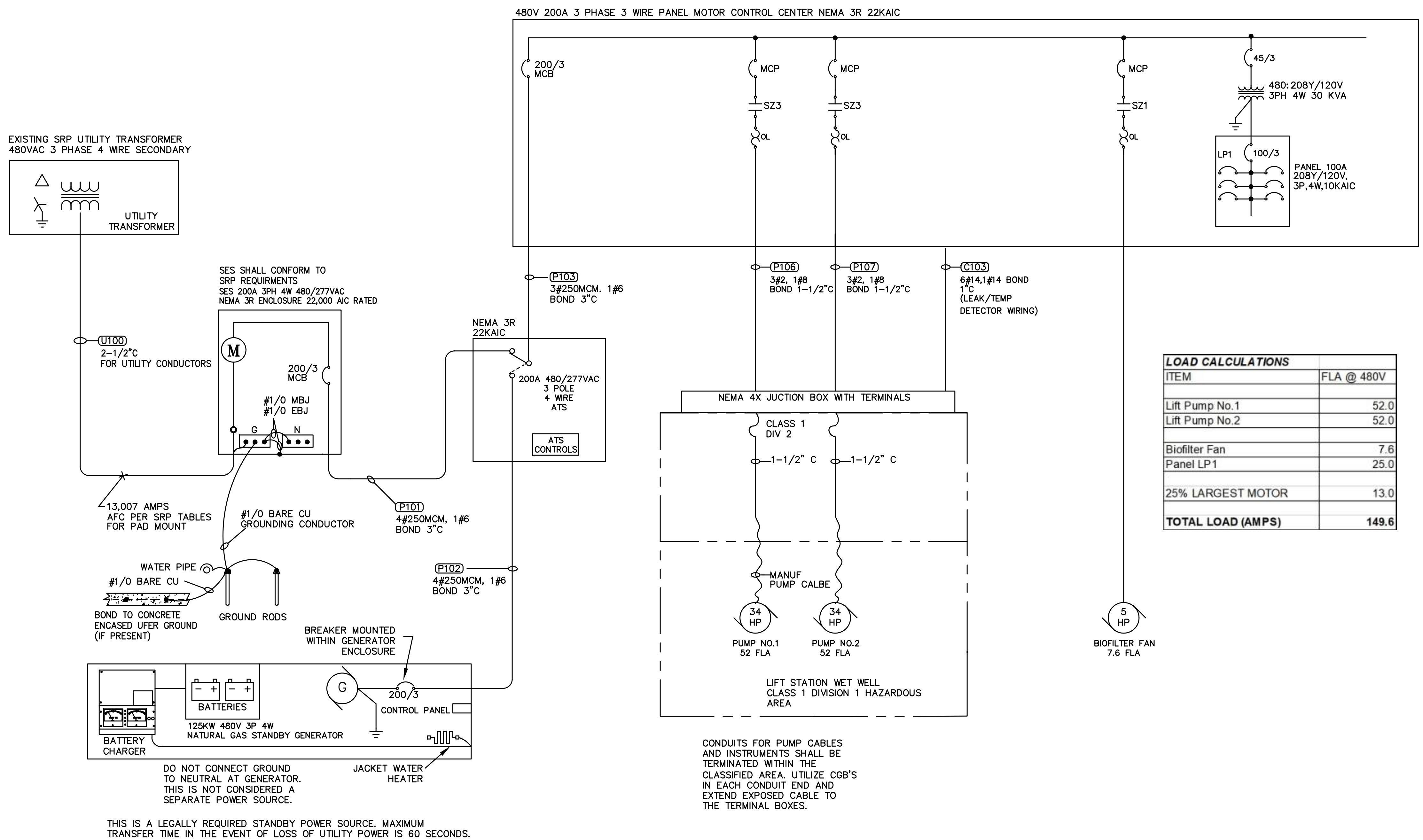



| ***LOAD CALCULATIONS*** | |
|---|---|
| ITEM | FLA @ 480V |
| | |
| Lift Pump No.1 | 52.0 |
| Lift Pump No.2 | 52.0 |
| | |
| Biofilter Fan | 7.6 |
| Panel LP1 | 25.0 |
| | |
| 25% LARGEST MOTOR | 13.0 |
| | |
| **TOTAL LOAD (AMPS)** | **149.6** |

mesa·az

Jensen Engineering, LLC
Cave Creek, Arizona
Est. 1988 (480) 595-9342

GHD

CITY OF MESA
LIFT STATION IMPROVEMENTS

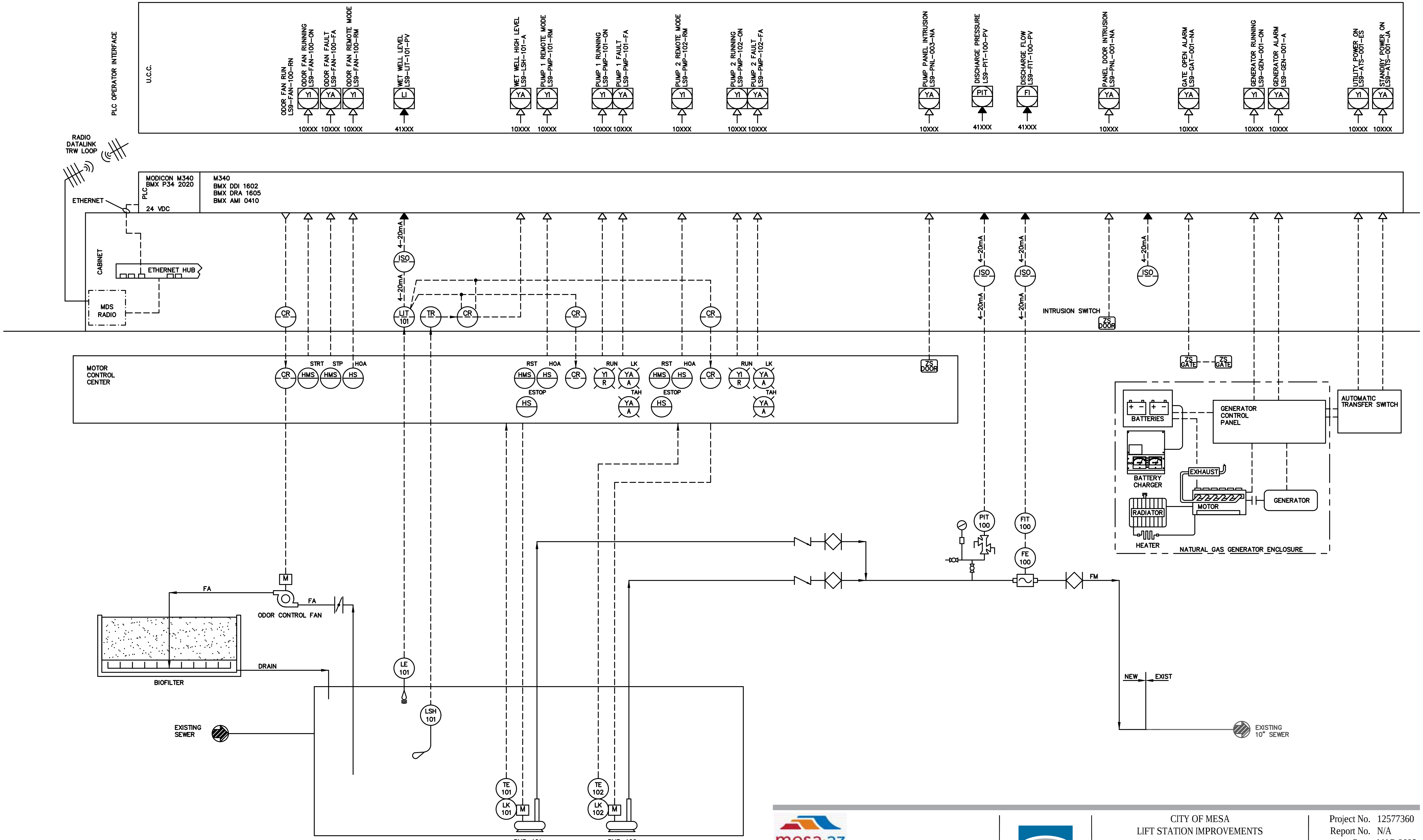
STAR VALLEY LIFT STATION LS9
ELECTRICAL
SINGLE LINE DIAGRAM

Project No. 12577360
Report No. N/A
Date MAR 2023

FIG E1

Filename: S:\E02017 GHD Mesa Lift Stations\Star Valley\DCR SLD.dwg
Plot Date: 31 March 2023 - 2:57 PM

Source:




CITY OF MESA
LIFT STATION IMPROVEMENTS

STAR VALLEY LIFT STATION LS9
PROCESS & INSTRUMENTATION DIAGRAM

mesa·az

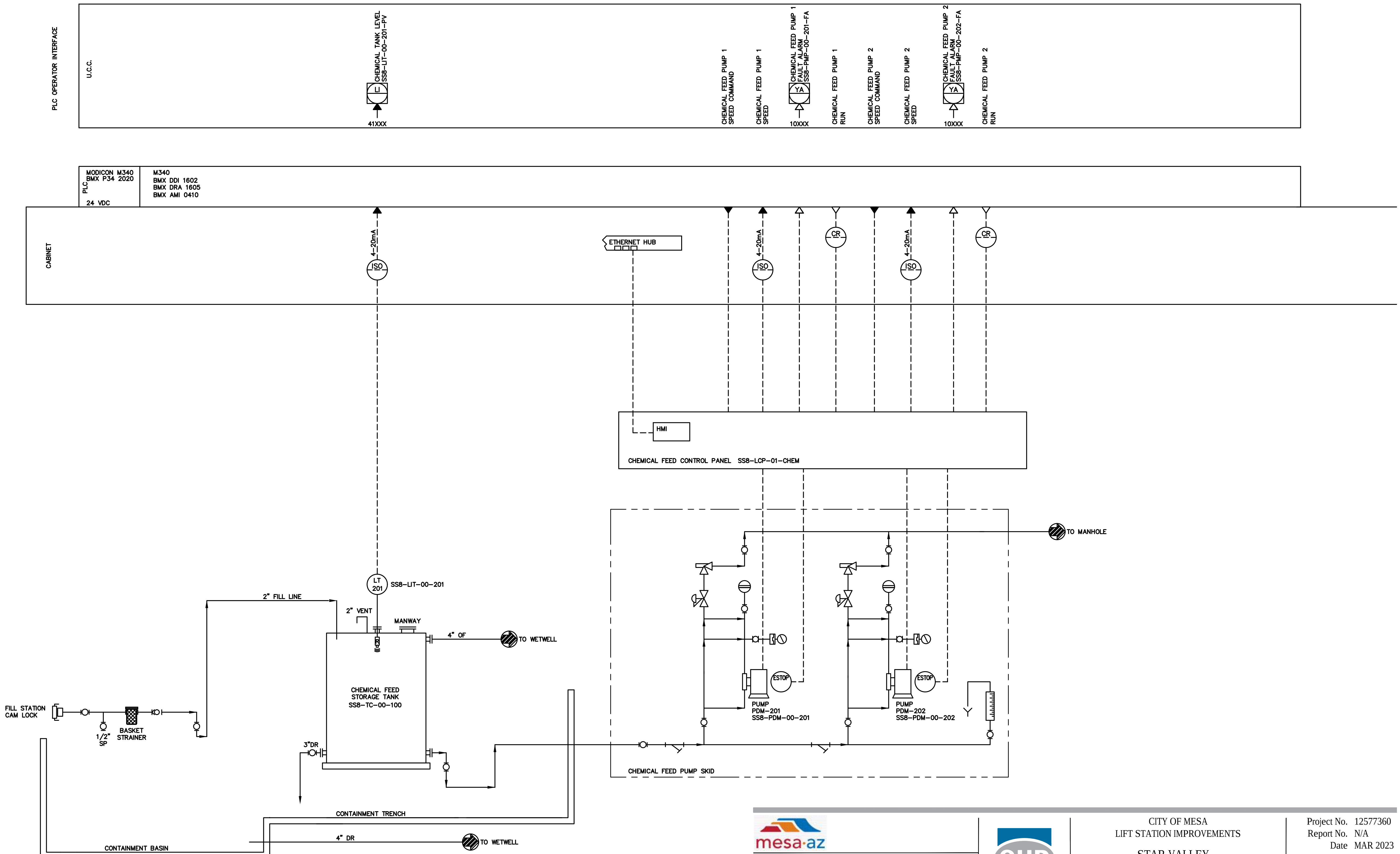
Jensen Engineering, LLC
Cave Creek, Arizona
(480) 595-9342
Est. 1988

GHD

Project No. 12577360
Report No. N/A
Date MAR 2023

FIG E2

Filename: S:\E02017 GHD Mesa Lift Stations\Star Valley\DCR PID Lift Station.dwg
Plot Date: 31 March 2023 - 2:47 PM




mesa·az

Jensen Engineering, LLC
Cave Creek, Arizona
(480) 595-9342
Est. 1988

GHD

CITY OF MESA
LIFT STATION IMPROVEMENTS

STAR VALLEY
SULFIDE CONTROL STATION SS8
PROCESS & INSTRUMENTATION
DIAGRAM

Project No. 12577360
Report No. N/A
Date MAR 2023

FIG E3

Filename: S:\E02017 GHD Mesa Lift Stations\Star Valley\DCR PID SCS.dwg
Plot Date: 31 March 2023 - 2:49 PM

# Appendix B

# Reserve at Redrock Basis of Design Report

WOOD
PATEL

**WASTEWATER COLLECTION SYSTEM**
**BASIS OF DESIGN REPORT**
**FOR**
**RESERVE AT RED ROCK**

April 9, 2020
WP# 194961

Registered Professional Engineer (Civil)
CERTIFICATE NO.
53408
DANIEL W.
MATTHEWS
Date Signed 04/09/2020
ARIZONA, U.S.A.

EXPIRES 06/30/21

2051 W Northern Ave #100
Phoenix AZ 85021
P: 602.335.8500
F: 602.335.8580
www.woodpatel.com

Darrel E. Wood, PE, RLS
Ashok C. Patel, PE, RLS, CFM
Michael T. Young, PE, LEED AP
James S. Campbell, PE, LEED GA
Thomas R. Gettings, RLS
Darin L. Moore, PE, LEED GA
Jeffrey R. Minch, PE, CFM
Robert D. Gofonia, PE, RLS
Nicholas E. Brown, PE

April 9, 2020

Mr. Gordon Haws
Deputy Director
City of Mesa
55 North Center Street
Mesa, AZ 85211

480.644.3380
gordon.haws@mesaaz.gov

Re: **Reserve at Red Rock**
Wastewater Collection Improvement Plan, Basis of Design
WP# 194961

Dear Mr. Haws:

Reserve at Red Rock (Site) is a proposed 133-acre residential development located within the City of Mesa. The Site is bounded on the north by State Land leased to Talley Defense Systems, on the east by North Recker Road and Red Rock Park, on the west by undeveloped private desert land, and on the south by East Thomas Road. The northern 14± acres will be retained by the City of Mesa. The property is located within the southeast quarter section of Section 26, Township 2 North, Range 6 East of the Gila and Salt River Meridian (refer to attached *Vicinity Map*).

The proposed Site consists of 294 single-family residential lots. The proposed public wastewater collection system is comprised of 8-inch gravity sewer pipes and existing 12-inch gravity sewer pipes. The flow will outfall to the Star Valley Lift Station, located near the western boundary of the Site. Lots 198 to 294 collect flow in the northern part of the Site and convey flow west in existing 12-inch sewer pipes located in Star Valley Street and south towards the lift station. Lots 1 to 197 collect flow in the southern part of the Site in proposed 8-inch gravity sewer pipes and convey flow north to the lift station. In the southwest Site corner near Thomas Road, an 8-inch sewer stub has been included for a future connection to undeveloped land south of Thomas Road.

According to the City of Mesa, the Star Valley Lift Station currently has an available peak flow capacity of approximately 400,000 GPD. The Site's flows are less than the available capacity for the lift station. Therefore, no improvements to the lift station are proposed.

The wastewater collection system design is based on WOODPATEL's understanding of the *2019 City of Mesa Engineering and Design Standards*.

The proposed total peak flow design for the Reserve at Red Rock is 209,736 GPD, as calculated below:

<u>Lots 1-197</u>

| | |
|---|---|
| Land Use: | Medium Density Residential (LDR) |
| Average Daily Flow: | 240 (GPD/DU) |
| Peaking Factor: | 3.0 (New lines) |
| Average Daily Flow: | 197 DU's x 240 GPD/DU = 47,280 GPD |
| Peak Flow: | 47,280 GPD x 3.0 = **141,840 GPD** |

Lots 198-228

| | |
|---|---|
| Land Use: | Medium Density Residential (LDR) |
| Average Daily Flow: | 240 (GPD/DU) |
| Peaking Factor: | 3.0 (New lines) |
| Average Daily Flow: | 31 DU's x 240 GPD/DU = 7,440 GPD |
| Peak Flow: | 7,440 GPD x 3.0 = **22,320 GPD** |

Lots 229-240 & 284-294

| | |
|---|---|
| Land Use: | Medium Density Residential (LDR) |
| Average Daily Flow: | 240 (GPD/DU) |
| Peaking Factor: | 3.0 (New lines) |
| Average Daily Flow: | 23 DU's x 240 GPD/DU = 5,520 GPD |
| Peak Flow: | 5,520 GPD x 3.0 = **16,560 GPD** |

Lots 241-283

| | |
|---|---|
| Land Use: | Medium Density Residential (LDR) |
| Average Daily Flow: | 240 (GPD/DU) |
| Peaking Factor: | 2.3 (Existing lines) |
| Average Daily Flow: | 43 DU's x 240 GPD/DU = 10,320 GPD |
| Peak Flow: | 10,320 GPD x 2.3 = **23,736 GPD** |

Pool Amenity

| | |
|---|---|
| DU's: | 294 |
| Population Density: | 3 Patrons/DU |
| Utilization Rate: | 20% |
| Patrons per Day: | 94 DU's x 3 patrons/DU x 20% = 176 Patrons |
| Average Daily Flow: | 176 Patrons x 10 GPD/Patron = 1,760 GPD |
| Peak Flow: | 1,760 GPD x 3.0 = **5,280 GPD** |

**Total Peak Flow = 209,736 GPD**

The proposed 8-inch sewer line draining north to the lift station was designed with a peak flow of 141,840 GPD. At a minimum slope of 0.0040 ft/ft, an 8-inch sewer line has the capacity to convey the peak of 141,840 GPD. The pipe is flowing at 36.6% of the capacity flowing full, using a Manning's coefficient of 0.013. With the pipe flowing at a d/D=0.67, the velocity is 2.42 feet per second (fps).

The Site is proposed to contribute a peak flow of 67,896 GPD to the existing 12-inch sewer line located in Star Valley Street that drains south to the lift station. At a minimum slope of 0.0027 ft/ft, a 12-inch sewer line has the capacity to convey approximately 1,196,453 GPD, using a Manning's coefficient of 0.013, which is several times more capacity than the lift station and can accommodate the additional peak flow of 67,896 GPD from the Site. With the pipe flowing at d/D=0.67, the velocity is 2.61 fps.

Thank you for your prompt review of the wastewater collection system provided for Reserve at Red Rock. Please contact us if you have any questions.

Sincerely,

**Wood, Patel & Associates, Inc.**

Registered Professional Engineer (Civil)
CERTIFICATE NO.
53408
DANIEL W.
MATTHEWS
Date Signed 04/09/2020
ARIZONA, U.S.A.
EXPIRES 06/30/21

Daniel W. Matthews, PE
Principal

DWM/km

Attachment(s): Table 1 – Wastewater Design Criteria
Table 2 – Wastewater Flows
Appendix A – Sewer Pipe Outfall Calculations
Exhibit 1 – Vicinity Map
Exhibit 2 – Wastewater Layout

Y:\WP\Reports\Residential\194961 Reserve at Red Rock Wastewater Basis of Design Report.docx

## TABLE 1 – WASTEWATER DESIGN CRITERIA

## TABLE 1
WASTEWATER DESIGN CRITERIA

**Project** Reserve at Red Rock
**Location** Mesa AZ
**Project Number** 194961
**Project Engineer** Charles Witt, EIT
**References** City of Mesa 2019 Engineering & Design Standards

| **RESIDENTIAL WASTEWATER FLOW** | | | |
|---|---|---|---|
| **LAND USE** | **AVERAGE DAILY FLOW (ADD)** | | **Land Use Category** |
| | **VALUE** | **UNITS** | |
| Single Family Residential | 240 | gpd/DU | Medium Density Residential (LDR) |
| **NON-RESIDENTIAL WASTEWATER FLOW** | | | |
| **LAND USE** | **AVERAGE DAILY FLOW (ADD)** | | |
| | **VALUE** | **UNITS** | |
| Pool Amenity | 10 | gpd/patron | |

| **DESCRIPTION** | | **VALUE[1]** |
|---|---|---|
| **PEAK FLOW** | | |
| | Peak Flow = Peaking Factor (PF) x ADD | |
| | Existing Lines | 2.3 |
| | New Lines | 3.0 |
| **HYDRAULICS** | | |
| | Minimum Pipe Diameter (in) | 8 |
| | Manning's "n" value | 0.013 |
| | Maximum d/D ratio at peak flow | 0.67 |

| PIPE SIZE | MEAN VELOCITY[1] | | DESIGN SLOPE[1] | |
|---|---|---|---|---|
| (in) | Minimum (ft/sec) | Maximum (ft/sec) | Minimum (%) | Maximum (%) |
| 8 | 2.0 | 9.0 | 0.33 | 5.52 |
| 10 | 2.0 | 9.0 | 0.25 | 4.10 |
| 12 | 2.0 | 9.0 | 0.20 | 3.21 |

**Notes**
1. Per City of Mesa 2019 Engineering & Design Standards or Arizona Administrative Code.

## TABLE 2 – WASTEWATER FLOWS

WOOD PATEL

## TABLE 2
WASTEWATER FLOWS

**Project** Reserve at Red Rock
**Location** Mesa AZ
**Project Number** 194961
**Project Engineer** Charles Witt, EIT
**References** City of Mesa 2019 Engineering & Design Standards
Arizona Administrative Code, Title 18, Chapter 9

| OUTFALL | LOTS | DU's | LAND USE CATEGORY | AVERAGE DAILY FLOW (GPD PER DU) | AVERAGE DAILY FLOW (GPD) | PEAKING FACTOR | PEAK DAILY FLOW (GPD) |
|---|---|---|---|---|---|---|---|
| 8-INCH SEWER SOUTH OF LIFT STATION | 1 TO 197 | 197 | Medium Density Residential (LDR) | 240 | 47,280 | 3.0 | 141,840 |
| STAR VALLEY STREET 12-INCH SEWER | 198 TO 228 | 31 | Medium Density Residential (LDR) | 240 | 7,440 | 3.0 | 22,320 |
| | 229 TO 240 & 284 TO 294 | 23 | Medium Density Residential (LDR) | 240 | 5,520 | 3.0 | 16,560 |
| | 241 TO 283 | 43 | Medium Density Residential (LDR) | 240 | 10,320 | 2.3 | 23,736 |
| TOTAL | | 294 | | | 70,560 | - | 204,456 |
| **OUTFALL** | **LAND USE CATEGORY** | **DU's** | **PATRONS[2]** | **AVERAGE DAILY FLOW (GPD PER PATRON)** | **AVERAGE DAILY FLOW (GPD)** | **PEAKING FACTOR** | **PEAK DAILY FLOW (GPD)** |
| STAR VALLEY STREET 12-INCH SEWER | Non-Residential (Pool Amenity) | 294 | 176 | 10 | 1,760 | 3.0 | 5,280 |
| **TOTAL** | | **294** | | | **72,320** | **-** | **209,736** |

**Notes:**
1) The outfall for the Site is the Star Valley Lift Station, located near the west boundary.
2) Assumes 3 patrons per DU and a 20% utilization rate: 294 DU x 3 patrons/DU x 20% (Utilization Rate) = 176 patrons

# APPENDIX A – SEWER PIPE OUTFALL CALCULATIONS

# Worksheet for d/D (8-inch)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00400 | ft/ft |
| Normal Depth | 5.33 | in |
| Diameter | 8.00 | in |

## Results

| | | |
|---|---|---|
| Discharge | 386995.05 | gal/day |
| Flow Area | 0.25 | ft² |
| Wetted Perimeter | 1.27 | ft |
| Hydraulic Radius | 2.33 | in |
| Top Width | 0.63 | ft |
| Critical Depth | 0.36 | ft |
| Percent Full | 66.6 | % |
| Critical Slope | 0.00734 | ft/ft |
| Velocity | 2.42 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 0.54 | ft |
| Froude Number | 0.68 | |
| Maximum Discharge | 0.82 | ft³/s |
| Discharge Full | 0.76 | ft³/s |
| Slope Full | 0.00245 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | in |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | in |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 66.61 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for d/D (8-inch)

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 5.33 | in |
| Critical Depth | 0.36 | ft |
| Channel Slope | 0.00400 | ft/ft |
| Critical Slope | 0.00734 | ft/ft |

# Cross Section for d/D (8-inch)

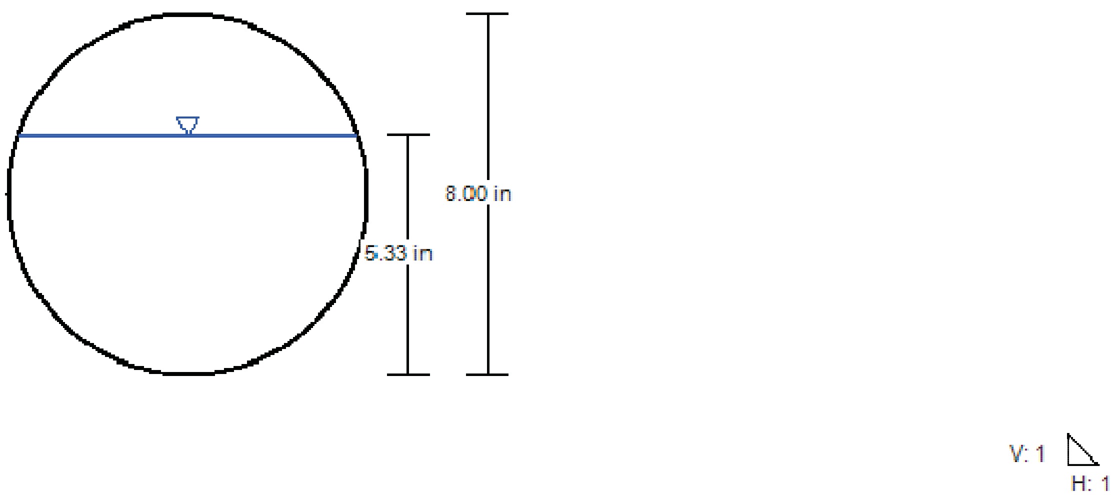
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00400 | ft/ft |
| Normal Depth | 5.33 | in |
| Diameter | 8.00 | in |
| Discharge | 386995.05 | gal/day |

## Cross Section Image



# Worksheet for % Full (8-inch)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00400 | ft/ft |
| Diameter | 8.00 | in |
| Discharge | 141840.00 | gal/day |

## Results

| | | |
|---|---|---|
| Normal Depth | 2.93 | in |
| Flow Area | 0.12 | ft² |
| Wetted Perimeter | 0.87 | ft |
| Hydraulic Radius | 1.60 | in |
| Top Width | 0.64 | ft |
| Critical Depth | 0.22 | ft |
| Percent Full | 36.6 | % |
| Critical Slope | 0.00645 | ft/ft |
| Velocity | 1.89 | ft/s |
| Velocity Head | 0.06 | ft |
| Specific Energy | 0.30 | ft |
| Froude Number | 0.79 | |
| Maximum Discharge | 0.82 | ft³/s |
| Discharge Full | 0.76 | ft³/s |
| Slope Full | 0.00033 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | in |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | in |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 36.64 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for % Full (8-inch)

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 2.93 | in |
| Critical Depth | 0.22 | ft |
| Channel Slope | 0.00400 | ft/ft |
| Critical Slope | 0.00645 | ft/ft |

# Cross Section for % Full (8-inch)

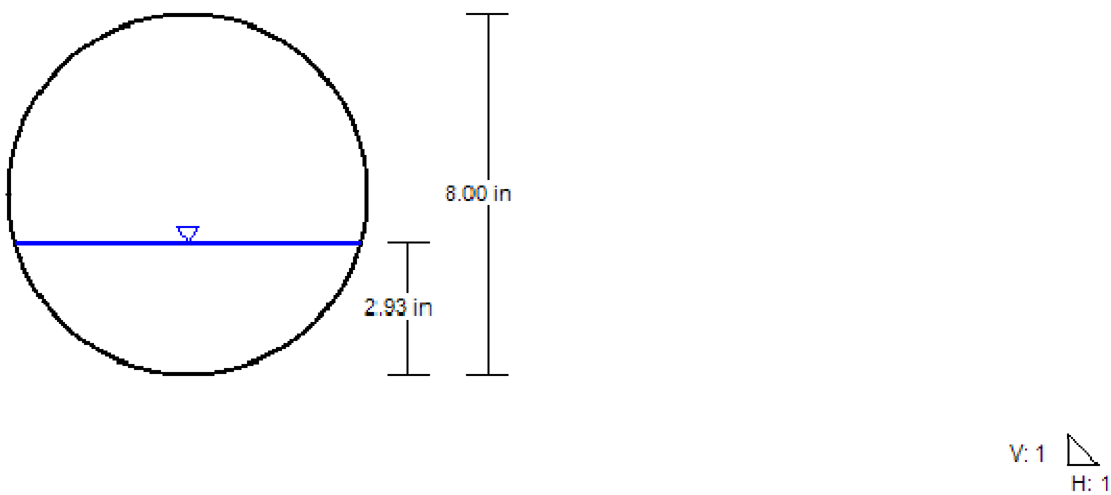
## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00400 | ft/ft |
| Normal Depth | 2.93 | in |
| Diameter | 8.00 | in |
| Discharge | 141840.00 | gal/day |

## Cross Section Image



# Worksheet for Full Capacity (8-inch)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Full Flow Capacity |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00400 | ft/ft |
| Normal Depth | 8.00 | in |
| Diameter | 8.00 | in |
| Discharge | 493931.97 | gal/day |

## Results

| | | |
|---|---|---|
| Discharge | 493931.97 | gal/day |
| Normal Depth | 8.00 | in |
| Flow Area | 0.35 | ft² |
| Wetted Perimeter | 2.09 | ft |
| Hydraulic Radius | 2.00 | in |
| Top Width | 0.00 | ft |
| Critical Depth | 0.41 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 0.00802 | ft/ft |
| Velocity | 2.19 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 0.74 | ft |
| Froude Number | 0.00 | |
| Maximum Discharge | 0.82 | ft³/s |
| Discharge Full | 0.76 | ft³/s |
| Slope Full | 0.00400 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | in |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | in |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |

# Worksheet for Full Capacity (8-inch)

## GVF Output Data

| | | |
|---|---|---|
| Normal Depth Over Rise | 100.00 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 8.00 | in |
| Critical Depth | 0.41 | ft |
| Channel Slope | 0.00400 | ft/ft |
| Critical Slope | 0.00802 | ft/ft |

# Worksheet for d/D (12-inch)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00270 | ft/ft |
| Normal Depth | 8.00 | in |
| Diameter | 12.00 | in |

## Results

| | | |
|---|---|---|
| Discharge | 937877.38 | gal/day |
| Flow Area | 0.56 | ft² |
| Wetted Perimeter | 1.91 | ft |
| Hydraulic Radius | 3.49 | in |
| Top Width | 0.94 | ft |
| Critical Depth | 0.51 | ft |
| Percent Full | 66.7 | % |
| Critical Slope | 0.00619 | ft/ft |
| Velocity | 2.61 | ft/s |
| Velocity Head | 0.11 | ft |
| Specific Energy | 0.77 | ft |
| Froude Number | 0.60 | |
| Maximum Discharge | 1.99 | ft³/s |
| Discharge Full | 1.85 | ft³/s |
| Slope Full | 0.00166 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | in |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | in |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |
| Normal Depth Over Rise | 66.67 | % |
| Downstream Velocity | Infinity | ft/s |

# Worksheet for d/D (12-inch)

## GVF Output Data

| | | |
|---|---|---|
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 8.00 | in |
| Critical Depth | 0.51 | ft |
| Channel Slope | 0.00270 | ft/ft |
| Critical Slope | 0.00619 | ft/ft |

# Cross Section for d/D (12-inch)

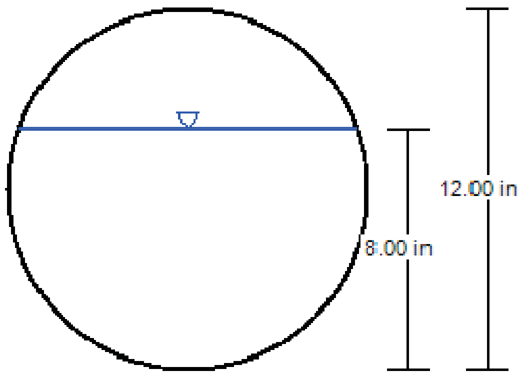
## Project Description

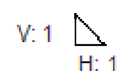
| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Discharge |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00270 | ft/ft |
| Normal Depth | 8.00 | in |
| Diameter | 12.00 | in |
| Discharge | 937877.38 | gal/day |

## Cross Section Image



# Worksheet for Full Capacity (12-inch)

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Full Flow Capacity |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 0.00270 | ft/ft |
| Normal Depth | 12.00 | in |
| Diameter | 12.00 | in |
| Discharge | 1196453.19 | gal/day |

## Results

| | | |
|---|---|---|
| Discharge | 1196453.19 | gal/day |
| Normal Depth | 12.00 | in |
| Flow Area | 0.79 | ft² |
| Wetted Perimeter | 3.14 | ft |
| Hydraulic Radius | 3.00 | in |
| Top Width | 0.00 | ft |
| Critical Depth | 0.58 | ft |
| Percent Full | 100.0 | % |
| Critical Slope | 0.00666 | ft/ft |
| Velocity | 2.36 | ft/s |
| Velocity Head | 0.09 | ft |
| Specific Energy | 1.09 | ft |
| Froude Number | 0.00 | |
| Maximum Discharge | 1.99 | ft³/s |
| Discharge Full | 1.85 | ft³/s |
| Slope Full | 0.00270 | ft/ft |
| Flow Type | SubCritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | in |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

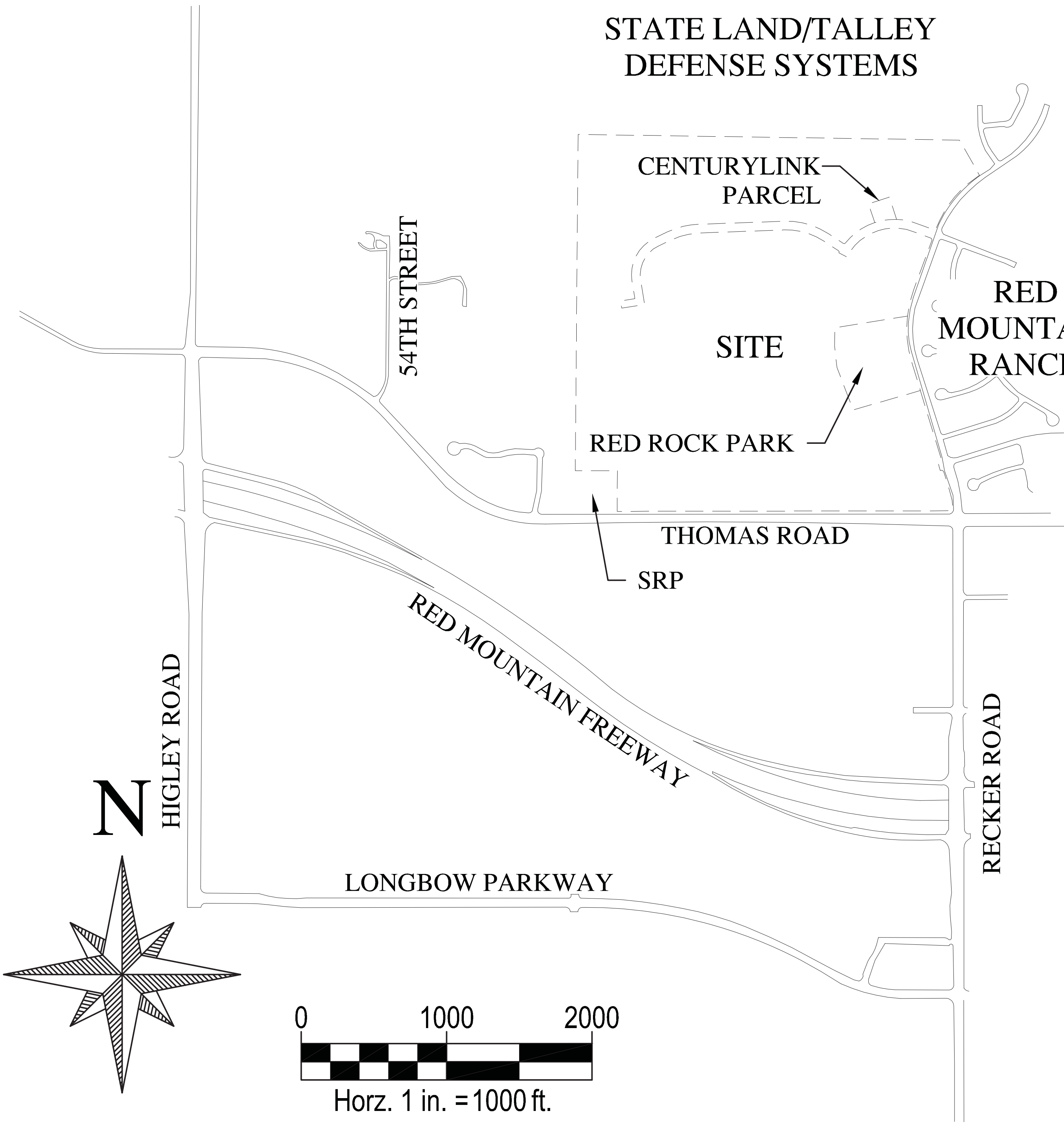
| | | |
|---|---|---|
| Upstream Depth | 0.00 | in |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Average End Depth Over Rise | 0.00 | % |

# Worksheet for Full Capacity (12-inch)

## GVF Output Data

| | | |
|---|---|---|
| Normal Depth Over Rise | 100.00 | % |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 12.00 | in |
| Critical Depth | 0.58 | ft |
| Channel Slope | 0.00270 | ft/ft |
| Critical Slope | 0.00666 | ft/ft |

## EXHIBIT 1 – VICINITY MAP




**NOT**
**FOR**
**CONSTRUCTION**
**OR RECORDING**

WOOD PATEL

# RESERVE AT RED ROCK

## EXHIBIT 1
## VICINITY MAP

| | | | | | |
|---|---|---|---|---|---|
| | | SCALE | 1" = 1000' | SHEET | 1 OF 1 |
| JOB NO. | 194961 | DESIGN | CW | CHECK | DWM |
| | | DRAWN | CW | | |

Z:\2019\194961\Project Support\Reports\Sewer BOD\Preliminary\Exhibits\4961-Exhibit 1-Vicinity Map.dwg

## EXHIBIT 2 – WASTEWATER LAYOUT


N

0 150 300

Horz. 1 in. = 150 ft.

*REFER TO UTILITY SHEETS SEWER DEPTHS AND SLOPES

LEGEND

| PROPOSED | EXISTING | |
|---|---|---|
| | | 8-INCH |
| | | 12-INCH |
| | | 4-INCH FORCE MAIN |
| | | 10-INCH FORCE MAIN |
| | | SEWER MANHOLE |
| | | SEWER CLEANOUT |

**NOT** FOR CONSTRUCTION OR RECORDING

WOOD PATEL

# RESERVE AT RED ROCK

EXHIBIT 2 - WASTEWATER LAYOUT

| DATE | | SCALE | 1" = 150' | SHEET | 1 OF 1 |
|---|---|---|---|---|---|
| JOB NO. | 194961 | DESIGN | CW | DRAWN | CW |

Z:\2019\194961\Project Support\Reports\Sewer BOD\Final\Exhibits\4961-Exhibit 2 Sewer Layout.dwg

# Appendix C

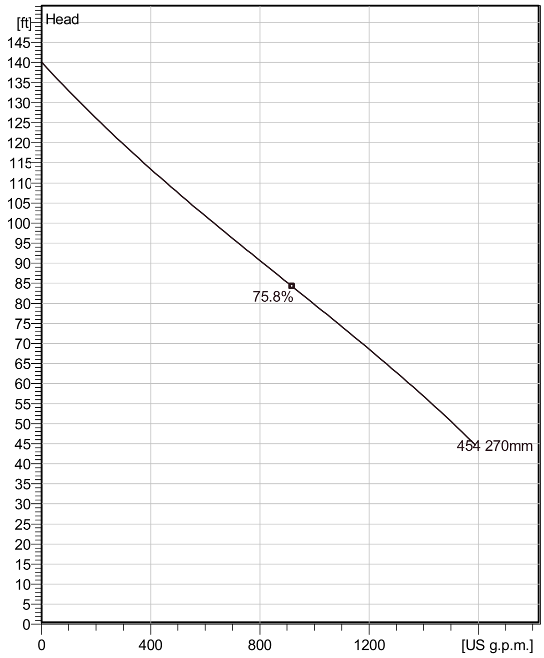
# Submersible Pump Data Sheets

# NP 3171 HT 3~ 454

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

## Technical specification

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



Curve: ISO 9906

## Configuration

**Motor number**
N3171.185 25-19-4AA-W 34hp

**Installation type**
P - Semi permanent, Wet

**Impeller diameter**
270 mm

**Discharge diameter**
4 inch

## Pump information

**Impeller diameter**
270 mm

**Discharge diameter**
4 inch

**Inlet diameter**
150 mm

**Maximum operating speed**
1760 rpm

**Number of blades**
2

**Max. fluid temperature**
40 °C

## Materials

**Impeller**
Hard-Iron ™

| | | | | | |
|---|---|---|---|---|---|
| **Project** | | **Created by** | ED Martin | | |
| **Block** | | **Created on** | 10/18/2022 | **Last update** | 10/18/2022 |

# NP 3171 HT 3~ 454

Technical specification

## Motor - General

| | | | |
|---|---|---|---|
| **Motor number**<br>N3171.185 25-19-4AA-W 34hp | **Phases**<br>3~ | **Rated speed**<br>1760 rpm | **Rated power**<br>34 hp |
| **ATEX approved**<br>No | **Number of poles**<br>4 | **Rated current**<br>40 A | **Stator variant**<br>7 |
| **Frequency**<br>60 Hz | **Rated voltage**<br>460 V | **Insulation class**<br>H | **Type of Duty**<br>S1 |
| **Version code**<br>185 | | | |

## Motor - Technical

| | | | |
|---|---|---|---|
| **Power factor - 1/1 Load**<br>0.87 | **Motor efficiency - 1/1 Load**<br>90.0 % | **Total moment of inertia**<br>4.13 lb ft² | **Starts per hour max.**<br>30 |
| **Power factor - 3/4 Load**<br>0.83 | **Motor efficiency - 3/4 Load**<br>91.0 % | **Starting current, direct starting**<br>281 A | |
| **Power factor - 1/2 Load**<br>0.74 | **Motor efficiency - 1/2 Load**<br>91.0 % | **Starting current, star-delta**<br>93.7 A | |

| | | | | | |
|---|---|---|---|---|---|
| **Project** | | **Created by** | ED Martin | | |
| **Block** | | **Created on** | 10/18/2022 | **Last update** | 10/18/2022 |

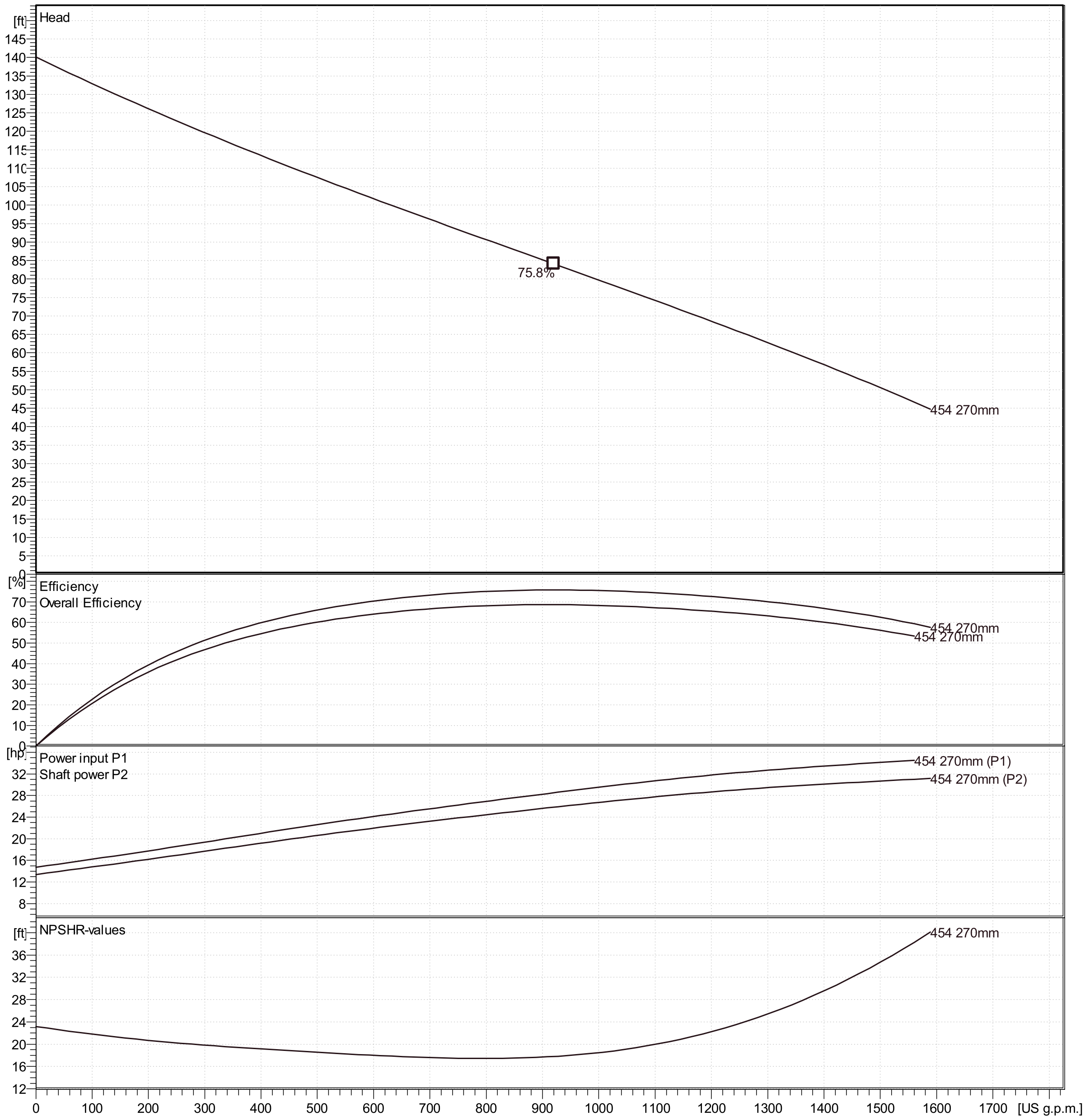
# NP 3171 HT 3~ 454

Performance curve

## Duty point

**Flow** **Head**

Curves according to: Water, pure Water, pure [100%],39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s




Curve: ISO 9906

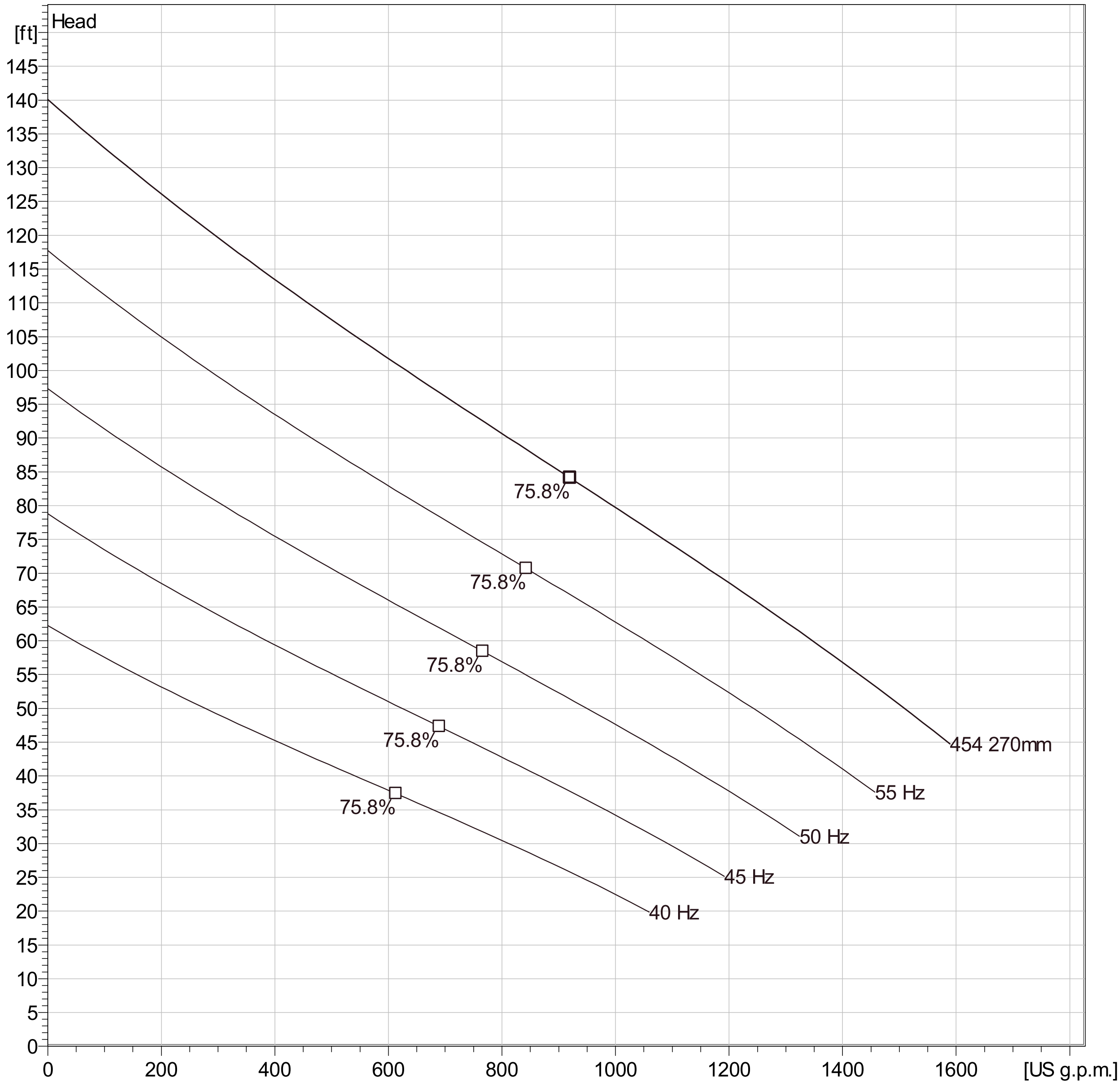
ED Martin

**Created on** 10/18/2022 **Last update** 10/18/2022

# NP 3171 HT 3~ 454

Duty Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s




## Operating characteristics

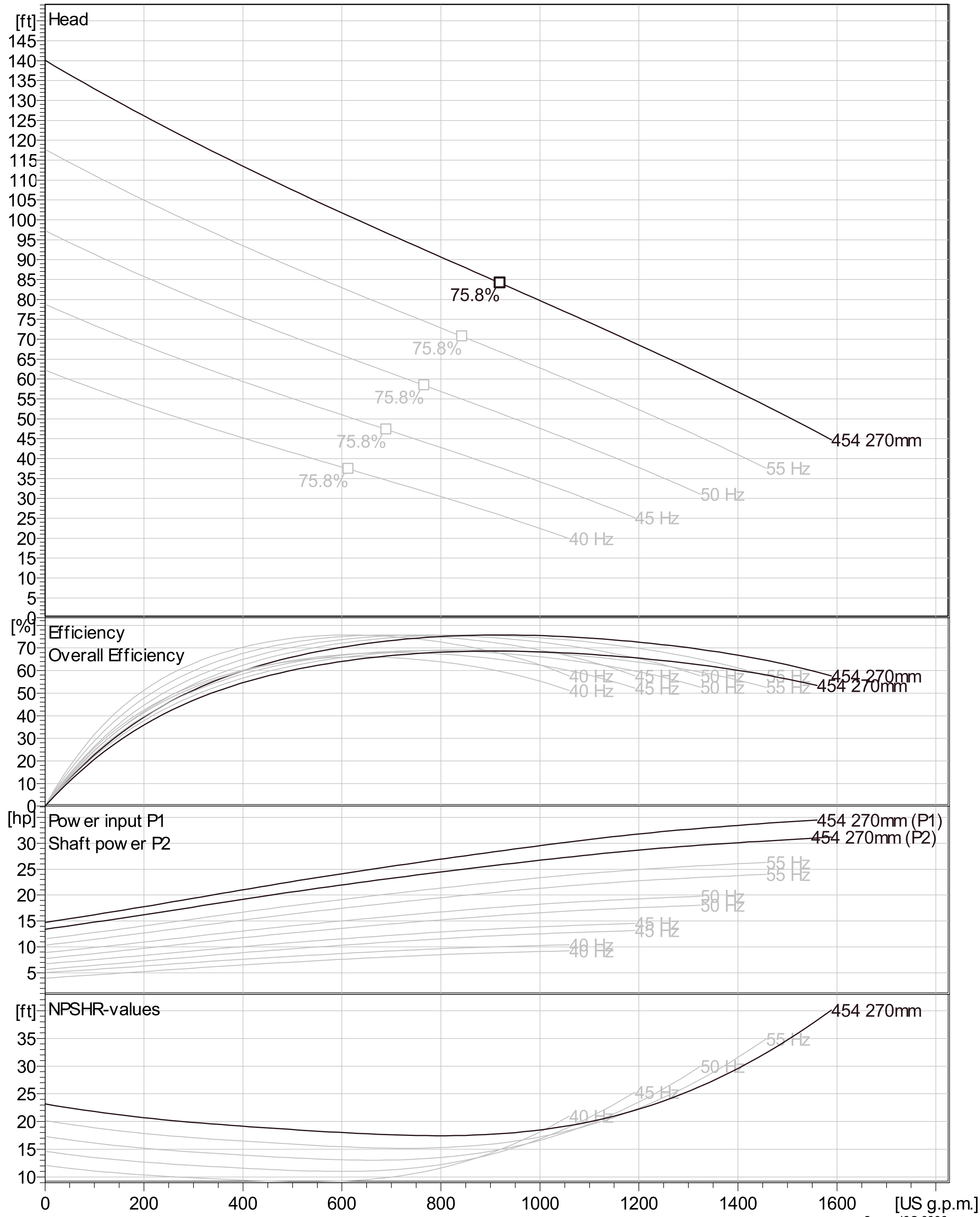
| Pumps / Systems | Flow | Head | Shaft power | Flow | Head | Shaft power | Hydr.eff. | Spec. Energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|
| | US g.p.m. | ft | hp | US g.p.m. | ft | hp | | kWh/US MG | ft |

| | | | |
|---|---|---|---|
| **Project** | **Created by** | ED Martin | |
| **Block** | **Created on** | 10/18/2022 | **Last update** 10/18/2022 |

# NP 3171 HT 3~ 454

VFD Curve

Curves according to: Water, pure ,39.2 °F,62.42 lb/ft³,1.6891E-5 ft²/s



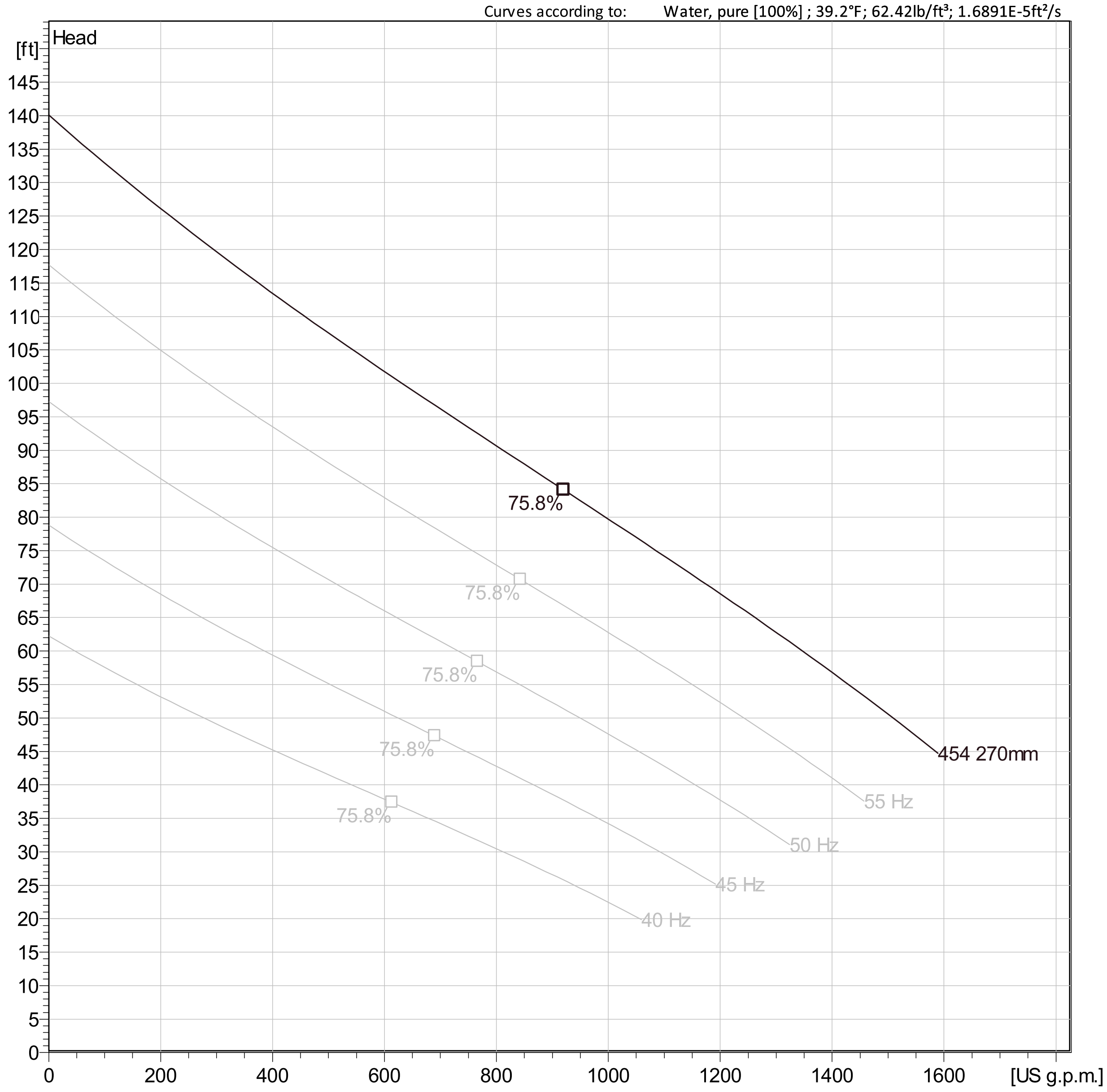

Curve: ISO 9906

| | | | |
|---|---|---|---|
| **Project** | **Created by** | ED Martin | |
| **Block** | **Created on** | 10/18/2022 | **Last update** 10/18/2022 |

# NP 3171 HT 3~ 454

VFD Analysis

Curves according to: Water, pure [100%] ; 39.2°F; 62.42lb/ft³; 1.6891E-5ft²/s




## Operating Characteristics

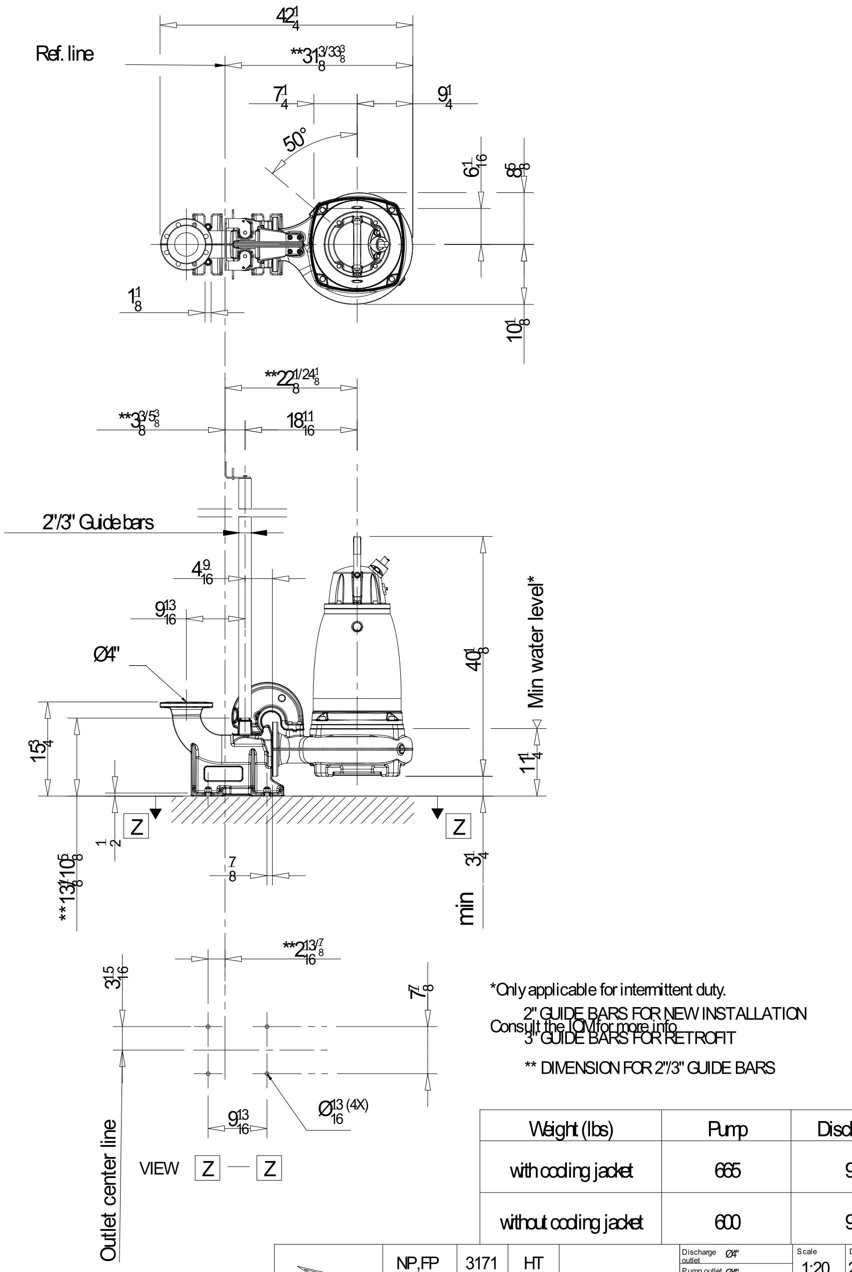
| Pumps / Systems | Frequency | Flow | Head | Shaft power | Flow | Head | Shaft power | Hydr.eff. | Specific energy | NPSHre |
|---|---|---|---|---|---|---|---|---|---|---|
| | | US g.p.m. | ft | hp | US g.p.m. | ft | hp | | kWh/US MG | ft |

| | | | | |
|---|---|---|---|---|
| **Project** | | **Created by** | ED Martin | | |
| **Block** | | **Created on** | 10/18/2022 | **Last update** | 10/18/2022 |

# NP 3171 HT 3~ 454

Dimensional drawing

FLYGT
a xylem brand




| Weight (lbs) | Pump | Discharge |
|---|---|---|
| with cooling jacket | 665 | 95 |
| without cooling jacket | 600 | 95 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FLYGT | NP,FP | 3171 | HT | Discharge outlet Ø4" / Pump outlet Ø4" | Scale 1:20 | Date 220225 |
| | 091, 095, 181, 185, 350, 390, 660, 670 | | | Pump inlet / Suction inlet | Drawing number 6599600 | Revision 15 |

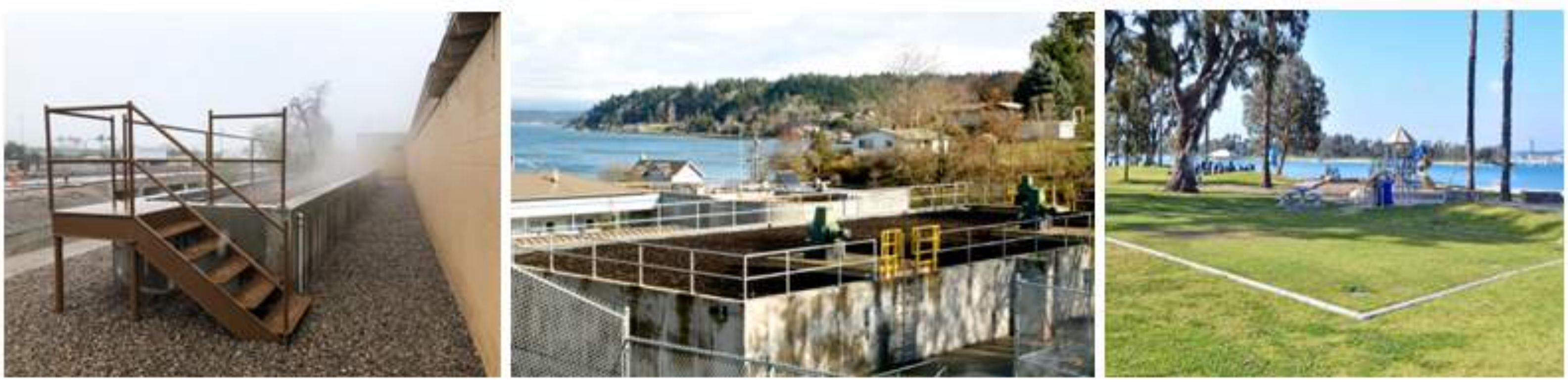
| | | | | |
|---|---|---|---|---|
| **Project** | | **Created by** | ED Martin | |
| **Block** | | **Created on** | 10/18/2022 **Last update** | 10/18/2022 |

# Appendix D

# Bohn Biofilter Budgetary Proposal

BOHN BIOFILTER CORP

Odor and Air Emissions Control



# STAR VALLEY LIFT STATION

CITY OF MESA

GHD

BOHN BIOFILTER BUDGETARY PROPOSAL – R1

**BOHN BIOFILTER CORP**
Odor and Air Emissions Control

bohnbiofilter.com
P.O. Box 44235
Tucson, AZ 85733
520.624.4644

| | |
|---|---|
| PREPARED FOR: | GHD |
| ATTENTION: | Damian De La Torre |
| DATE: | 10 February 2023 |
| PROJECT REFERENCE: | Star Valley Lift Station – Biofilter Odor Control – Revision 1 |

Dear Damian,

BOHN is pleased to offer the following revised budgetary proposal (Revision #1) for Star Valley Lift Station in Mesa, AZ per our Teams Meeting on February 7th, 2023.

For this application, Bohn proposes two systems: 1) our in-ground (or above-ground) raised flooring biofilter system and 2) our in-ground perforated pipe biofilter system; both with the following characteristics:

- A long-life biofilter media for reliable performance
- Minimal maintenance and operating costs
- Removal of nuisance odors and 99% hydrogen sulfide

The Bohn Biofilter system uses our unique soil biofilter medium, or soil media, which is a blend of sands, soils, top-soils, and amendments. It is self-regulating, pH stable, and has a large surface area that provides an extremely high capacity for adsorption. As an inorganic substrate, it will not settle, compact or plug.

Biofiltration effectively eliminates gases by facilitating the microbial consumption of gas molecules. Foul air passes over the filter medium covered with microorganisms. These microbes then consume, degrade and oxidize, the gas molecules using the digestive enzymes they produce as catalysts.

With extensive research and experience, Bohn Biofilter is a leader in the biofilter industry. Our biofilters are successful in treating air emissions for a wide range of facilities, including wastewater treatment, food processing, composting and more.

Thank you for your consideration and interest in our product…

a soil biofilter benefits your facility and your community.

Sincerely,

Kira McAvoy
***BOHN BIOFILTER CORP.***
C: 520.904.0684
www.bohnbiofilter.com

**Table of Contents:**



**Design Criteria:**

| **Updated Site Parameters** | |
|---|---|
| 10ft diameter Wetwell (new) | 600 CFM |
| 8ft diameter Wetwell (old/surcharge) | 300 CFM |
| 60” Manhole (new) | 100 CFM |
| 60” Influent Piping | 150 CFM |
| Existing Influent Manhole (old) | 150 CFM |
| **Total CFM = 1,300 (at 12 AC/H per Maricopa County)** | |

**Bohn Specification Table:**

| **Bohn Biofilter In-Ground Perforated Pipe System & In-Ground (or Above-ground) Raised Flooring System** | | |
|---|---|---|
| **Location/Name** | Star Valley Lift Station<br>City of Mesa | |
| **Odor Source** | Wet Well and Manhole | |
| **Air Flow** | 1,300 CFM | |
| **Inlet Air Temperature** | 50 – 120 degrees F | |
| **Airstream Contaminants** | $H_2S$, RSCs, Wastewater Odors | |
| **Biofilter Ductwork Size** | 16” | |
| **Biofilter Dimensions** | 400 $ft^2$ // 25’ L x 16’ W (ID)*<br>*In-ground Perforated Pipe Biofilter has a larger OD due to wall slope. | |
| **Media** | Bohn Soil Blend | |
| **Media Depth** | 5 ft | |
| **Media Weight** | 120 $lbs/ft^3$ | |
| **Media Volume** | 2,000 $ft^3$ | |
| **Removal Efficiency $H_2S$** | 99% DRE of $H_2S$ for concentrations of 10-200 ppm.<br>For concentrations below 10 ppm, a maximum discharge concentration of 0.1 ppm. | |
| **Design Conditions** | Design conditions are as stated per table. | |
| **Operating Requirements** | | |
| **Electrical** | Fan | 12-14” SP // 7.5 HP (estimated)<br>480 V, 60 Hz, 3 PH |
| | Irrigation Controller // Valve | 120 V // 24 V |
| **Water** | Irrigation | Potable/non-potable<br>40 psi minimum |
| **Drain** | 6” biofilter drain diameter recommended<br>Biofilter p-trap to be a minimum of 24 inches. | |

**Estimated Water Requirements**

| | |
|---|---|
| **Irrigation Zone** | One (1) – Entire Biofilter |
| **Irrigation PSI** | 35 PSI minimum |
| **Total GPM** | 6.16 GPM |
| **Anticipated Peak Flow** | 7 GPM |
| **Sprinkler Type** | Rainbird Series 3500 |
| **Sprinkler Count** | Six (6) |
| **Sprinkler Controller** | Rainbird ESP-ME3 |
| **Irrigation Pipe** | PVC – Schedule 80 |
| **Irrigation Pipe Size** | 1 inch |

**Bohn Biofilter Scope of Supply: In-Ground (or Above-ground) Raised Flooring Biofilter**

## I. <u>Included are the following components:</u>

A. Bohn soil media, the filter medium: a blend of sands, soils and top-soils.
B. Gravel and bedding material.
C. FRP Ductwork: above-ground.
D. Raised flooring air distribution system.
E. PE containment liner.
F. Grease Filter: mounted on fan inlet ductwork.
G. Foul air fan: FRP, with motor, flex-couplers, and discharge transition.
H. Fan Enclosure: blower sound attenuation.
I. Automated irrigation system: sprinkler type.
J. On-site construction consultation and start-up assistance.
K. Operator training and Operation & Maintenance manuals.
L. A ten (10) year life-span guarantee of the soil media.
M. Performance Test.

## II. <u>Included Components Detail:</u>

| | |
|---|---|
| Soil Media | Provide biofilter soil media, selected and amended per laboratory analysis, for the degradation of pollutant gases. It is a blend of sands, soils and topsoils. This Bohn soil blend will be delivered to the job site in bulk, moist, blended and ready-to-place. |
| Gravel/Media Bedding | Provide gravel for air distribution and media support; a clean, washed rock tested for suitability with corrosive gases. |
| FRP Ductwork | Provide above-ground (SMACNA) FRP ductwork from the above/below ground connection point to the biofilter inlet header. |
| Raised Flooring System | Provide a raised flooring system composed of support columns, flooring grid and perforated sheeting. All connections and perforations are prefabricated. |
| Polyethylene (PE) Containment Liner | Provide a BTL 40-mil single-sheet PE containment liner including: wall attachments for concrete curb/vault (curb/vault by contractor), biofilter seep rings, 8oz felt geomembrane and drain penetration boot. Installation assistance included for one (1) day. |

| | |
|---|---|
| Grease Filter | Provide a grease filter housing with filter pad(s), removable for cleaning, mounted prior to fan inlet for any airstream particulates. One (1) set of spare filters with housing grid included. |
| Foul Air Fan | Provide a 1,300 CFM centrifugal type FRP foul air fan suitable for foul air and corrosive gases at 12-14"SP. Includes fan motor, fan housing, LVR wrap, two (2) flexible connectors, discharge transition and drain. |
| Fan Sound Enclosure | Provide a FRP sound enclosure for foul air fan sound attenuation. Powered ventilator included. |
| Automated Irrigation System | Provide a sprinkler system for surface irrigation of the biofilter; independently controlled by an automated timer, and all ancillary components are provided up to the valve box. |
| On-site Construction Consultation | Provide authorized personnel for two (2) person-days for construction consultation. Includes certificate of proper installation. |
| Operator Training & Manuals | Provide authorized personnel for one (1) person-day for hands-on training to the operations staff in the correct operation of the biofilter. Includes Operation & Maintenance manuals produced specifically for the project. |
| Warranty | A ten (10) year life-span guarantee of the soil media. Includes a written guarantee that the soil media will not need removal or replacement for at least ten (10) years. |
| Performance Test | Provide a performance test. Testing will not occur until biofilter manufacturer deems ready; typically a minimum of 14 consecutive days of operation. |

**III. <u>Excluded are the following components:</u>**

A. Installation of any components.
B. Any below-ground ductwork or piping.
C. Any fan control components.
D. Any concrete works for vault, curb, fan, or other.
E. Any duct supports, anchors, or fasteners.
F. Any electrical wiring to the fan, irrigation controller, or other.
G. Any plumbing to the irrigation system.
H. Drain pipe and drain pipe cleanouts outside the wall of the biofilter.

**Bohn Biofilter Scope of Supply: In-Ground Perforated Pipe Biofilter**

## I. Included are the following components:

A. Bohn soil media, the filter medium: a blend of sands, soils and top-soils.
B. Gravel, air distribution and pipe-bedding material.
C. FRP Ductwork: above-ground.
D. PE containment liner.
E. Perforated pipe air distribution system.
F. Grease Filter: mounted on fan inlet ductwork.
G. Foul air fan: FRP, with motor, flex-couplers, and discharge transition.
H. Fan Enclosure: blower sound attenuation.
I. Automated irrigation system: sprinkler type.
J. On-site construction consultation and start-up assistance.
K. Operator training and Operation & Maintenance manuals.
L. A ten (10) year life-span guarantee of the soil media.
M. Performance Test.

## II. Included Components Detail:

| | |
|---|---|
| Soil Media | Provide biofilter soil media, selected and amended per laboratory analysis, for the degradation of pollutant gases. It is a blend of sands, soils and topsoils. This Bohn soil blend will be delivered to the job site in bulk, moist, blended and ready-to-place. |
| Gravel/Pipe Bedding | Provide gravel for air distribution, media support and bedding of pipe; a clean, washed rock tested for suitability with corrosive gases. |
| FRP Ductwork | Provide above-ground (SMACNA) FRP ductwork from the above/below ground connection point to the biofilter inlet header. |
| Polyethylene (PE) Containment Liner | Provide a BTL 40-mil single-sheet PE containment liner including: tape-on boots and fittings for pipe penetrations. Installation assistance included for one (1) day. |
| Perforated Pipe Air Distribution System | Provide a 15” header manifold with prefabricated lateral connection stubs and perforated air distribution pipe/fittings/cleanouts made of HDPE. All connections and perforations are prefabricated. |

| | |
|---|---|
| Grease Filter | Provide a grease filter housing with filter pad(s), removable for cleaning, mounted prior to fan inlet for any airstream particulates. One (1) set of spare filters with housing grid included. |
| Foul Air Fan | Provide a 1,300 CFM centrifugal type FRP foul air fan suitable for foul air and corrosive gases at 12-14”SP. Includes fan motor, fan housing, LVR wrap, two (2) flexible connectors, discharge transition and drain. |
| Fan Sound Enclosure | Provide a FRP sound enclosure for foul air fan sound attenuation. Powered ventilator included. |
| Automated Irrigation System | Provide a sprinkler system for surface irrigation of the biofilter; independently controlled by an automated timer, and all ancillary components are provided up to the valve box. |
| On-site Construction Consultation | Provide authorized personnel for two (2) person-days for construction consultation. Includes certificate of proper installation. |
| Operator Training & Manuals | Provide authorized personnel for one (1) person-day for hands-on training to the operations staff in the correct operation of the biofilter. Includes Operation & Maintenance manuals produced specifically for the project. |
| Warranty | A ten (10) year life-span guarantee of the soil media. Includes a written guarantee that the soil media will not need removal or replacement for at least ten (10) years. |
| Performance Test | Provide a performance test. Testing will not occur until biofilter manufacturer deems ready; typically a minimum of 14 consecutive days of operation. |

**III. Excluded are the following components:**

A. Installation of any components.
B. Any below-ground ductwork or piping.
C. Any fan control components.
D. Any concrete works for vault, curb, fan, or other.
E. Any duct supports, anchors, or fasteners.
F. Any electrical wiring to the fan, irrigation controller, or other.
G. Any plumbing to the irrigation system.
H. Drain pipe and drain pipe cleanouts outside the wall of the biofilter.

**Excluded Components Detail:**

Components that are required but not included are: contractor services, concrete work, all foul air duct/piping other than biofilter air pipe, fan control components, electrical wiring, water supply, drain plumbing, any anchors or fasteners.

**Included Services:**

An authorized manufacturers' representative shall provide on-site consultation for installation, start-up and operator training; a total of two (2) visits.

**Excluded Services:**

Any installation of components is not included.

**System Warranty:**

The Bohn Biofilter Corporation guarantees all soil biofilter media for a minimum service life of ten (10) years, without the need for replacement or major repair due to wear or failure.

The Bohn Biofilter Corporation further guarantees, when the biofilter is operated at design conditions, the performance of the biofilter, for the lifetime of the soil biofilter media will be: as stated in the Design Performance.

**Pricing:**

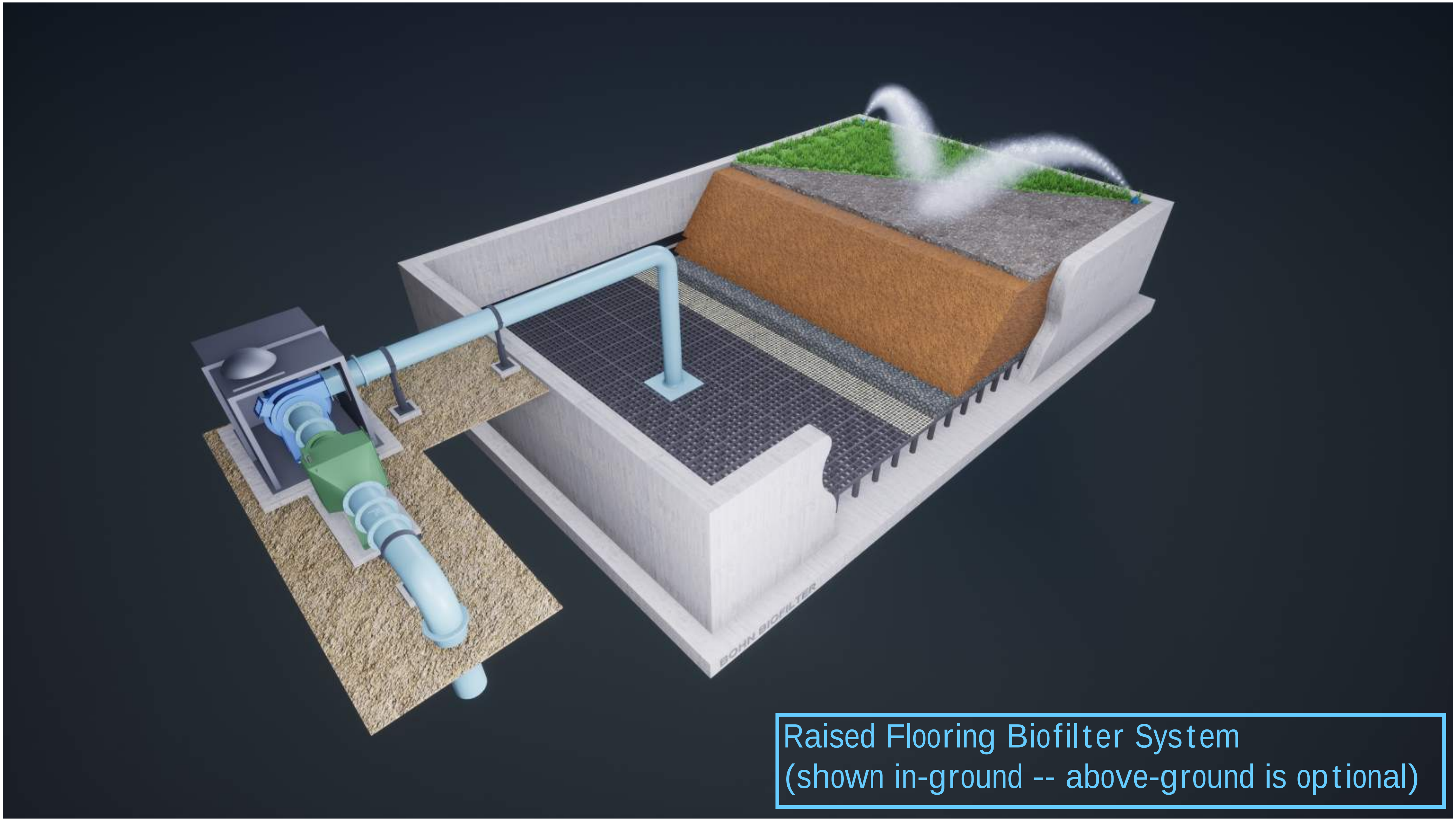
↳ For the biofilter odor control system(s) and service(s) described above, we are pleased to quote the following budgetary prices:

| | |
|---|---|
| In-ground (or Above-ground) Raised Flooring Biofilter System (OPT. #1) | $208,000.^{00}$ |
| In-ground Perforated Pipe Biofilter System (OPT. #2) | $215,000.^{00}$ |

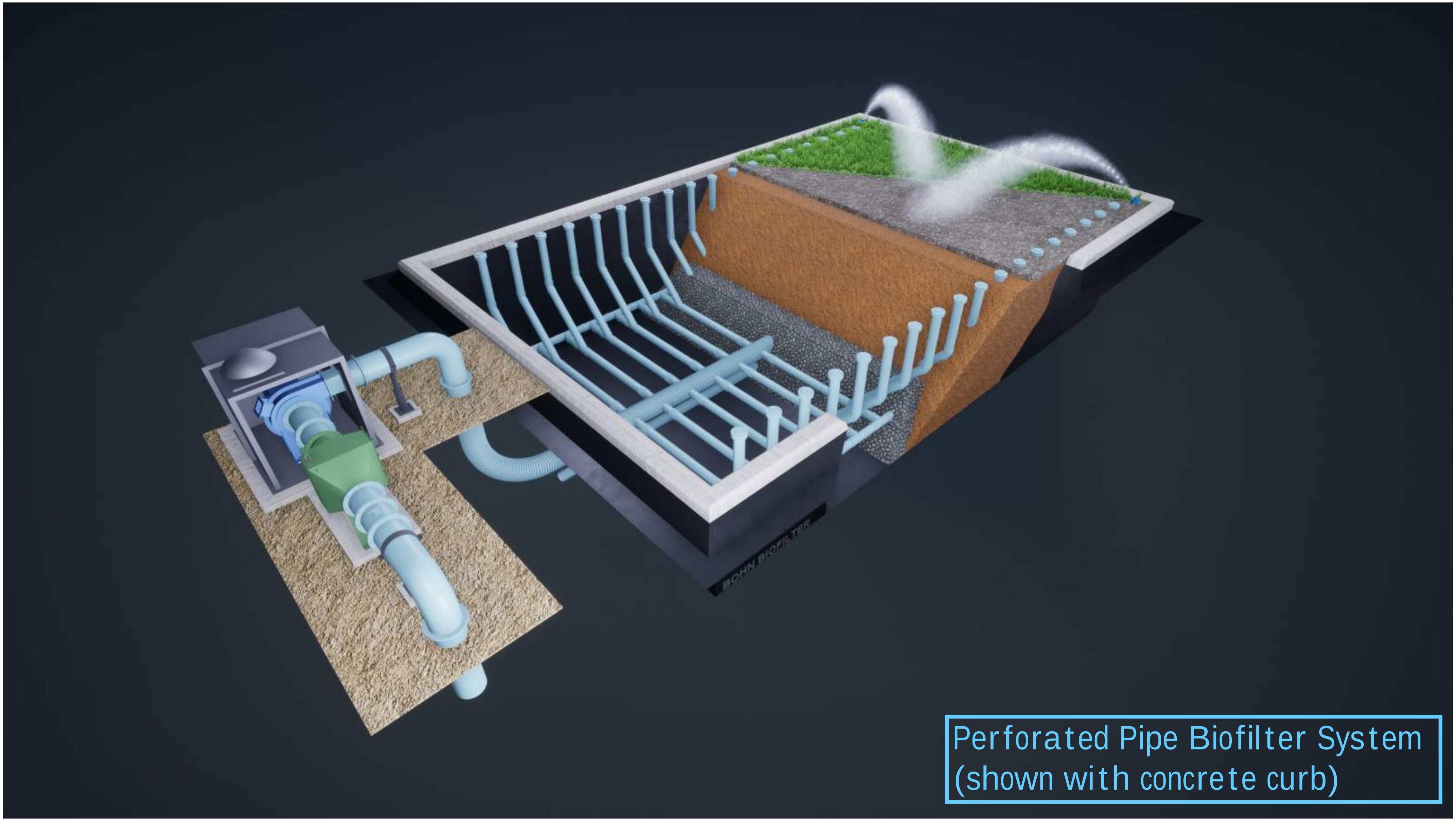
Price Includes freight to the job site.
Price does not include taxes, if any.

Pricing valid for six (6) months from date of proposal.

End of Section




Raised Flooring Biofilter System
(shown in-ground -- above-ground is optional)

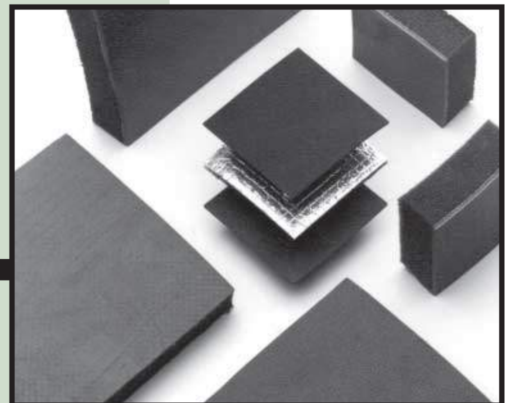

BOHN BIOFILTER
Perforated Pipe Biofilter System
(shown with concrete curb)

# SOUNDSCREEN™ Vinyl Noise Barriers and Mats

## a McGill AirSilence™ Product

**Product Bulletin 4241**

United McGill® products



**Vinyl Noise Barriers**

Our vinyl noise barriers are easy to install. Materials may be laid on floors, draped over uneven surfaces or suspended as a curtain wall.

### SOUNDSCREEN Vinyl Noise Barriers Effectively Block Airborne Noise

SOUNDSCREEN Vinyl Noise Barrier is flexible fused vinyl sheet material loaded with high density inert fillers. This combination of materials provides the limpness and mass necessary for the effective blocking of airborne noise. Easy to cut and install, the material may be laid on floors, draped over uneven surfaces or suspended as a curtain wall.

### Standard Products

**Reinforced Loaded Vinyl (LVR):** The basic 1/8-inch-thick, 1 lb/sq ft density loaded vinyl is reinforced in the center with a polyester scrim. Use in all hanging or other applications where superior integral material strength is needed.

**Clear Vinyl (LVC):** Used as a transparent curtain or as a window in a curtain enclosure, SOUNDSCREEN standard LVC is 0.08 inches thick to 0.5 lb/sq ft density. Where required, 0.75 and 1 lb/sq ft densities can be furnished.

**Plain Black Reinforced (LV):** Our lowest-cost LV bonds to sheet metal or plywood to make machinery covers or walls. Lay it under rugs or over ceilings to cut down on noise transmitted into plant offices.

**Floor Mat (FVM-1 or FVM-1S):** Unreinforced black loaded vinyl with a 1/4-inch backing of decoupling foam fused to LV. It is used on floors, bulkheads, and side panels to cut down road, engine, and drive train noise. Plain surface model (FVM-1) is coated with a scuff-resistant vinyl to improve wear resistance (FVM-1S).

### Installation

The 1/8-inch-thick loaded vinyl comes in rolls and can be easily cut with a knife, shears, or steel rule die. When suspended from an existing wall or partition, the vinyl should be pinched between bolted support strips and suspended from a suitable structural support.

For curtain applications, a grommeting kit (SOUNDSCREEN GK-1) containing a tool and grommets is available for economical self-installation. Grommets should be spaced on maximum 12-inch centers, and adjacent sections can be overlapped 6 inches to reduce acoustical leakage.

A variety of methods can be used to acoustically seal overlapping seams. For flashing existing partitions up to a ceiling, the adjoining vinyl sheets can be riveted or bolted together. For custom-designed curtain enclosures and barriers, Velcro® strips can be sewn onto the vinyl edges to provide a positive sealing mechanism.

Loaded vinyl contains a plasticizer ingredient that can create adhesion problems. For applications where an adhesive seal is appropriate, using a two-part urethane is recommended.

Products depicted in this specification sheet were current at the time of publication. As a quality-conscious manufacturer, McGill AirSilence is continually seeking ways to improve its products to better serve its customers. Therefore, all designs, specifications, and product features are subject to change without notice.

United McGill® is a registered trademark, and McGill AirSilence™ and SOUNDSCREEN™ are trademarks of United McGill Corporation.

Velcro® is a registered trademark of Velcro Industries B.V.

**Acoustical Properties**

| Material | Typical Sound Loss in dB | | | | | | STC |
|---|---|---|---|---|---|---|---|
| | 125 | 250 | 500 | 1K | 2K | 4K | |
| 1 lb/sq ft LV and LVR | 15 | 19 | 21 | 26 | 33 | 37 | 27 |
| 0.5 lb/sq ft LVC | 8 | 19 | 16 | 21 | 25 | 30 | 20 |

**Physical Properties**

| Product | Thickness and Weight | Temperature Range (°F) | Color | Resistance (all products) |
|---|---|---|---|---|
| LVR | 1/8″, 1 lb/sq ft | 0-180 | black | water: excellent<br>petroleum: excellent |
| LV | 1/8″, 1 lb/sq ft | 0-180 | black | alkalis: good |
| LVC | 0.08″, 0.5 lb/sq ft | 0-120 | clear | flame: meets MVSS 302 |

**Product Availability**

| Model | Roll Size | Vinyl Description |
|---|---|---|
| LVR | 54″ x 60′ | gray, reinforced vinyl |
| LVC | 48″ x 60′ | clear vinyl |
| LV | 54″ x 60′ | black, unreinforced vinyl |
| FVM-1 | 54″ x 60′ | black, vinyl floor mat |
| FVM-1S | 54″ x 60′ | black, vinyl floor mat with scuff coating |

McGill AirSilence LLC

An enterprise of United McGill Corporation — Founded in 1951

2400 Fairwood Avenue
Columbus, Ohio 43207-2700
614/443-5520, Fax: 614/542-2620
E-mail: acoustics@mcgillairsilence.com
Web site: mcgillairsilence.com



Form No. MASIL-4241 4/05

# Appendix E

# Opinion of Cost

# City of Mesa
## Star Valley Sewer Lift Station Rehabilitation
## Preliminary Opinion of Cost

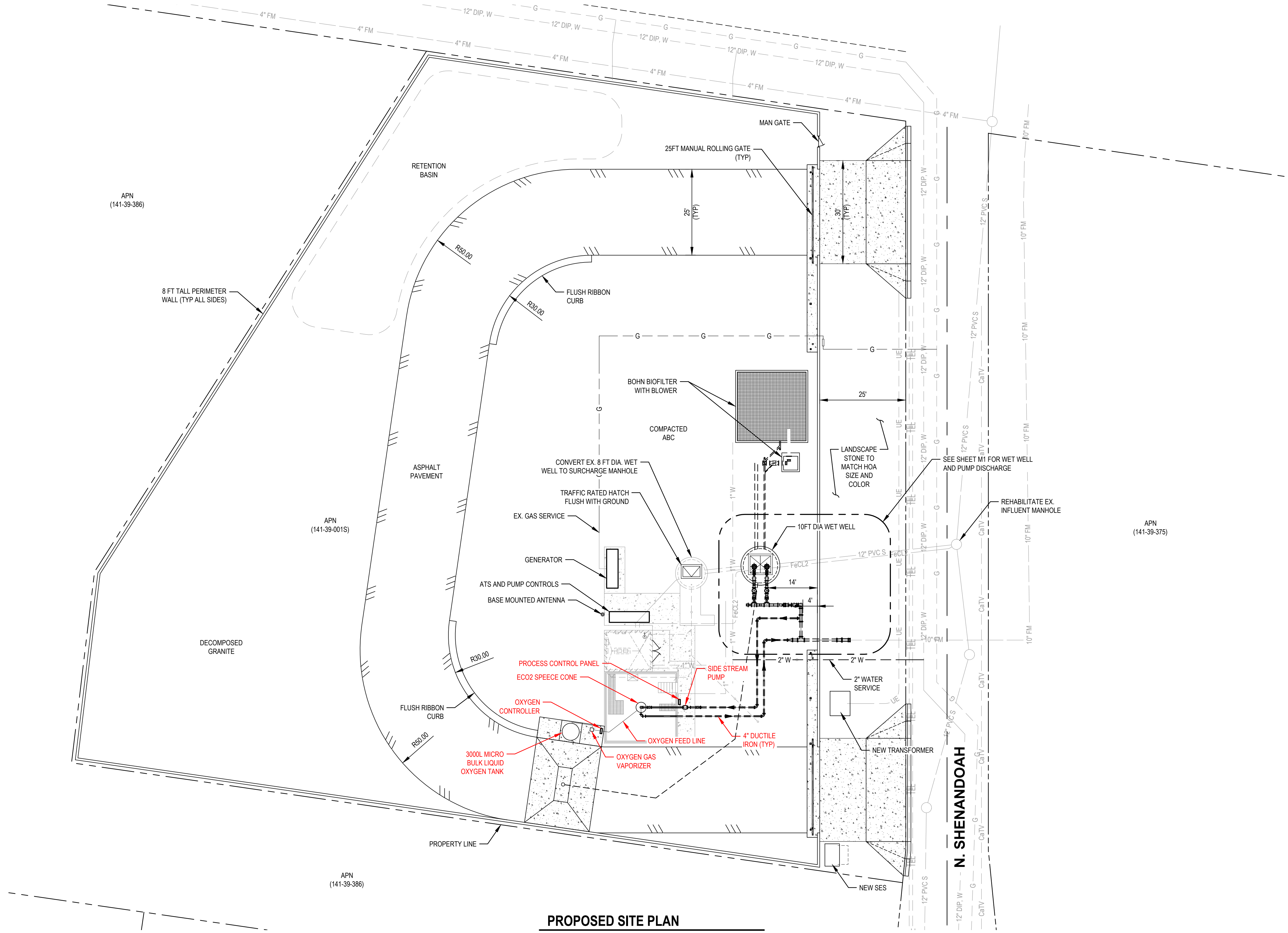
| Description | Unit | Quantity | Unit Price | Total |
|---|---|---|---|---|
| | | | | |
| Construction Staking and As-Builts | LS | 1 | $11,400 | $11,400 |
| Traffic Control | LS | 1 | $11,200 | $11,200 |
| Mobilization/De-Mobilization | LS | 1 | $49,800 | $49,800 |
| Utility Locating | LS | 1 | $21,000 | $21,000 |
| Demolition and Removal of Existing Piping | LS | 1 | $15,000 | $15,000 |
| Connect to Existing Surcharge Overflow Manhole | EA | 1 | $6,480 | $6,480 |
| Connect to Existing Forcemain | EA | 1 | $5,000 | $5,000 |
| CMU Wall | LF | 735 | $400 | $294,000 |
| Excavation, Shoring, Backfill, & Hauling | LS | 1 | $132,750 | $132,750 |
| Site Grading | LS | 1 | $42,000 | $42,000 |
| Compacted ABC Driveway (8") | SY | 1333 | $60 | $79,980 |
| Asphalt Pavement | SY | 900 | $116 | $104,400 |
| 1-1/2" - 1/4" DG | SY | 1594 | $50 | $79,700 |
| Concrete Pavement | SF | 2260 | $25 | $56,500 |
| Ribbon Curb | LF | 84 | $150 | $12,600 |
| 25' Rolling Gate | EA | 2 | $25,000 | $50,000 |
| Man Gate | EA | 1 | $5,000 | $5,000 |
| Replace Pump Room Doors | EA | 2 | $3,000 | $6,000 |
| Replace Existing 8-ft dia.Wet Well Hatch with Traffic Rated Hatch | EA | 1 | $10,000 | $10,000 |
| Rehab Existing MH | EA | 2 | $29,592 | $59,184 |
| 5' Diameter MH | EA | 1 | $10,000 | $10,000 |
| 10' Diameter 34' Deep Wet Well | EA | 1 | $147,500 | $147,500 |
| Wet Well Coating | SF | 1800 | $30 | $54,000 |
| Submersible Pump | EA | 3 | $51,828 | $155,483 |
| 8" DIP Force Main | LF | 180 | $310 | $55,800 |
| 8" DIP 90 Bend | EA | 3 | $2,000 | $6,000 |
| 8" DIP 45 Bend | EA | 6 | $1,600 | $9,600 |
| 8" DIP Tee | EA | 3 | $1,200 | $3,600 |
| 4" x 8" DIP 90 Bend Reducer | EA | 3 | $1,500 | $4,500 |
| 8" Plug Valve | EA | 5 | $2,738 | $13,688 |
| 8" Swing Check Valve | EA | 3 | $4,994 | $14,981 |
| 8" Ultrasonic Flow Meter | EA | 1 | $14,675 | $14,675 |
| 8" x 10" DIP Reducer | EA | 1 | $1,800 | $1,800 |
| New 2" Water Service | LS | 1 | $2,500 | $2,500 |
| 10" Restrained Coupling Adapter | EA | 1 | $1,000 | $1,000 |
| 2" H-Tec Air Release Valve, Epoxy Coated | EA | 4 | $2,625 | $10,500 |
| Pipe and Equipment Coating | LS | 1 | $30,000 | $30,000 |

# City of Mesa
## Star Valley Sewer Lift Station Rehabilitation
## Preliminary Opinion of Cost

| | | | | |
|---|---|---|---|---|
| Pipe Support | EA | 8 | $2,600 | $20,800 |
| Wet Well Wizard | EA | 1 | $16,826 | $16,826 |
| 12" PVC Gravity Sewer | LF | 10 | $351 | $3,510 |
| Temporary Sewer Bypass Pumping | LS | 1 | $55,200 | $55,200 |
| New Chemical Metering Pump Skid | EA | 1 | $62,500 | $62,500 |
| New 6,000 Gallon Fiberglass Tank with Ladder and Walkway | EA | 1 | $40,000 | $40,000 |
| Recoat Chemical Containment Area | SF | 980 | $30 | $29,407 |
| Chemical Fill Station | LS | 1 | $15,000 | $15,000 |
| Emergency Eyewash Station | EA | 2 | $1,850 | $3,700 |
| New Biofilter, in-ground, raised floor | EA | 1 | $313,148 | $313,148 |
| Electrical Improvements | LS | 1 | $377,995 | $377,995 |
| | | | | |
| Subtotal | | | | $2,525,707 |
| Project Contingency | 10% | | | $252,571 |
| Market Escalation Factor | 15% | | | $378,856 |
| Overhead & Profit | 15% | | | $473,570 |
| Bond & Insurance | 3% | | | $94,714 |
| **Total** | | | | **$3,725,417** |

# Appendix F

# $ECO_2$ System Site Plan




## PROPOSED SITE PLAN

SCALE: 1" = 15'

N

0 15' 30'

CITY OF MESA
LIFT STATION IMPROVEMENTS
STAR VALLEY

PROPOSED SITE PLAN
ECO2 SYSTEM

Project No. 12577360
Report No. N/A
Date JUNE 2024

C3

Filename: G:\561\12577360\Digital_Design\ACAD 2020\Figures\Sheets\Star Valley\12577360-GHD-STRV-DWG-CI-0003_ECO.dwg
Plot Date: 3 June 2024 - 2:26 PM

Source:

# Appendix G

# $ECO_2$ Life Cycle Cost Comparison

## Replace FeCl2 System
## Capital Cost

| Description | Unit | Quantity | Unit Price | Total |
|---|---|---|---|---|
| | | | | |
| Concrete Pavement | SF | 432 | $25 | $10,800 |
| New Chemical Metering Pump Skid | EA | 1 | $62,500 | $62,500 |
| New 6,000 Gallon Fiberglass Tank with Ladder and Walkway | EA | 1 | $40,000 | $40,000 |
| Recoat Chemical Containment Area | SF | 980 | $30 | $29,407 |
| Chemical Fill Station | LS | 1 | $15,000 | $15,000 |
| Emergency Eyewash Station | EA | 1 | $1,850 | $1,850 |
| Electrical Improvements | LS | 1 | $5,000 | $5,000 |
| | | | | |
| Subtotal | | | | $164,557 |
| Overhead & Profit | 15% | | | $24,684 |
| Bond & Insurance | 3% | | | $4,937 |
| **Total** | | | | **$194,177** |

## ECO2 System
## Capital Cost

| Description | Unit | Quantity | Unit Price | Total |
|---|---|---|---|---|
| | | | | |
| Concrete Pavement | SF | 432 | $25 | $10,800 |
| 2" H-Tec Air Release Valve, Epoxy Coated | EA | 1 | $2,625 | $2,625 |
| 4" Plug Valve | EA | 2 | $1,500 | $3,000 |
| 4" 90 Degree Bend | EA | 9 | $800 | $7,200 |
| 8" x 4" Reducer | EA | 1 | $1,000 | $1,000 |
| 8" x 4" Tee | EA | 1 | $1,200 | $1,200 |
| 4" Ductile Iron Pipe | LF | 140 | $225 | $31,500 |
| ECO2 System (Speece Cone, Side Stream Pump & Controllers) | LS | 1 | $375,000 | $375,000 |
| Electrical Improvements | LS | 1 | $25,000 | $25,000 |
| | | | | |
| Subtotal | | | | $457,325 |
| Overhead & Profit | 15% | | | $68,599 |
| Bond & Insurance | 3% | | | $13,720 |
| **Total** | | | | **$539,644** |

## FeCl2 Annual Cost

| Description | Value | Unit |
|---|---|---|
| Anticipate Day Use | 365 | days/year |
| Cost of Power | 0.1 | $/kWhr |
| Pump Run Time | 24.0 | hr/day |
| 1/2 hp Pump Power | 0.4 | kW |
| Power Usage | 9.6 | kWhr/day |
| **Annual Power Cost** | **$ 350.40** | |
| Cost of FeCl2 | 1.63 | $/gal |
| FeCl2 Usage | 30.26 | gal/day |
| **Annual FeCl2 Cost** | **$ 18,003.19** | |
| **Total Annual FeCl2 Cost** | **$ 18,353.59** | |

## Oxygen Annual Cost (1,500L Micro Bulk Tank)

| Description | Value | Unit |
|---|---|---|
| Anticipate Day Use | 365 | days/year |
| Cost of Power | 0.1 | $/kWhr |
| Pump Run Time | 6.3 | hr/day |
| 5hp Pump Power | 8.0 | kW |
| Power Usage | 50.1 | kWhr/day |
| **Annual Power Cost** | **$ 1,829.87** | |
| Cost of Oxygen Gas (LOX, 99%) | 12.97 | $/1000 SCF |
| Oxygen Usage | 26,000 | SCF/month |
| Deliveries per Year | 7 | #/year |
| Oxygen Delivery Fee | 335 | $/delivery |
| Cost of Oxygen Lease | 526 | $/month |
| **Annual Oxygen Cost** | **$ 12,650.04** | |
| **Total Annual Oxygen Cost** | **$ 14,479.90** | |

## Oxygen Annual Cost (3,000L Micro Bulk Tank)

| Description | Value | Unit |
|---|---|---|
| Anticipate Day Use | 365 | days/year |
| Cost of Power | 0.1 | $/kWhr |
| Pump Run Time | 6.3 | hr/day |
| 5hp Pump Power | 8.0 | kW |
| Power Usage | 50.1 | kWhr/day |
| **Annual Power Cost** | **$ 1,829.87** | |
| Cost of Oxygen Gas (LOX, 99%) | 12.97 | $/1000 SCF |
| Oxygen Usage | 26,000 | SCF/month |
| Deliveries per Year | 3 | #/year |
| Oxygen Delivery Fees | 335 | $/delivery |
| Cost of Oxygen Lease/Delivery | 913 | $/month |
| **Annual Oxygen Cost** | **$ 16,148.34** | |
| **Total Annual Oxygen Cost** | **$ 17,978.20** | |

## FeCl2 Life Cycle Cost

| Annual Inflation | 2.5% | | |
|---|---|---|---|
| **Year** | **Capital Cost** | **Operational Cost** | **Total Cost** |
| 1 | $ 194,177 | $ 18,354 | $ 212,531 |
| 2 | | $ 18,812 | $ 231,344 |
| 3 | | $ 19,283 | $ 250,626 |
| 4 | | $ 19,765 | $ 270,391 |
| 5 | | $ 20,259 | $ 290,650 |
| 6 | | $ 20,765 | $ 311,415 |
| 7 | | $ 21,285 | $ 332,700 |
| 8 | | $ 21,817 | $ 354,517 |
| 9 | | $ 22,362 | $ 376,879 |
| 10 | | $ 22,921 | $ 399,800 |
| 11 | | $ 23,494 | $ 423,294 |
| 12 | | $ 24,081 | $ 447,375 |
| 13 | | $ 24,684 | $ 472,059 |
| 14 | | $ 25,301 | $ 497,360 |
| 15 | | $ 25,933 | $ 523,293 |
| 16 | | $ 26,581 | $ 549,874 |
| 17 | | $ 27,246 | $ 577,120 |
| 18 | | $ 27,927 | $ 605,047 |
| 19 | | $ 28,625 | $ 633,673 |
| 20 | | $ 29,341 | $ 663,014 |
| 21 | | $ 30,074 | $ 693,088 |
| 22 | | $ 30,826 | $ 723,914 |
| 23 | | $ 31,597 | $ 755,511 |
| 24 | | $ 32,387 | $ 787,898 |
| 25 | | $ 33,197 | $ 821,095 |
| 26 | | $ 34,027 | $ 855,122 |
| 27 | | $ 34,877 | $ 889,999 |
| 28 | | $ 35,749 | $ 925,748 |
| 29 | | $ 36,643 | $ 962,391 |
| 30 | | $ 37,559 | $ 999,950 |

## ECO2 Life Cycle Cost (1,500L Tank)
## 7 Deliveries per Year

| Annual Inflation | 2.5% | | |
|---|---|---|---|
| **Year** | **Capital Cost** | **Operational Cost** | **Total Cost** |
| 1 | $ 539,644 | $ 14,480 | $ 554,123 |
| 2 | | $ 14,842 | $ 568,965 |
| 3 | | $ 15,213 | $ 584,178 |
| 4 | | $ 15,593 | $ 599,772 |
| 5 | | $ 15,983 | $ 615,755 |
| 6 | | $ 16,383 | $ 632,137 |
| 7 | | $ 16,792 | $ 648,930 |
| 8 | | $ 17,212 | $ 666,142 |
| 9 | | $ 17,642 | $ 683,784 |
| 10 | | $ 18,083 | $ 701,867 |
| 11 | | $ 18,535 | $ 720,403 |
| 12 | | $ 18,999 | $ 739,402 |
| 13 | | $ 19,474 | $ 758,876 |
| 14 | | $ 19,961 | $ 778,836 |
| 15 | | $ 20,460 | $ 799,296 |
| 16 | | $ 20,971 | $ 820,267 |
| 17 | | $ 21,495 | $ 841,763 |
| 18 | | $ 22,033 | $ 863,796 |
| 19 | | $ 22,584 | $ 886,379 |
| 20 | | $ 23,148 | $ 909,528 |
| 21 | | $ 23,727 | $ 933,255 |
| 22 | | $ 24,320 | $ 957,575 |
| 23 | | $ 24,928 | $ 982,503 |
| 24 | | $ 25,551 | $ 1,008,054 |
| 25 | | $ 26,190 | $ 1,034,245 |
| 26 | | $ 26,845 | $ 1,061,089 |
| 27 | | $ 27,516 | $ 1,088,606 |
| 28 | | $ 28,204 | $ 1,116,810 |
| 29 | | $ 28,909 | $ 1,145,719 |
| 30 | | $ 29,632 | $ 1,175,350 |

## ECO2 Life Cycle Cost (3,000L Tank)
## 3 Deliveries per Year

| Annual Inflation | 2.5% | | |
|---|---|---|---|
| **Year** | **Capital Cost** | **Operational Cost** | **Total Cost** |
| 1 | $ 539,644 | $ 17,978 | $ 557,622 |
| 2 | | $ 18,428 | $ 576,049 |
| 3 | | $ 18,888 | $ 594,938 |
| 4 | | $ 19,361 | $ 614,298 |
| 5 | | $ 19,845 | $ 634,143 |
| 6 | | $ 20,341 | $ 654,484 |
| 7 | | $ 20,849 | $ 675,333 |
| 8 | | $ 21,370 | $ 696,703 |
| 9 | | $ 21,905 | $ 718,608 |
| 10 | | $ 22,452 | $ 741,060 |
| 11 | | $ 23,014 | $ 764,074 |
| 12 | | $ 23,589 | $ 787,663 |
| 13 | | $ 24,179 | $ 811,841 |
| 14 | | $ 24,783 | $ 836,625 |
| 15 | | $ 25,403 | $ 862,027 |
| 16 | | $ 26,038 | $ 888,065 |
| 17 | | $ 26,689 | $ 914,754 |
| 18 | | $ 27,356 | $ 942,110 |
| 19 | | $ 28,040 | $ 970,150 |
| 20 | | $ 28,741 | $ 998,891 |
| 21 | | $ 29,459 | $ 1,028,350 |
| 22 | | $ 30,196 | $ 1,058,546 |
| 23 | | $ 30,951 | $ 1,089,497 |
| 24 | | $ 31,725 | $ 1,121,221 |
| 25 | | $ 32,518 | $ 1,153,739 |
| 26 | | $ 33,331 | $ 1,187,069 |
| 27 | | $ 34,164 | $ 1,221,233 |
| 28 | | $ 35,018 | $ 1,256,251 |
| 29 | | $ 35,893 | $ 1,292,145 |
| 30 | | $ 36,791 | $ 1,328,935 |

about

# GHD

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**Karl Tobin**
Karl.Tobin@ghd.com
602.216.7236

www.ghd.com