DRAFT Technical Memorandum

Date: September 1, 2020

Project: Water System Recommendations Improvements

To: Mr. Andrew Degner, P.E.
Eastmont Water Company, Board Chair

From: Justin Ford, P.E.
Matt Hickey, P.E. (Reviewer)
Murraysmith

Re: Water System Evaluation and Recommended Improvements

Introduction

The purpose of this Technical Memorandum (report) is to summarize the on-site observations conducted, historical records review, overall system configuration, and recommended improvements for the Eastmont Water Company (EWC) community water system. The report provides conceptual cost estimates and figures in support of system improvement options and recommended upgrades for the EWC to increase resiliency and longevity of their existing facilities and construct new facilities.

The EWC is a community-owned drinking water utility located east of the Portland/Metro area which serves approximately 110 customers. The system is located within Sections 25, 26, 35, and 36 of Township 1 South, Range 3 east of the Willamette Meridian. The water system consists of a water supply well, a cast iron transmission main, two steel storage reservoir standpipes, and associated distribution piping. The general system configuration is shown in **Table 1**.

Table 1
General System Asset Existing Configuration Summary

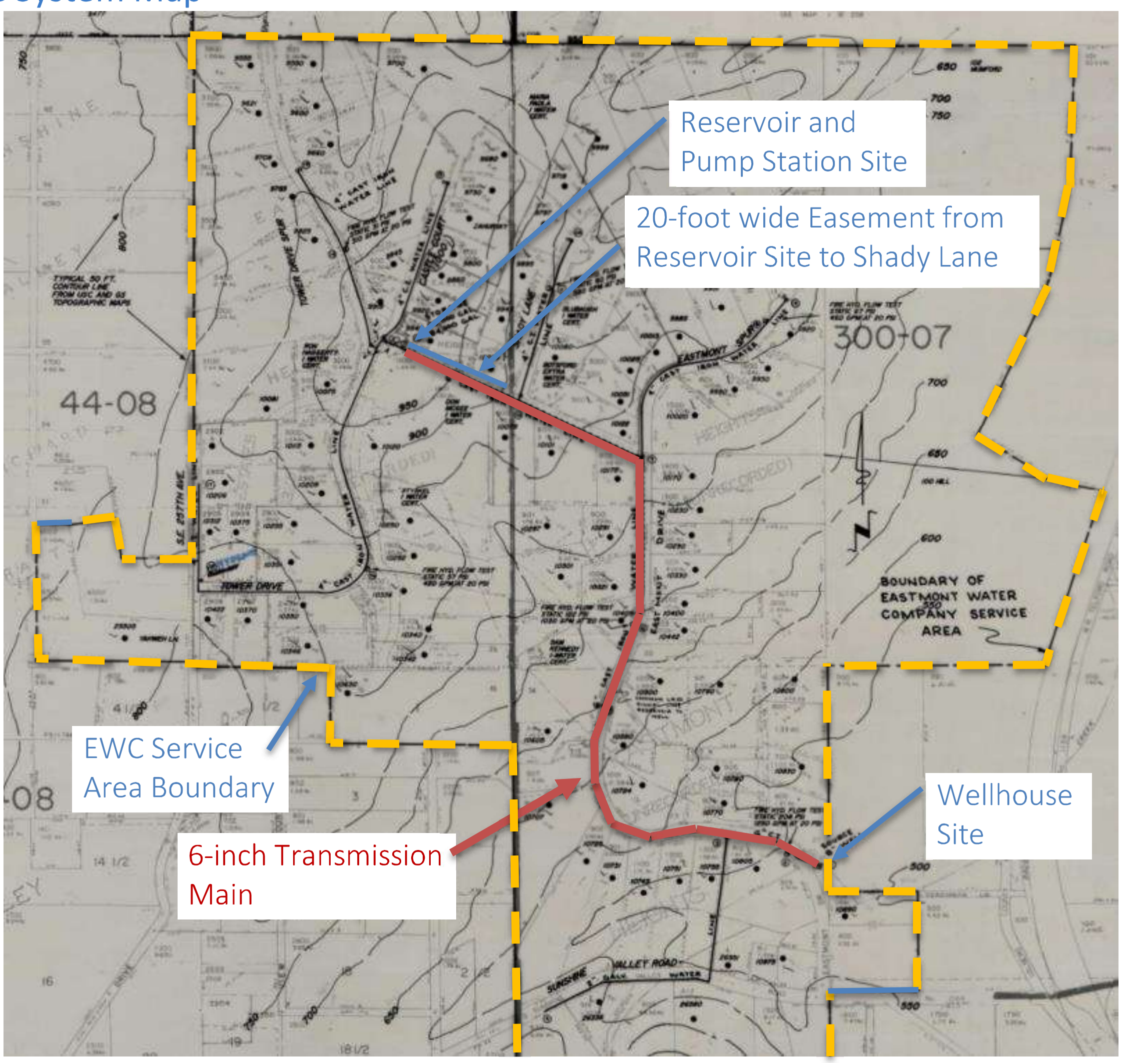
Facility	Year Built	Configuration
Reservoir 1 (West)	1965	60 KG Welded Steel Standpipe, 16’ diameter, 40’ Shell Height
Reservoir 2 (East)	1975	84 KG Welded Steel Standpipe, 19’ diameter, 40’ Shell Height
High Zone Pump Station / Storage Building	Pre-1975	Approx. 8’ wide by 16’ long by 8’ tall (Wall) w/ 5HP, 70 gpm Pump with Variable Frequency Drive (VFD), and 6.3’ tall Basement with one Decommissioned and one 81 gallon Active Pressure Tank
Well House and Pump	1965	308-foot deep, 8” dia. Casing w/ 50HP, 215 gpm Submersible Pump

This report presents findings of the evaluation and discusses alternatives for improvements relative to the EWC system as a whole. This evaluation is compiled based on observations made in the field, and EWC prioritization of improvements as conveyed to Murraysmith by EWC Board personnel. The three priority upgrade items for the EWC are as follows:

1. Seismic upgrades to the two water storage facility standpipe reservoirs.
2. Replacement of the 6-inch diameter main from the well to the reservoir site.
3. Addition of standby backup power generators at the reservoir site and well site.

Figure 1 below shows the EWC system, the system boundary shown on the perimeter, the piping network in bold, with locations of specific facilities discussed throughout this report denoted.

Figure 1
EWC System Map



Section 1 – Existing Water System Inventory and Evaluation

Murraysmith conducted field observations of the EWC system area and assets during a site visit on June 10, 2020. Andrew Degner (Board Chairperson) and two other Board Members with the EWC were present for the visit. See photos inserted throughout this memorandum for documentation of the visible system assets.

1.1 – Distribution and Transmission Piping System

Although the elevations throughout the service area vary greatly, the EWC system consists of two pressure zones: The High Zone is served by the pump station at the reservoir site; and The Main Zone is served by the reservoirs. The High Zone ground surface elevations range from 975 to 1,000 feet above mean sea level (AMSL), and the Main Zone ground surface elevations range from 500 to 950 feet AMSL. Individual services have pressure reducing valves as needed throughout the system. The reservoir overflow elevations are at approximately 1,040 feet AMSL. The EWC distribution and transmission piping system inventory is shown in **Table 2**.

Table 2
System Piping Configuration Inventory and Summary

Pipe Run	Diameter (inches) and Material	Approximate Length (feet)	Notes
SE Sunshine Valley Road	2" PEX	800	Distribution, replaced original galvanized steel line with PEX.
SE Sunshine Valley Road to SE Eastmont Drive (Easement)	2" Galvanized Steel	650	Distribution, original piping, off-road through an easement.
SE Eastmont Drive	6" Cast Iron	2,500	**Transmission**, original piping.
Eastmont Spur	4" Cast Iron	1,000	Distribution, original piping.
SE Shady Lane	6" Cast Iron	600	**Transmission**, original piping.
Shady Lane Spur	4" Cast Iron	600	Distribution, original piping.
SE Shady Lane to Reservoir Site (Easement)	6" Cast Iron	600	**Transmission**, original piping, off-road through an easement.
SE Castle Court	4" Cast Iron	700	Distribution, pressurized by pump station, original piping.
Tower Drive Spur	4" Cast Iron	800	Distribution, original piping.
SE Tower Drive	4" Cast Iron	1,700	Distribution, original piping.
SE 257th Avenue	4" Cast Iron	500	Distribution, original piping.

As can be seen in **Figure 1** and **Table 2**, there are 4-inch diameter cast iron distribution mains radiating downhill from the standpipes on SE Tower Drive, SE 257th Avenue, SE Castle Court (fed from pump station due to elevation being too high to be served by the reservoirs by gravity), the northern-most section of SE Shady Lane, and the northern-most section of SE Eastmont drive. A

6-inch diameter cast iron transmission main (also serves for distribution with services connected) is routed from the well site located at 10810 SE Eastmont Drive, along SE Eastmont Drive, SE Shady Lane, and through a 20-foot wide easement from the end of SE Shady Lane to the reservoir site. There is also a short run of 2-inch diameter PEX and galvanized steel from SE Eastmont Drive to, and along, SE Sunshine Valley Road. The system also includes seven fire hydrants and various blow-offs for system cleaning. The EWC supplied system pressure readings taken during October of 2019 at seven fire hydrant or blow-off locations, as shown in **Table 3** below.

Table 3
System Pressure Readings

Reading Number	Appurtenance	Location	Pressure Reading (psi)
1	Blow-off	End of SE Castle Court	65
2	Blow-off	End of SE Eastmont Drive	55
3	Fire Hydrant	Corner of SE Tower Drive and SE 257th Avenue	85
4	Blow-off	End of SE Eastmont Drive	69
5	Fire Hydrant	End of SE Shady Lane	82
6	Fire Hydrant	SE Eastmont Drive, adjacent to Well Site	200+
7	Blow-off	End of 2-inch main on SE Sunshine Valley Road	188

The majority of the existing piping is original (circa 1965), and potentially nearing the end of its useful service life. The EWC has expressed the desire to replace the 6-inch transmission pipe, which serves as the system backbone delivering groundwater from the well to the reservoirs. Piping upgrades are recommended for seismic resiliency, system reliability, and asset longevity in Section 2 of this report. Cost estimates for the options under consideration are presented in **Appendix A**.

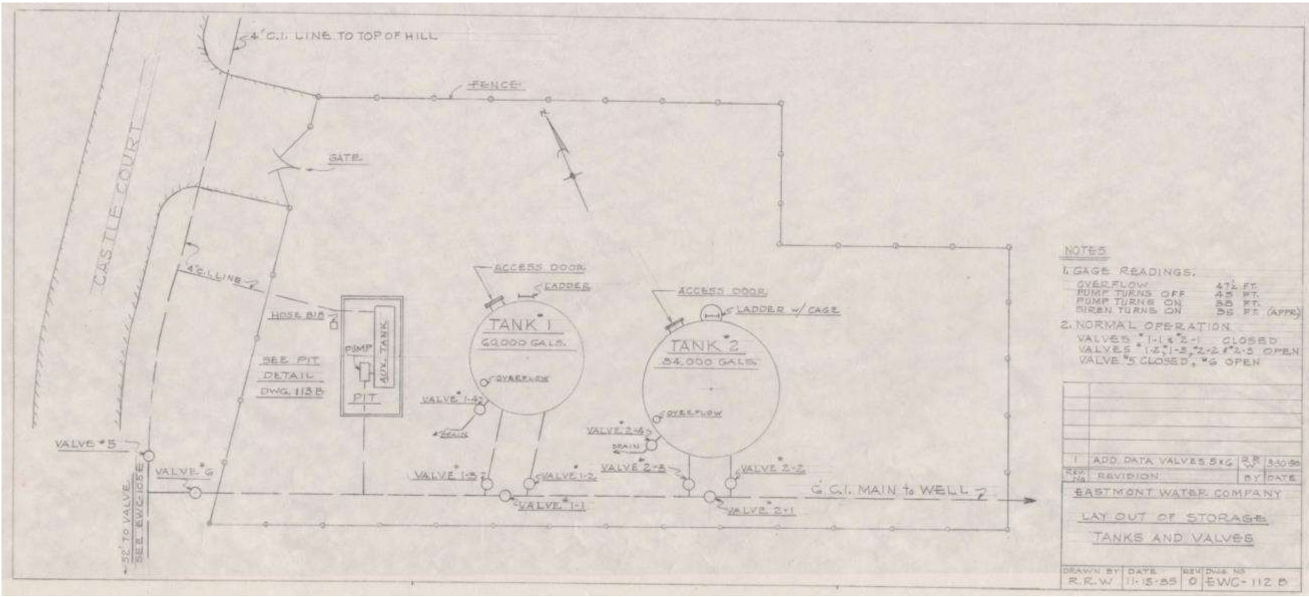
1.2 – Water Storage Facilities

As noted in the Introduction, there are two water storage facilities in the EWC system located on a single fenced in site on SE Castle Court near the intersection with SE Tower Drive. They are both standpipes, with 40-foot-tall shell heights, and other configuration as shown in **Table 1** and further described below. The reservoir and pump station site general schematic orientation is shown in **Figure 2**, below.

General reservoir and pump station site area as viewed from SE Castle Court.

Reservoir exterior upper areas as viewed from SE Castle Court, Reservoir 1 on right and 2 on left.

Figure 2
Reservoir and Pump Station Site Schematic and Orientation



Reservoir 1 - 60,000 Gallon Standpipe

Reservoir 1, also referred to by EWC personnel as the West Reservoir, was constructed in 1965 and is a 16-foot diameter, 40-foot tall, welded steel standpipe reservoir. Reservoir 1 is the facility located closest to the pump station and storage facility on the same site. From a review of the original Shop Drawings by American Pipe and Construction Co, circa 1965, and other EWC-provided drawings and photographs, Reservoir 1 appears to have the following design and appurtenance characteristics:

- Plan and elevation shown in **Figure 3**, below
- Welded steel standpipe, 60,000 gallon capacity
- 16-foot diameter, 40-foot tall shell height
- Self-supported cone roof
- Exterior ladder with flared opening at the roof, ladder begins approximately half-way up the shell: No safety cage and no fall prevention system
- Interior ladder full height, no fall prevention system
- 24-inch diameter circular access hatch at grade, with bolted cover
- 20-inch diameter roof center vent, "China Hat" construction
- 24-inch square roof access hatch
- GridBee submersible mixer, model GS-9 v2, with controls / junction boxes on the top and sidewall of the reservoir
- "Inverted tee" concrete ringwall foundation and bent plate anchor straps, per detailing shown in **Figure 4**, below
- Reservoir piping (generally depicted in **Figure 6**, below):

  - 6-inch diameter dedicated inlet piping, with isolation valve and silt-stop (in reservoir)
  - 6-inch diameter dedicated outlet piping, with isolation valve and silt-stop (in reservoir)
  - No dedicated drain piping: Draining occurs by opening a valve off the outlet line
  - 4-inch diameter overflow pipe with cone, negligible freeboard, routed through tank wall near grade and then piped to drain line
  - 3/4-inch diameter sensing line connected to outlet piping and routed to pressure transducer in pump station

It appears that Reservoir 1 was originally equipped with an external level indicator, which has since been removed from operation, but the guide pipes and other welded features are still in place. The reservoir roof has no handrailing, painter's appurtenances, or tie-off locations. The roof appears to be constructed of overlapped plates that are only welded on the outside (not seal-welded, corrosion is evident from interior photos provided by the tank divers from a separate cleaning and inspection effort in 2016). The interior ceiling appears to have erection bolts in place, and corrosion is evident at the crevice interface between the roof and the shell (evidence of not being seal-welded). The bottom of the reservoir shell is backfilled over a portion of the bottom plate on the west and north sides, which appears to be mainly from tree debris that has accumulated over time. At the time of the observation, most of the reservoir exterior was fairly clean and clear of organic growth, however the south side which is infringed-upon by trees did have some green growth where it could not be reached during recent cleaning efforts.

From a review of EWC records, the Reservoir 1 interior was last painted in 1991, wherein the interior was abrasive blasted to a near-white surface preparation standard and two coats of Tnemec Series 20 Pota-Pox were applied. The exterior was painted in 2005, including an overcoat system with a polyurethane topcoat. Both the reservoir interior and exterior, from the site observation and a review of diver-produced interior photos, appear to be in good condition without much evidence of compromised coating systems or excessive corrosion.

Reservoir 2 - 84,000 Gallon Standpipe

Reservoir 2, also referred to by EWC personnel as the East Reservoir, was constructed in 1975 and is a 19-foot diameter, 40-foot tall, welded steel standpipe reservoir. Reservoir 2 is the facility located furthest from the pump station and storage facility on the same site. From a review of the original Shop Drawings by U.S. Tank and Construction Co., Inc, circa 1965, and other EWC-provided drawings and photographs, Reservoir 2 appears to have the following design and appurtenance characteristics:

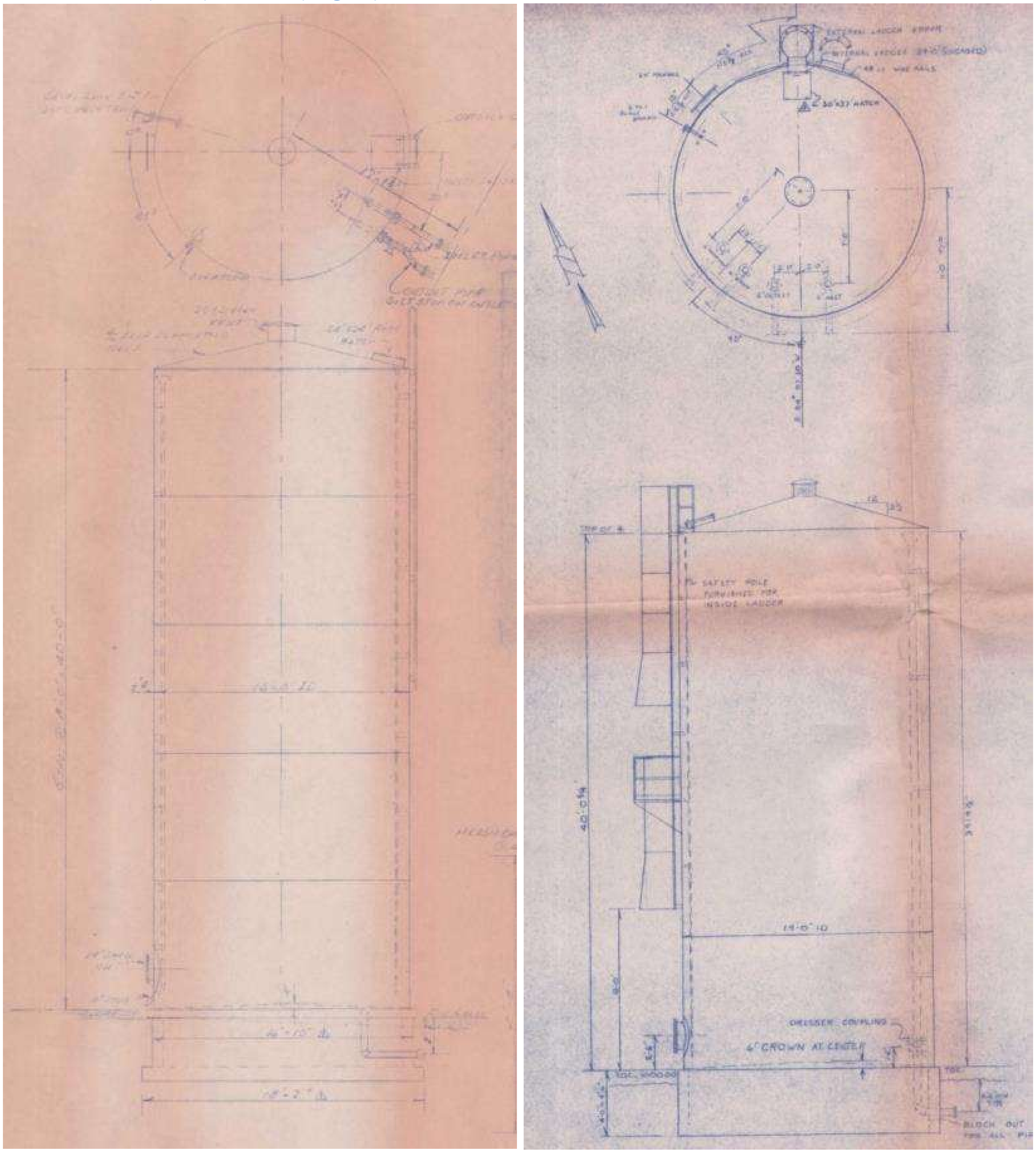
- Plan and elevation shown in **Figure 3**, below
- Welded steel standpipe, 84,000-gallon capacity
- 19-foot diameter, 40-foot tall shell height
- Self-supported cone roof

- Exterior ladder with safety cage, ladder begins approximately one-third of the way up the shell, with mid-height landing platform: No fall prevention system
- Interior ladder full height, with rail-style fall prevention system
- 24-inch diameter circular access hatch at grade, with bolted cover
- 20-inch diameter roof center vent, "China Hat" construction
- 30-inch by 37-inch roof access hatch
- GridBee submersible mixer, model GS-9 v2, with controls / junction boxes on the top and sidewall of the reservoir
- Standard concrete ringwall foundation and standard plate anchor straps, per detailing shown in **Figure 5**, below
- Reservoir piping (generally depicted in **Figure 6**, below):
    - 6-inch diameter dedicated inlet piping, with isolation valve
    - 6-inch diameter dedicated outlet piping, with isolation valve
    - 6-inch diameter dedicated drain piping, with isolation valve
    - 6-inch diameter overflow pipe with cone and dresser coupling, negligible freeboard, routed through tank floor and then piped to drain line
    - 3/4-inch diameter sensing line connected to drain piping and routed to pressure transducer in pump station

It appears that Reservoir 2 was originally equipped with an external level indicator, which has since been removed from operation, but the guide pipes and other welded features are still in place. The reservoir roof has a short section of handrailing 4 feet long along the edge of the roof on either side of the roof access hatch. The reservoir does not have any exterior painter's appurtenances or tie-off locations, but does appear to have an interior painter's rail. The roof appears to be constructed of overlapped plates that are welded on the outside, but it is uncertain if they are seal-welded, as no interior photos were made available by the tank divers from a separate cleaning and inspection effort in 2016. The reservoir roof is equipped with intermittent welded stiffening bent rods around the perimeter. The interior ceiling was not evaluated as no photos were made available for review. The bottom of the reservoir shell is not backfilled at all, in contrast to Reservoir 1. At the time of the observation, most of the reservoir exterior was fairly clean and clear of organic growth, however the south side which is infringed-upon by trees did have some green growth where it could not be reached during recent cleaning efforts.

From a review of EWC records, the Reservoir 2 interior was last painted in 1984, wherein the interior was abrasive blasted and re-painted. The records do not indicate the level of surface preparation, nor the materials used, although it is believed to be the same or similar materials to the surface preparation and coating work done on Reservoir 1 in 1991, as previously discussed. The exterior was painted in 2005, including an overcoat system with a polyurethane topcoat. Both the reservoir interior and exterior, from the site observation and a review of the dive report for the interior, appear to be in good condition without much evidence of compromised coating systems or excessive corrosion.

Figure 3
Reservoir 1 (Left) and 2 (Right) Plan and Elevation

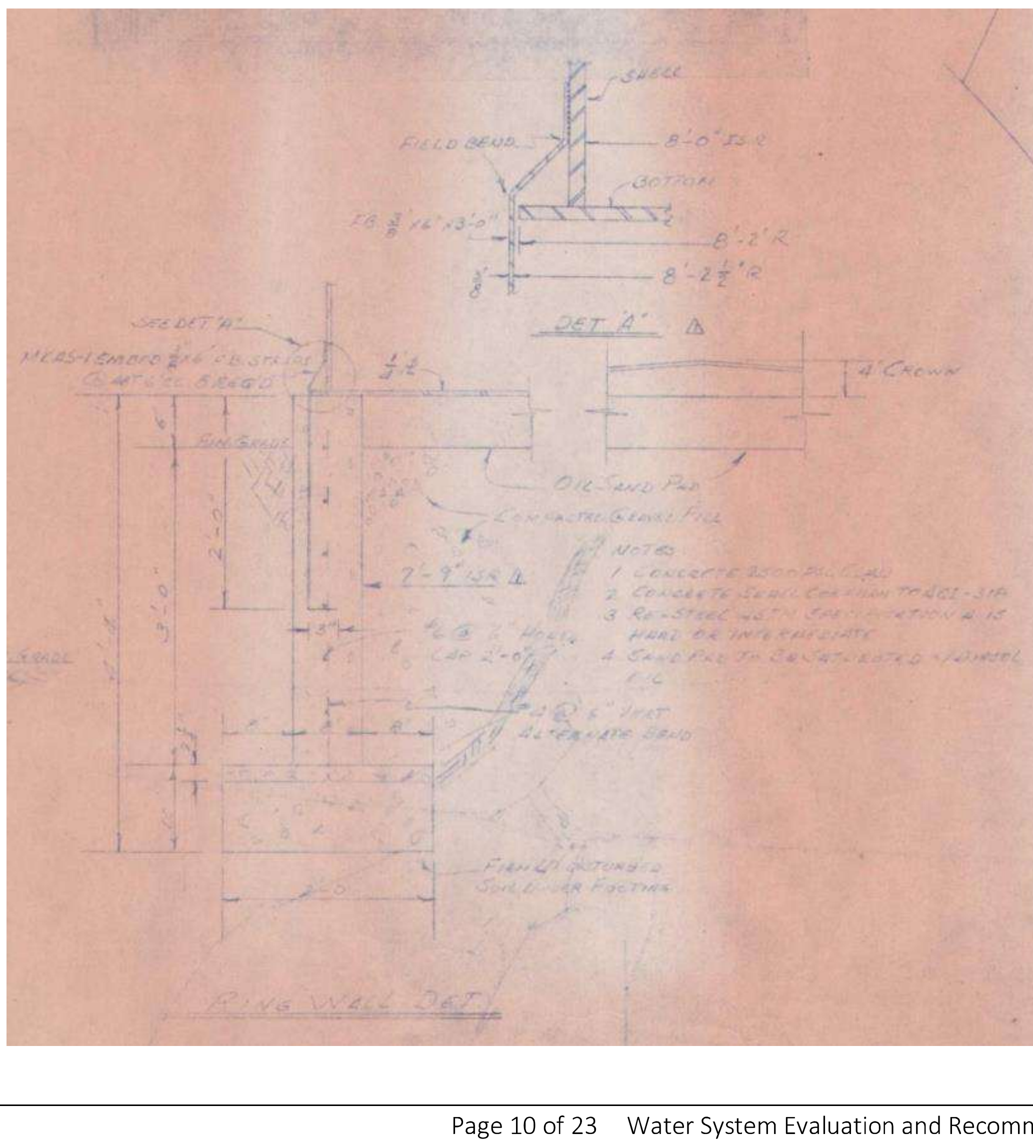


Reservoir 1 Foundation and Anchorage

The Reservoir 1 foundation and anchorage is shown in **Figure 4** below, and generally consists of the following:

- "Inverted tee" reinforced concrete ringwall foundation:
  - Horizontal portion is 2 feet wide by 10 inches tall
  - Vertical portion is 3 feet, 6 inches tall by 8 inches wide
  - Overall height is 4 feet, 4 inches
- Bent plate anchor straps:
  - 6 feet on center, eight total
  - 3/8 inches thick by 6 inches wide
  - 3 feet long, with 2 feet embedded into the concrete and a 3-inch 90-degree hook

Figure 4
Reservoir 1 Foundation and Anchorage



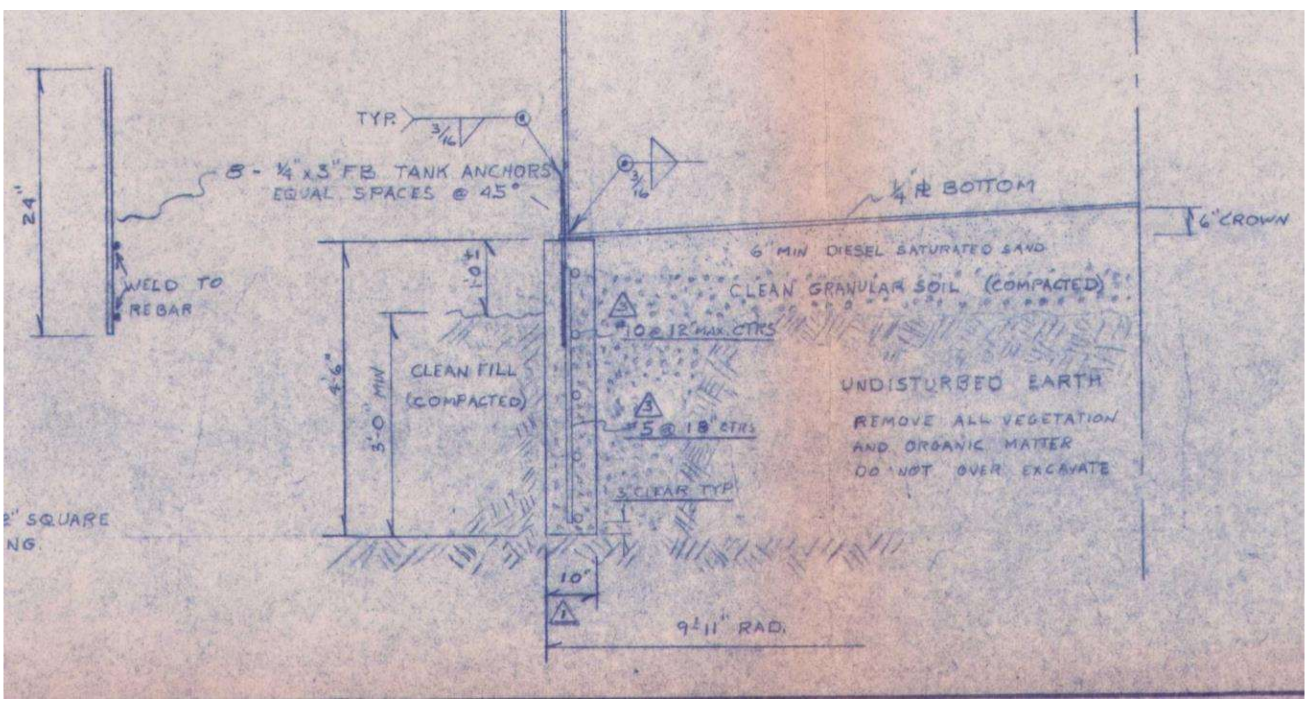
The Reservoir 1 concrete foundation and anchor straps appear to be in good condition as visible at grade. Although the Reservoir 1 foundation and anchorage has not been structurally evaluated as part of this report, it is clear based on our experience evaluating similar structures that the existing foundation does not meet current code for seismic resiliency, and possibly other parameters. The structure should be further evaluated for options to upgrade the foundation and anchorage to meet current seismic codes, as well as other reservoir elements such as shell thickness for wind and hydrostatic loading, and roof and freeboard for seismic slosh wave requirements.

Reservoir 2 Foundation and Anchorage

The Reservoir 2 foundation and anchorage is shown in **Figure 5** below, and generally consists of the following:

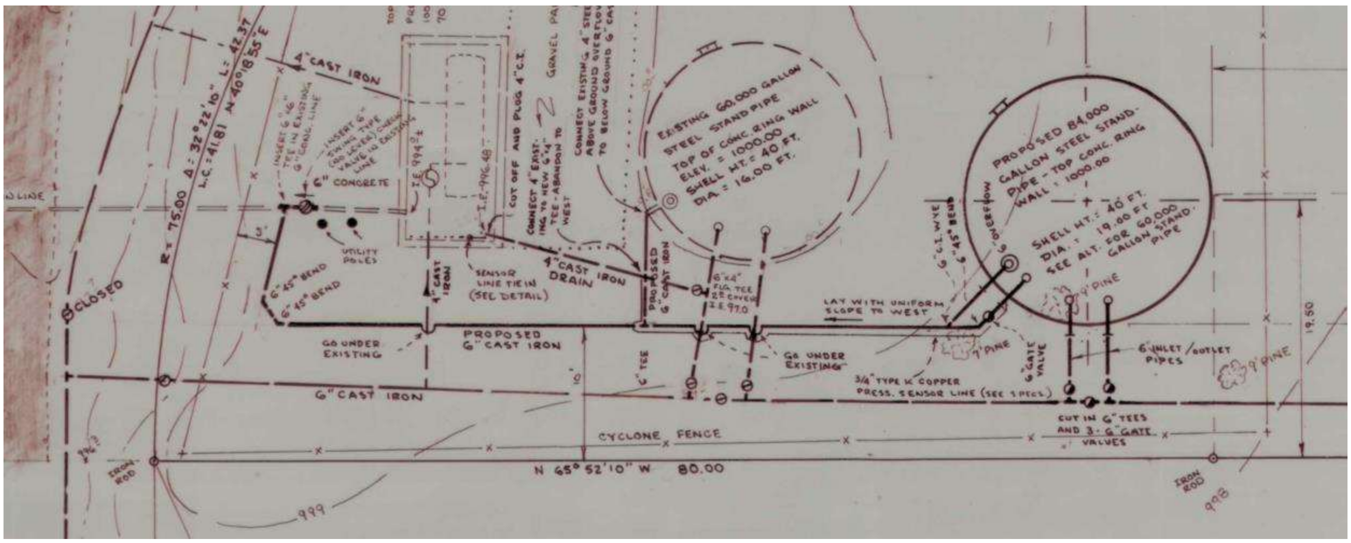
- Standard vertical reinforced concrete ringwall foundation
    - 4 feet, 6 inches tall by 10 inches wide
- Plate anchor straps:
    - Eight total, one at every 45 degrees radially
    - 1/4 inches thick by 3 inches wide
    - 2 feet long, with approximately 18 inches embedded into the concrete and welded to longitudinal rebar

Figure 5
Reservoir 2 Foundation and Anchorage



The Reservoir 2 concrete foundation and anchor straps appear to be in good condition as visible at grade. Although the Reservoir 2 foundation and anchorage has not been structurally evaluated as part of this report, it is clear based on our experience evaluating similar structures that the existing foundation does not meet current code for seismic resiliency, and possibly other parameters. The structure should be further evaluated for options to upgrade the foundation and anchorage to meet current seismic codes, as well as other reservoir elements such as shell thickness for wind and hydrostatic loading, and roof and freeboard for seismic slosh wave requirements.

Figure 6
Reservoir and Pump Station Site Piping Configuration



Reservoir Level Controls

The EWC system underwent telemetry and controls upgrades in 2016, designed and installed by Portland Engineering, Inc. (PEI). The control strategy for the well pump to turn on to increase reservoir level is accomplished via cell modem communication between two telemetry cabinets. There is a control panel mounted on the wall of the main floor of the High Zone pump station (discussed in Section 1.3 below) with a human machine interface (HMI) screen that reads current tank water surface level, well pump on/off settings as relates to reservoir level, and other information shown in the photo below. Reservoir sensing lines are routed from each tank as discussed above to the High Zone pump station for hydrostatic pressure sensing. The telemetry control panel receives a signal from the pressure transducer(s) in the building basement and converts it to feet of water in the reservoirs, and then calls the well pump (discussed in Section 1.4, below) to turn on and off based on programmable settings. There is currently no standby backup power generation at the reservoir site, although the telemetry panel discussed in Section 1.3 below does have a small backup power unit to keep communication alive for a short period of time with the well site in the event of a power outage, per the PEI telemetry system Operations and Maintenance (O&M) Manual. The High Zone pump and the reservoir mixers would not function in the event of a power outage.

Reservoir level and well pump control panel and interface screen, in the High Zone pump station.

1.3 – High Zone Pump Station

The EWC's only pump station, aside from the well pump, is within the wood-framed storage building adjacent to the reservoirs. The structure houses the following system components:

- Main Floor:
  - Electrical circuit breaker box
  - High Zone Pump starter and variable frequency drive
  - Telemetry equipment cabinet
  - Uninterruptable power supply (UPS) for telemetry controls
  - Storage racks for equipment
- Basement (also called "Pump Pit" in existing drawings):
  - 70 gpm, 5 HP, end suction centrifugal pump serving the High Zone
  - Decommissioned, original 1,000-gallon pressure (hydro-pneumatic) tank
  - New, smaller (size unknown) active pressure (hydro-pneumatic) tank
  - Pump suction and discharge piping and valving
  - Pressure transducer(s) for reservoir level

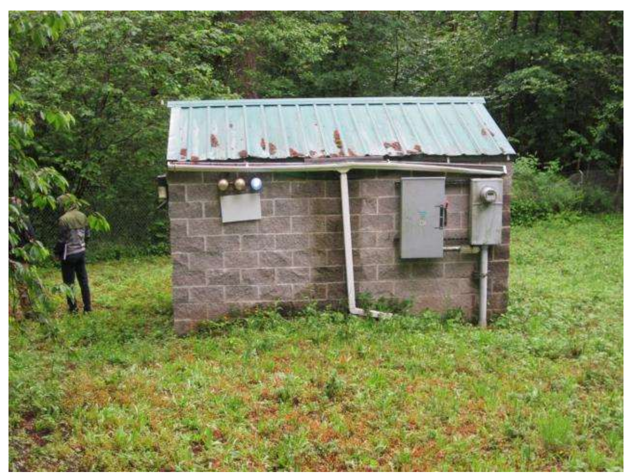
High Zone pump and hydro-pneumatic tank in the High Zone pump station basement.

1.4 – Well and Well House

The EWC's only water supply source is a groundwater well located in a well house within a fully fenced property at 10810 SE Eastmont Drive, at the southeast end of the system and near the lowest elevations served. The well house is an approximately 9-foot by 12-foot concrete masonry unit building with a metal roof, which houses a submersible pump in the well, discharge piping and control valving in a recessed pit, a telemetry unit, and power cabinetry. Well drilling logs from 1965 were transmitted to convey original well construction timeline, however no original construction drawings were made available by EWC to review for the constructed well or well house. The EWC did provide a well upgrade (new pump and motor) design drawing from 1986, which is included as **Figure 7** below, showing that the well has the following design configuration (depths are assumed to be relative to the adjacent ground surface):

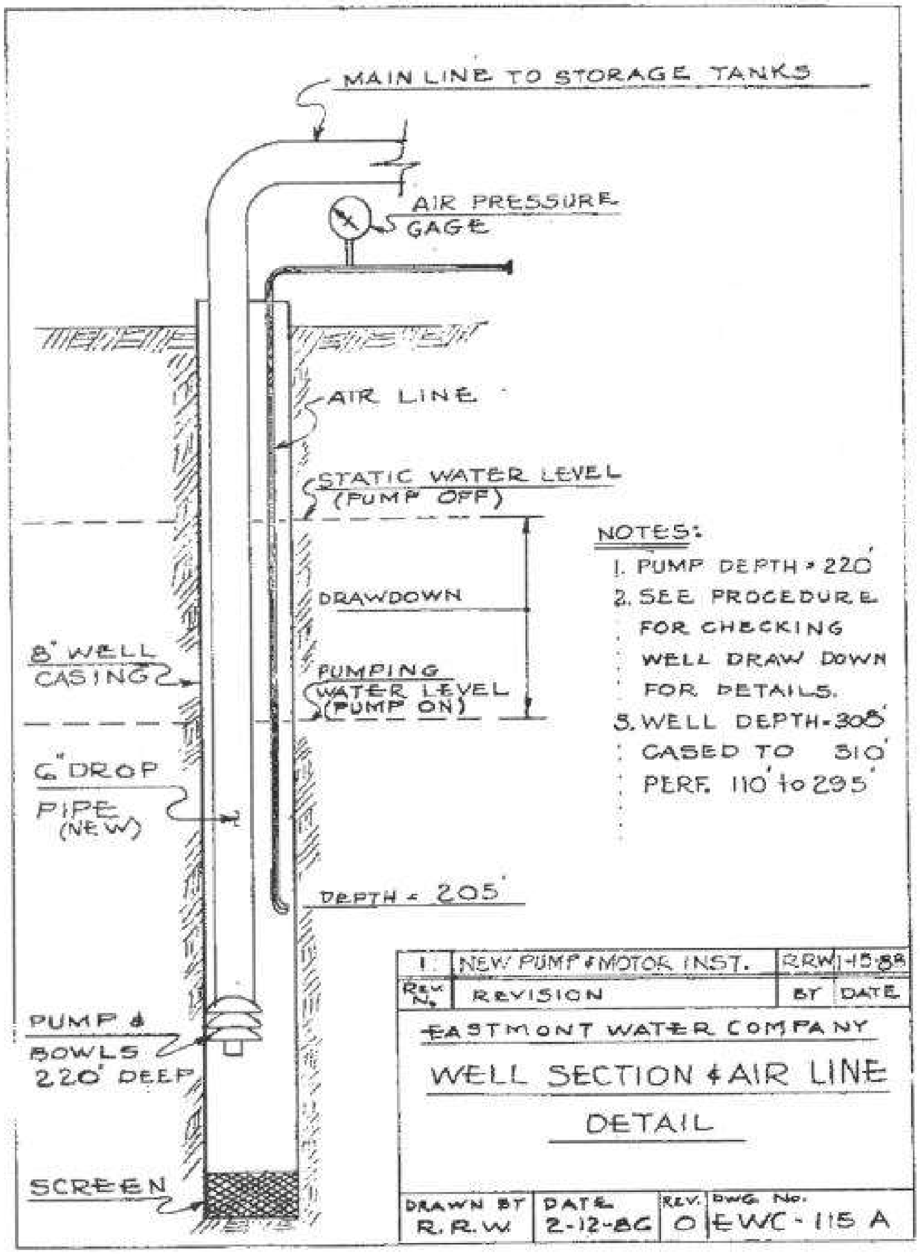
- Well Casing Diameter = 8 inches
- Drop Pipe Diameter = 6 inches
- Overall Depth = 308 feet
- Pump Depth = 220 feet
- Well Perforations: 110 feet to 295 feet
- Air Line Depth to 205 feet

There is currently no standby backup power generation at the well site, although the telemetry panel discussed above does have a small backup power unit to keep communication alive for a short period of time with the reservoir site in the event of a power outage, per the PEI telemetry system O&M Manual. The well pump and the solenoid-operated control valves would not function in the event of a power outage.

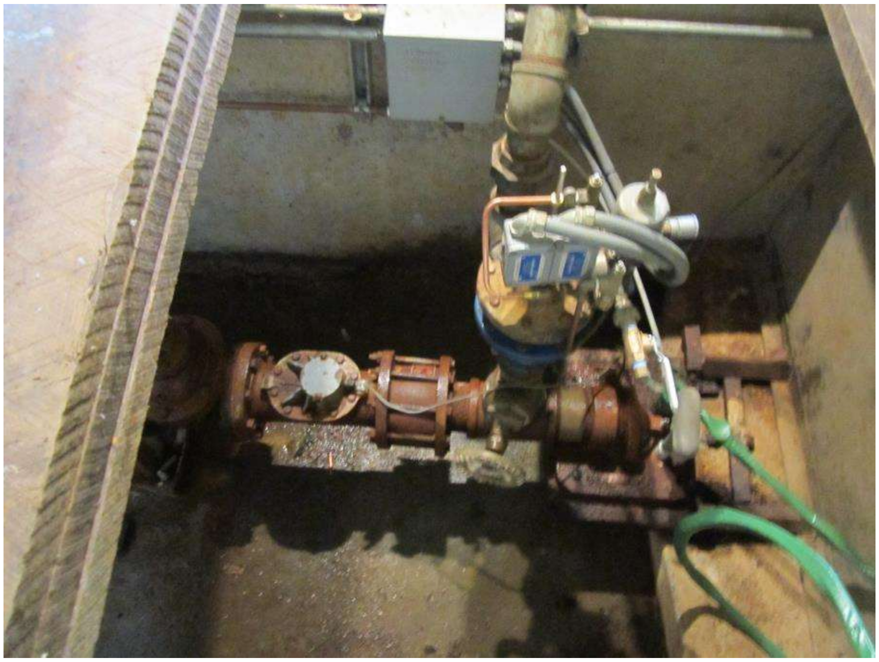


Well house exterior.

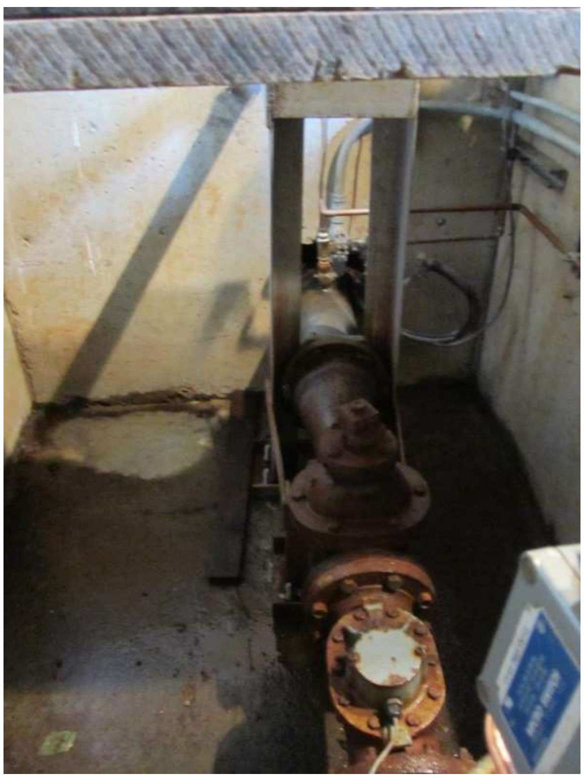
Figure 7
1986 Well Upgrade Drawing Showing Well Configuration



The well is called to run via cellular antenna communication from the reservoir site when the reservoirs hit their programmed low level. The communication hardware is relatively new, having been installed during the 2016 telemetry upgrades. When the well turns on, a solenoid-operated pump control valve sends well discharge water to a drainage system to a nearby creek for a pre-determined amount of time (pump-to-waste), before opening the valve to the approximately 3,700-foot long, 6-inch diameter cast iron transmission main and filling the reservoirs as discussed in Section 1.2 above. The well site pump and piping configuration is shown in **Figure 8** below.



Well discharge piping and solenoid-operated pump control valve.

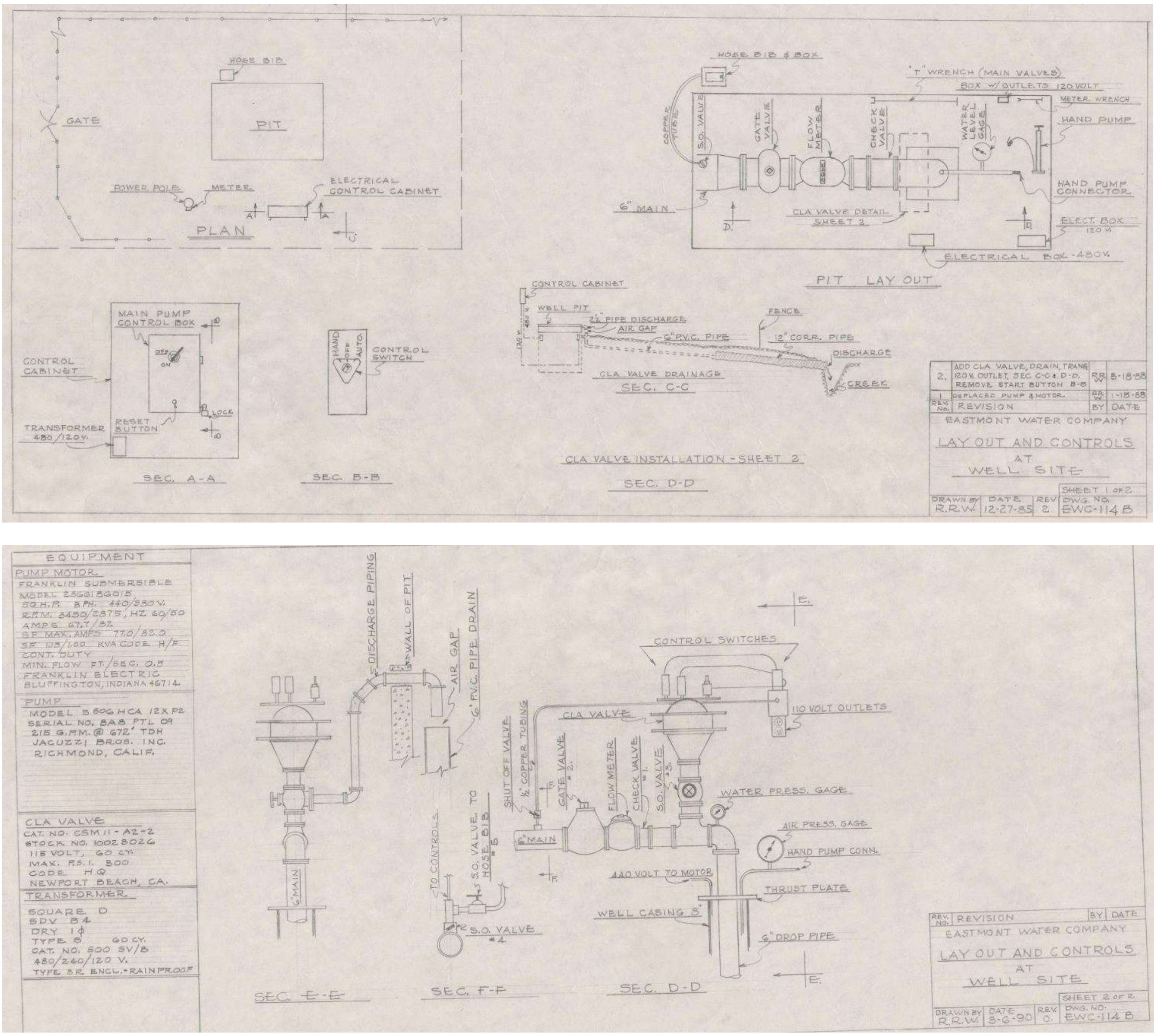


Well discharge piping.

Well pump status lights and HOA switch.

The EWC reports that the submersible well pump is currently being replaced approximately every five years <<EWC to confirm>>. This may be due to issues regarding pump cooling or other mechanical failures, or simply be a result of the wear and tear the pump receives in order to pump the over 500 feet of elevation to pressurize the EWC system and fill the reservoirs.

Figure 8
Well Site Pump and Piping Configuration



1.5 – System Flushing

The EWC reports that, as a result for the system not being chlorinated, they annually flush their reservoirs, well, and transmission / distribution system with manual chlorine addition in order to preserve water quality and protect their customers. The procedure for system flushing is generally as follows:

1. Check reservoir water levels, determine water volume, and calculate amount of sodium hypochlorite required to reach a 3.0 ppm target residual.
2. Activate GridBee mixers and add sodium hypochlorite, open hose bib at tank building and wait for residual to appear.
3. Open hydrants and blow-offs in system and run until residual appears, then close.
4. Shut off pump controls locally at well house and add hypo to pump column, after 24 hours bypass control valve (Cla-val) at pump and manually flush the chlorine from the well column.
5. Allow chlorine in the remainder of the system to dissipate over time as water turns over in the system due to consumption.

EWC has stated that this procedure functions for them, and they are not interested in a more automated or permanent chlorination system to be recommended for installation in the systems recommendations portion of this report.

Section 2 – Water System Recommendations

2.1 – Distribution and Transmission Piping System

The EWC system distribution and transmission piping was constructed circa 1965. Due to the age of the system, there is a strong possibility that portions of the system piping are in a state of advanced corrosion, although the EWC does not report having recurring leaking issues or other issues of concern. The following projects are recommended for EWC planning moving forward, noted as either "T" for transmission, or "D" for Distribution:

> <u>Project T1</u> - Replace 6-inch cast iron transmission main - approximately 3,700 linear feet (LF) - with 6-inch restrained ductile iron piping. Assume the pipe will be installed in the paved roadway and asphalt pavement surface restoration will be required.
>
> <u>Project D1</u> - Replace remaining portion of 2-inch galvanized steel distribution piping - approximately 650 LF - with 2-inch PEX piping. Assume the pipe will be installed overland in a forested easement and asphalt pavement surface restoration will not be required.

Note that for Project T1 the EWC requested that Murraysmith look into re-using the existing cast iron pipe as a host pipe for addition of a new structural liner (commonly referred to as "cast-in place pipe, or CIPP). This option was investigated, and was subsequently ruled out as an option due to excessive costs. It is estimated that CIPP will result in a 1.5 to 2 times more expensive project cost than open-cut installation methods. This is due to the amount of locations where excavation would still be required for bends and to make connections, and the inherent challenges with the certified CIPP installation contractors being cost-competitive at smaller pipe diameters and the lack of sufficient length of piping for economy of scale.

2.2 – Water Storage Facilities

The exterior or each reservoir was overcoated approximately 15 years ago per EWC records. The exterior coating still appears to be in good condition, with minor chalking and moderate color and gloss reduction. The interior coating systems for Reservoir 1 and Reservoir 2 have been in service approximately 29 and 36 years, respectively. The EWC noted during the site visit that the reservoir interiors are inspected and cleaned by divers approximately every five years, and the exterior is cleaned by pressure washing regularly. From a review of the dive report information, the reservoir interiors are in good condition, with little corrosion evident. Due to the EWC system not using any chemicals regularly such as chlorine, the reservoir interiors do not experience as corrosive of an environment as a typical water storage reservoir, which helps with coating longevity for the interior, especially when the reservoir is not seal-welded in the headspace (area above the water surface).

It is recommended that the EWC continue regular maintenance washing and diving of the reservoirs to keep in front of any larger maintenance issues. In addition, the following long-term reservoir upgrade projects are recommended, noted as "R" for reservoir:

Project R1 - Minor site regrade to remove earth from against Reservoir 1 top-of-footing and sidewalls. Apply coating repairs and re-grout or re-apply sealant at interface between top of concrete footing and bottom of floor plate where it was buried.

Project R2 - Full evaluation of both Reservoirs 1 and 2 to analyze the structures and engineering / design of seismic upgrades and appurtenance improvements.

- Geotechnical evaluation to determine site soils characteristics.
- Structural analysis to evaluate reservoir performance (code compliance check).
- Civil / Architectural analysis to evaluate appurtenances and safe access.

Project R3 - Construction of seismic upgrades and appurtenance improvements of both Reservoirs 1 and 2 (assumed upgrades are based on similar project experience).

- Expand concrete foundation, including doweling into existing foundation
- Addition of steel anchor chairs and anchor bolts for mechanical anchoring of foundation to reservoir shell.
- Appurtenance improvements, such as vent replacement, ladder modifications, etc.
- Major Cost Assumption: Site soils are suitable for standard upgrades and will not require deep ground improvements such as micropiles or similar.

2.3 – High Zone Pump Station

The pump station and storage building at the reservoir site is generally in good condition for continued service. The EWC has noted that they are comfortable with the operations of the High Zone Pump Station, and that no upgrades to that facility need to be included in this report. In the future, the EWC could consider making upgrades including tying the pump station operations into an overall supervisory control and data acquisition (SCADA) system.

The EWC has expressed interest in having emergency standby power generation capabilities, but no knowledge was passed along as to whether there is natural gas available on SE Castle Court or SE Tower Drive for a possible fuel source for a backup generator. If natural gas is not available, the generator will need to have an enclosed fuel tank (diesel) for operations. The following projects are recommended for EWC planning moving forward, noted as "P" for Pump Station:

Project P1 - Design and install standby power generator and remove unused electrical / telemetry equipment.

2.4 – Well House

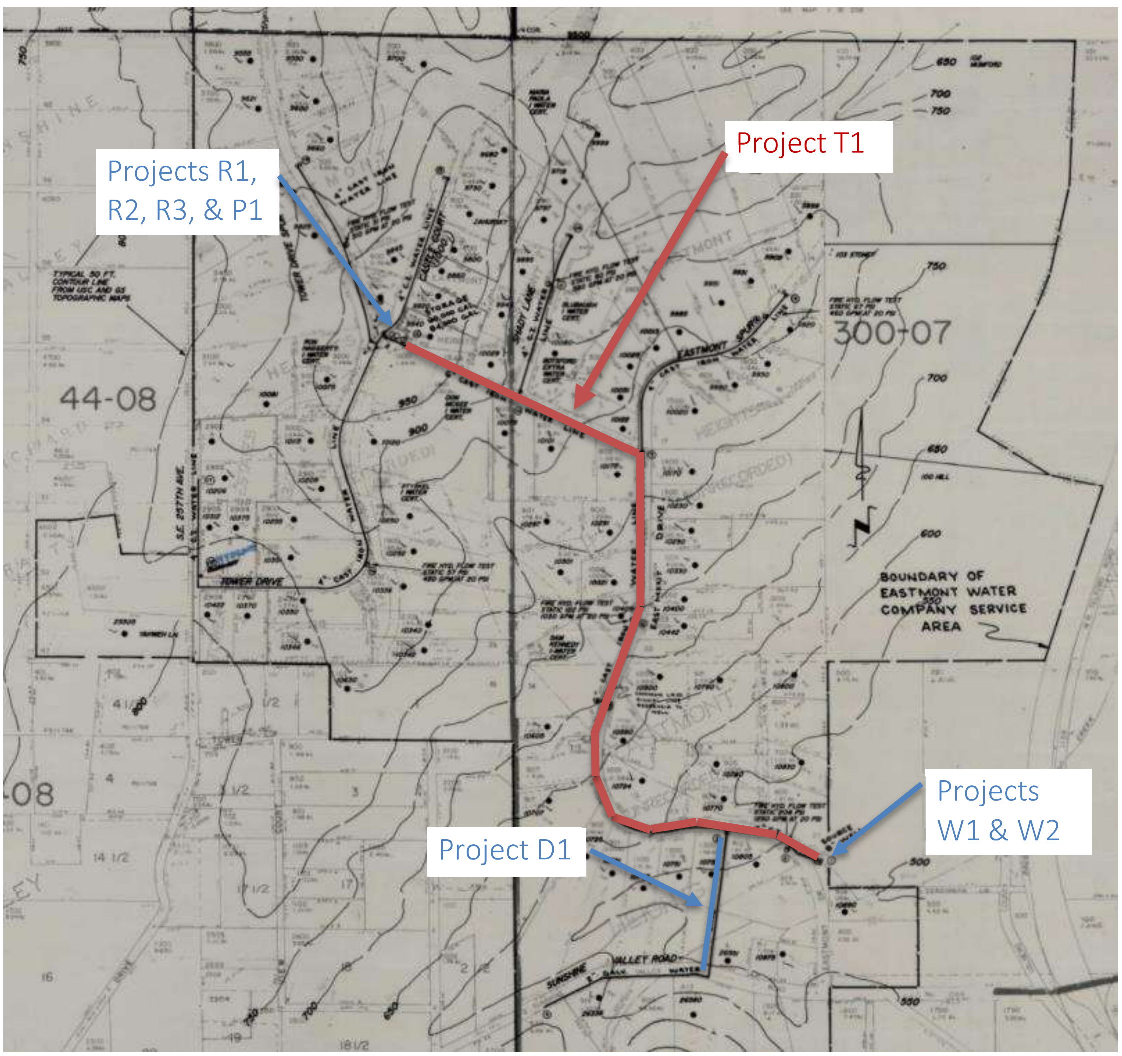
Although no original construction drawings were made available for the well site, it is assumed it was built in 1965 along with Reservoir 1. The exposed piping in the well house has been in service for approximately 55 years, and it is showing signs of corrosion and should be considered for replacement. The EWC is also interested in having emergency standby power generation capabilities and reported that there is natural gas available on SE Eastmont Drive for a possible fuel source for a backup generator.

> <u>Project W1</u> - Design and install standby power generator and remove unused electrical / telemetry equipment.

> <u>Project W2</u> - Retrofit well house to replace submersible well pump with vertical turbine well pump and replace piping and valving in the well house.

Cost estimate breakdowns for all the project options listed above under consideration are presented in **Appendix A**.

Figure 9
Recommended Improvement Projects Location Map



Section 3 – Conceptual Cost Estimates and Recommended Improvements

See **Appendix A** for an itemized breakdown of conceptual level engineer's opinion of probable construction costs for each system upgrade alternative presented herein. **Table 4** below presents a summarized list of the recommended improvements to the system:

Table 4
Recommended Improvement Projects Summary

Project Indicator	Project Description	Total Project Cost
T1	Replace 3,700 LF of 6" CI transmission main	$1,183,000
D1	Replace 650 LF of 2" distribution main	$149,000
R1	Minor reservoir site regrade	$10,000
R2	Reservoir seismic and appurtenance evaluation	$60,000
R3	Reservoir seismic and appurtenance upgrades	$1,163,000
P1	HZPS standby power generator and electrical cleanup	$208,000
W1	Well standby power generator and electrical cleanup	$208,000
W2	Well vertical turbine pump installation	$579,000
	Total Improvements Costs:	**$3,560,000**

Major cost assumptions in the cost estimates presented are as follows:

- All cost estimates for projects that would require telemetry or controls elements (P1, W1, and W2) assume that system integration work will be provided for separately by the District's Systems Integrator, and the cost is not included.
- No environmental mitigation or right-of-way / property acquisition is included in any of the estimates.
- All estimates include a 30% contingency to account for unforeseen project components.
- For Project W2, it is assumed the EWC will pre-purchase the vertical turbine well pump as that is the most common and cost-effective approach (the cost is included in the estimate).
- Construction by private contractors, with BOLI/Davis-Bacon Wage Rates being assumed due to funding agency requirements.
- The Engineering News Record (ENR) Construction Cost Index for Seattle, Washington is 12,430.98, August 2020.

Section 4 – Project Sequencing and Conclusion

4.1 – Project Sequencing

It is our understanding that the EWC's goal for design, bidding, and construction of these projects will be contingent on the success of funding efforts through various agencies.

EWC's proposed project sequencing, in the absence of other factors, is as follows:

- <<TO FOLLOW AFTER REVIEW OF DRAFT REPORT BY EWC>>

4.2 – Conclusion

The EWC community water system is functioning as intended, but the recommendations for system upgrades presented herein will enhance the system to provide seismic resiliency and better system reliability for the community members. Separate to this report, the EWC is investigating funding partners to provide grant/loan assistance for the Capital Improvements Projects proposed.

Other considerations that the EWC may benefit from looking into further include the following:

- Attend a One-Stop funding meeting to determine the best funding partners.
- FEMA Funding - Research if any of the projects included in this report would be eligible for grant funding due to the nature of them being seismic upgrades.
- Energy Trust of Oregon - Research if the Wellhouse pump replacement project (W2) will result in significant energy savings and thus eligibility for grant funding.

JHF:mlh

Appendix

murraysmith

APPENDIX A
CONCEPTUAL CONSTRUCTION COST ESTIMATES

Appendix A: Conceptual Construction Cost Estimates

Conceptual project cost estimates for the various recommended elements of the EWC Water System Recommendations Improvements are presented in this Appendix. Preliminary project cost estimates are an opinion of cost based on information available at the time of the estimate. Final costs will depend on actual field conditions, actual material and labor costs, market conditions for construction, regulatory factors, final project scope, method of implementation, schedule, and other variables.

The preliminary construction cost estimates are based on conceptual level design elements and are considered Class 3 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) with an expected accuracy range of +30% to -20%. The suggested contingency for projects similar in scale and size to the construction of the these project is 30 percent of the overall estimated construction cost to allow for flexibility in addressing any possible unforeseen conditions that may arise during construction, as well as a percentage allowance for engineering services.

Key Assumptions:

- All cost estimates for projects that would require telemetry or controls elements (P1, W1, and W2) assume that system integration work will be provided for separately by the District's Systems Integrator, and the cost is not included.
- No environmental mitigation or right-of-way / property acquisition is included in any of the estimates.
- All estimates include a 30% contingency to account for unforeseen project components.
- For Project W2, it is assumed the EWC will pre-purchase the vertical turbine well pump as that is the most common and cost-effective approach.
- Construction by private contractors, with BOLI/Davis-Bacon Wage Rates being assumed due to funding agency requirements.
- The Engineering News Record (ENR) Construction Cost Index for Seattle, Washington is 12,430.98, August 2020.

Project T1 - Replace 6-inch Cast Iron Transmission Main

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	6-inch Class 52 Ductile Iron Pipe, Restrained, with imported gravel trench backfill	3,700	LF	$75.00	$25.00	$100.00	$370,000
2	6-inch Ductile Iron Pipe Fittings, Restrained	10,000	LB	$2.00	$2.00	$4.00	$40,000
3	Paving for Trench Resurfacing (assume 6-inch thick)	450	TON	$75.00	$75.00	$150.00	$67,500
4	Distribution and Other Piping Connections	6	EA	$500.00	$2,000.00	$2,500.00	$15,000
5	Service Piping Connections	25	EA	$200.00	$800.00	$1,000.00	$25,000
6	6-inch Isolation Gate Valves	8	EA	$2,000.00	$1,000.00	$3,000.00	$24,000
7	4-inch Isolation Gate Valves	3	EA	$1,500.00	$1,000.00	$2,500.00	$7,500
8	Tree Removal and Hillside Construction Challenges	1	LS	$15,000.00	$15,000.00	$30,000.00	$30,000
9	Pipeline Disinfection and Testing	1	LS	$1,000.00	$9,000.00	$10,000.00	$10,000
10	Construction Surveying and Staking	1	LS		$7,500.00	$7,500.00	$7,500
				SubTotal:			**$597,000**

Material & Labor Total:		**$597,000**
Bonds and Insurance:	2%	$11,940
Mobilization:	8%	$47,760
Contractor's Overhead & Profit:	10%	$59,700
Subtotal		**$717,000**
Owner's Allowance/Contingency:	*30%*	*$215,100*
Permitting	*2%*	*$14,340*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$946,000***
Engineering and Site Surveying	15%	$141,900
Construction Eng./Admin.	10%	$94,600
Estimated Project Cost		***$1,183,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$899,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$1,088,000**

Project D1 - Replace 2-inch Distribution Main

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	2-inch PEX Distribution Piping, with select native trench backfill	650	LF	$30.00	$30.00	$60.00	$39,000
2	Paving at Connections (assume 6-inch thick)	40	TON	$75.00	$75.00	$150.00	$6,000
3	Piping Connections	2	EA	$500.00	$2,000.00	$2,500.00	$5,000
4	Service Piping Connections	5	EA	$200.00	$800.00	$1,000.00	$5,000
5	2-inch Isolation Gate Valves	2	EA	$500.00	$500.00	$1,000.00	$2,000
6	Tree Removal and Offroad Construction Challenges	1	LS	$5,000.00	$5,000.00	$10,000.00	$10,000
7	Pipeline Disinfection and Testing	1	LS	$500.00	$4,500.00	$5,000.00	$5,000
8	Construction Surveying and Staking	1	LS		$2,500.00	$2,500.00	$2,500
				SubTotal:			**$75,000**

Material & Labor Total:		**$75,000**
Bonds and Insurance:	2%	$1,500
Mobilization:	8%	$6,000
Contractor's Overhead & Profit:	10%	$7,500
Subtotal		**$90,000**
Owner's Allowance/Contingency:	*30%*	*$27,000*
Permitting	*2%*	*$1,800*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$119,000***
Engineering and Site Surveying	15%	$17,850
Construction Eng./Admin.	10%	$11,900
Estimated Project Cost		***$149,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$113,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$137,000**

Project R1 - Minor Reservoir Site Regrading and Repairs

Probable Cost of Construction
Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Site Grading	1	LS	$0.00	$3,500.00	$3,500.00	$3,500
2	Coating Repairs	1	LS	$500.00	$500.00	$1,000.00	$1,000
3	Sealant/Grout Repairs	1	LS	$200.00	$300.00	$500.00	$500
				SubTotal:			**$5,000**

Material & Labor Total:		**$5,000**
Bonds and Insurance:	2%	$100
Mobilization:	8%	$400
Contractor's Overhead & Profit:	10%	$500
Subtotal		**$6,000**
Owner's Allowance/Contingency:	*30%*	*$1,800*
Permitting	*0%*	*$0*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$8,000***
Engineering	15%	$1,200
Construction Eng./Admin.	15%	$1,200
Estimated Project Cost		***$10,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$8,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$9,000**

Project R2 - Reservoir Seismic and Appurtenance Evaluation

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Geotechnical Work	1	LS		$15,000.00	$15,000.00	$15,000
2	Structural Evaluation	1	LS		$20,000.00	$20,000.00	$20,000
3	Civil/Architectural Evaluation	1	LS		$20,000.00	$20,000.00	$20,000
4	Site Surveying	1	LS		$5,000.00	$5,000.00	$5,000
				SubTotal:			**$60,000**

Material & Labor Total:		**$60,000**
Bonds and Insurance:	0%	$0
Mobilization:	0%	$0
Contractor's Overhead & Profit:	0%	$0
Subtotal		**$60,000**
Owner's Allowance/Contingency:	*0%*	*$0*
Permitting	*0%*	*$0*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$60,000***
Engineering	0%	$0
Construction Eng./Admin.	0%	$0
Estimated Project Cost		***$60,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$57,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$69,000**

Project R3 - Reservoir Seismic and Appurtenance Upgrades

Probable Cost of Construction
Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Structural Seismic Improvements*	2	EA	$50,000.00	$100,000.00	$150,000.00	$300,000
2	Vent Replacements	2	EA	$15,000.00	$5,000.00	$20,000.00	$40,000
3	Ladder and Handrailing Modifications to Reservoir 1	1	LS	$15,000.00	$25,000.00	$40,000.00	$40,000
4	Fall Prevention Systems for Exterior Ladders	2	EA	$5,000.00	$2,000.00	$7,000.00	$14,000
5	Coating Repairs for all Damages from Welding	1	LS	$10,000.00	$15,000.00	$25,000.00	$25,000
6	Underground Piping Modifications	1	LS	$3,000.00	$3,000.00	$6,000.00	$6,000
7	New 6" Tank Isolation Valves	2	EA	$1,500.00	$1,500.00	$3,000.00	$6,000
8	New Flexible Expansion Joints	4	EA	$5,000.00	$3,000.00	$8,000.00	$32,000
9	Seismic Valve Vaults and Seismic Sensors	2	EA	$50,000.00	$20,000.00	$70,000.00	$140,000
10	Tank Startup, Disinfection, and Testing	1	LS	$1,000.00	$4,000.00	$5,000.00	$5,000
11	Construction Surveying and Staking	1	LS		$2,500.00	$2,500.00	$2,500
*	Project assumed to include concrete foundation expansion, steel anchor chairs and bolts, and no deep ground improvements						
					SubTotal:		**$611,000**

Material & Labor Total:		**$611,000**
Bonds and Insurance:	2%	$12,220
Mobilization:	8%	$48,880
Contractor's Overhead & Profit:	10%	$61,100
Subtotal		**$734,000**
Owner's Allowance/Contingency:	*30%*	*$220,200*
Permitting	*2%*	*$14,680*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$969,000***
Engineering	10%	$96,900
Construction Eng./Admin.	10%	$96,900
Estimated Project Cost		***$1,163,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$921,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$1,114,000**

Project P1 - High Zone Pump Station Electrical and Standby Generator

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Standby Generator	1	LS	$30,000.00	$30,000.00	$60,000.00	$60,000
2	Site Electrical Upgrades	1	LS	$10,000.00	$15,000.00	$25,000.00	$25,000
3	Electrical Clean-up in HZPS	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
4	Start-up and Testing	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
				SubTotal:			**$105,000**

Material & Labor Total:		**$105,000**
Bonds and Insurance:	2%	$2,100
Mobilization:	8%	$8,400
Contractor's Overhead & Profit:	10%	$10,500
Subtotal		**$126,000**
Owner's Allowance/Contingency:	*30%*	*$37,800*
Permitting	*2%*	*$2,520*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$166,000***
Engineering	15%	$24,900
Construction Eng./Admin.	10%	$16,600
Estimated Project Cost		***$208,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$158,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$191,000**

Project W1 - Wellhouse Electrical and Standby Generator

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Standby Generator	1	LS	$30,000.00	$30,000.00	$60,000.00	$60,000
2	Site Electrical Upgrades	1	LS	$10,000.00	$15,000.00	$25,000.00	$25,000
3	Electrical Clean-up in Wellhouse	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
4	Start-up and Testing	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
				SubTotal:			**$105,000**

Material & Labor Total:		**$105,000**
Bonds and Insurance:	2%	$2,100
Mobilization:	8%	$8,400
Contractor's Overhead & Profit:	10%	$10,500
Subtotal		**$126,000**
Owner's Allowance/Contingency:	*30%*	*$37,800*
Permitting	*2%*	*$2,520*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$166,000***
Engineering	15%	$24,900
Construction Eng./Admin.	10%	$16,600
Estimated Project Cost		***$208,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$158,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$191,000**

Project W2 - Wellhouse Mechanical Upgrades

Probable Cost of Construction

Water System Recommendations Improvements - DRAFT Water System Evaluation TM

Project: Water System Recommendations Improvements
Submittal: DRAFT Water System Evaluation TM
Owner: Eastmont Water Company
Project No.: 19-2624
Date: August 2020

Item No.	Item	Quantity		Unit Costs			Total Cost
				Material	Labor/Equipment (L/E)	Total	
1	Demolition of Wellhouse Pump, Piping, and Valving	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
2	Vertical Turbine Pump Installation (EWC to pre-purchase Pump*)	1	LS	$0.00	$30,000.00	$30,000.00	$30,000
3	Piping and Valving Upgrades	1	LS	$20,000.00	$20,000.00	$40,000.00	$40,000
4	Site and Building Electrical Upgrades	1	LS	$15,000.00	$25,000.00	$40,000.00	$40,000
5	Variable Frequency Drive	1	LS	$30,000.00	$15,000.00	$45,000.00	$45,000
6	Building Modifications	1	LS	$10,000.00	$10,000.00	$20,000.00	$20,000
7	Temporary Water Delivery System (Tanks and Pump)	1	LS	$10,000.00	$10,000.00	$20,000.00	$20,000
8	System Startup and Testing	1	LS	$0.00	$10,000.00	$10,000.00	$10,000
				SubTotal:			**$215,000**

Material & Labor Total:		**$215,000**
Bonds and Insurance:	2%	$4,300
Mobilization:	8%	$17,200
Contractor's Overhead & Profit:	10%	$21,500
Subtotal		**$258,000**
Owner's Allowance/Contingency:	*30%*	*$77,400*
Permitting	*0%*	*$0*
Environmental Mitigation, Right of Way / Property Acquisition	*Not included*	
Estimated Construction Cost		***$335,000***
* Well Vertical Turbine Pump Pre-Purchase	-	$160,000
Engineering	15%	$50,250
Construction Eng./Admin.	10%	$33,500
Estimated Project Cost		***$579,000***
Construction Cost w/ Owner's Allowance (minimum range: -5%)		**$318,000**
Construction Cost w/ Owner's Allowance (maximum range: +15%)		**$385,000**