BEFORE THE

WASHINGTON UTILITIES & TRANSPORTATION COMMISSION

UW-240151

CASCADIA WATER, LLC

January 13, 2025

Direct Exhibit of Matthew J. Rowell and Culley J. Lehman

CASCADIA WATER LLC'S SUPPLEMENTAL RESPONSE TO WCAW DR 47

Exh. MJR-CJL-6

NW Natural®

Rates & Regulatory Affairs
UW-240151
Cascadia Water LLC Proposed General Rate Case
Data Request Response

Date of Response: 9/24/2024
Responder/Witness: Culley Lehman

Request No.: UW-240151 WCAW DR 47

If so, please produce all planning documents, project reports, construction documents and source approval documents prepared by Cascadia or its consulting engineers, for each of the eight referenced projects.

Response:

Construction plans and project reports are provided for all eight referenced projects except the generators. Please see UW-240151 WCAW DR 47 Attachments 1-10. The two PRV projects for W&B Waterworks #1 were replacements, and therefore do not have project reports, only construction plans.

Note: the CAL Waterworks system loop and CAL Waterworks Reservoir/Booster Pump projects have the same construction plans and project report.

Supplemental Response:

After reviewing the prefiled Response Testimony of Scott Duren on behalf of the Public Counsel and preparing its Rebuttal Testimony, the Company found that it inadvertently did not include the following supplemental project reports prepared by Facet (formerly Davido Consulting Group) as attachments to this response:

CAL Waterworks – Reservoir Replacement & Booster Pump Improvements (UW-240151 WCAW DR 47 Attachment 11)

W&B Waterworks #1 – Reservoir, Pumphouse, Treatment & Watermain Replacement (UW-240151 WCAW DR 47 Attachment 12)

CAL WATERWORKS
BOOSTER PUMPS AND RESERVOIR REPLACEMENT
PROJECT REPORT

CAL WATERWORKS: PWS ID #31040 6

July 2022

System Owner/Contact:
Culley Lehman
Cascadia Water LLC
PO Box 549
Freeland, WA 98249
Phone: (360) 331-7388

For Submittal to:
Washington State Department of Health
Northwest Drinking Water Operations
20425 72nd Ave. S
Building 2, Suite 310
Kent, WA 98032-2388

Davido Consulting Group
Seattle | Mount Vernon | Whidbey Island | Federal Way | Spokane
P. O. Box 1132
Freeland, WA 98249
Tel 360.331.4131

CERTIFICATE OF ENGINEER

The technical material and data contained within this report has been prepared by or under the direction of the following registered professional engineer(s), licensed in accordance with the laws of the State of Washington to practice in the State of Washington.

QUICK REFERENCE PROJECT INFORMATION

General Project Information

Water System Name	CAL Waterworks
Water System ID Number	32140 6
System Owner	Cascadia Water, LLC
Project Description	Reservoir & Pumphouse Replacement
Reservoir, Pumphouse, and Treatment Site	Island County Parcel #: R22902-136-5260
System Owner/Operator	Culley Lehman (Manager)
System Engineer	Robert Bennion, P.E. - Davido Consulting Group, Inc.

Project Summary

Proposed Storage	79,400-gallon Reinforced Circular Concrete Reservoir (26' Diameter x 20' Tall)
System Design Values	Average Day Demand (ADD) = 250 gpd/ERU Maximum Day Demand (MDD) = 500 gpd/ERU Peak Hour Demand (PHD): [a]Max System Capacity (193 ERUs) = 178 gpm [b]Pressure Zone #1 Future Capacity (150 ERUs) = 148 gpm [b]Pressure Zone #2 Future Capacity (10 ERUs) = 28 gpm *[a]50-70-year forecast used for reservoir sizing* *[b]15-20-year forecast used for booster pump sizing*
Connections	DOH Approved Connections – 146 Active Residential Service Connections – 114 Active Nonresidential Service Connection – 1
Sources	Well #1 (S01), DOE Tag: AGA928, 45 gpm Well #1 (S01), DOE Tag: AGA927, 45 gpm Island County Parcel #: R22902-136-5260
Water Rights	**Water Right #1** Permit Number: G1-00032P Priority Date: December 23, 1971 Q_i = 55 gpm & V_a = 27.5 acre-ft/year **Water Right #2** Permit Number: G1-27478P Priority Date: June 1, 1994 Q_i = 35 gpm & V_a = 26.5 acre-ft/year **Total:** Q_i = 90 gpm & V_a = 54 acre-ft/year
Proposed Booster Pumps	(4) 10-hp Grundfos CR 32-3-2-3ph Centrifugal Booster Pumps (2) 3-hp Grundfos CR 5-9-3ph Centrifugal Booster Pumps

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1 PROJECT DESCRIPTION

This project report describes the proposed system improvements for the CAL Waterworks Water System (Public Water System Identification Number 310406). These improvements include replacing the pumphouse, booster pump system, hydropneumatic tanks, installing a larger concrete reservoir, and providing a loop in the distribution system

1.1 Background

CAL Waterworks (CAL) was first formed under the name Harbor Sands Distribution System (Harbor Sands) in 1963. The name of the system was changed from Harbor Sands to W&B Waterworks #2 and then changed to its current name of CAL Waterworks by 1996. Harbor Sands installed their first well (Well #1) in 1963 and the system was originally approved to serve 105 lots. In 1972, a 40,000-gallon concrete storage reservoir and booster pump station were installed. A second well (Well #2) was installed in 1985 and was approved as a source in 1996. Each well has an approved capacity of 45-gpm. A copy of CAL's Water Facility Inventory (WFI) form is included in Appendix A.

CAL Waterworks (CAL) is currently owned and operated by Cascadia Water, LLC. The System is located off East Harbor Road north of Freeland, WA in the southern portion of Whidbey Island. The location of the service area is shown in Figure 1. CAL has a Washington State Department of Health (DOH) approved capacity of 146 connections, currently CAL has 99 single-family residential connections and one nonresidential connection. The non-residential connection is a wholesale water supply to Goss Lakeridge Acres Association (PWS ID # 220700). Goss Lakeridge Acres has 15 single family residences. Therefore, CAL is currently providing service to a total of 114 residences. A copy of Goss Lakeridge Acres Association WFI form is included in Appendix A. The Goss Lakeridge Acres Water System is located on the north end of the CAL distribution system along East Goodell Road. Goss Lakeridge Acres has its own booster pump system to provide adequate pressure within their distribution system.

The *Cascadia Unified Water System Plan* included the identification of capital improvement projects for the CAL Water System. This proposed project addresses the four (4) highest priority projects. The proposed work includes the following:

1. Waterline Installation – Installing approximately 150-feet of 6" water main to loop the water main along East Harbor Road between Beachwood Drive and Harbor Sands Lane. This project addresses the primary deficiency in the distribution system that limits capacity to the connection with Goss Lakeridge Acres.
2. Pumphouse Building with Booster Pump Station – Installation of a new building with sufficient size for the updated booster pumps, hydropneumatics tanks, and other appurtenances. Includes the design and installation of a booster pump station to maintain system pressures.
3. New storage reservoir – Installation of a new reservoir to provide adequate storage for anticipated future system needs. The existing reservoir will be demolished and replaced with a new storage tank.
4. System Security – Security fencing will be installed around the reservoir, pumphouse, and wells located off Pheasant Farm Lane.

Figure 1: Project Location

1.2 Existing System Configuration

CAL has two wells located on a system owned lot containing the storage reservoir and the pumphouse containing the booster pump stations (Island County Parcel R22902-136-5260). The two wells function in a lead/lag configuration which are controlled by reservoir levels. A well field was designated in 1994 for the purpose of water quality monitoring. The system has water right certificates with a combined withdrawal rate of 90-gpm and annual withdrawal of 54.0 acre-feet per year.

The system includes a single concrete reservoir with a total storage volume of 40,000-gallons (nominal volume). Four 5-hp pumps supply water to the primary (low pressure) service area. A second booster pump station, consisting of twin 1.5-hp pumps further increase the pressure from the discharge of the 5-hp pumps to properly supply the homes in the high elevation pressure zone. The high-elevation pressure zone is referred to as Pressure Zone #2 in this report, while the rest of the service area is referred to as Pressure Zone #1; pressure zones can be seen in Figure 2. Fire flow is not provided by the existing booster system. The four 5-hp booster pump motors are protected from frequent on-off cycling by three 315-gallon vertical hydropneumatic tanks. Two 220-gallon vertical hydropneumatic tanks provide pump protection to the twin 1.5-hp booster pump motors.

Hydraulic modeling indicates that while supplying Peak Hour Demands (PHD) there are portions of the distribution system that experience low service pressures along Ravenridge Drive, Harbor Sands Lane, and east along Goodell Road into Goss Lakeridge Acres. The low pressures are caused by distribution system constraints along East Harbor Road between Beachwood Drive and Harbor Sands Lane. The low-

pressure regions are fed off 3-inch water mains. This system deficiency is addressed by this project (Item Section 1.3.1).

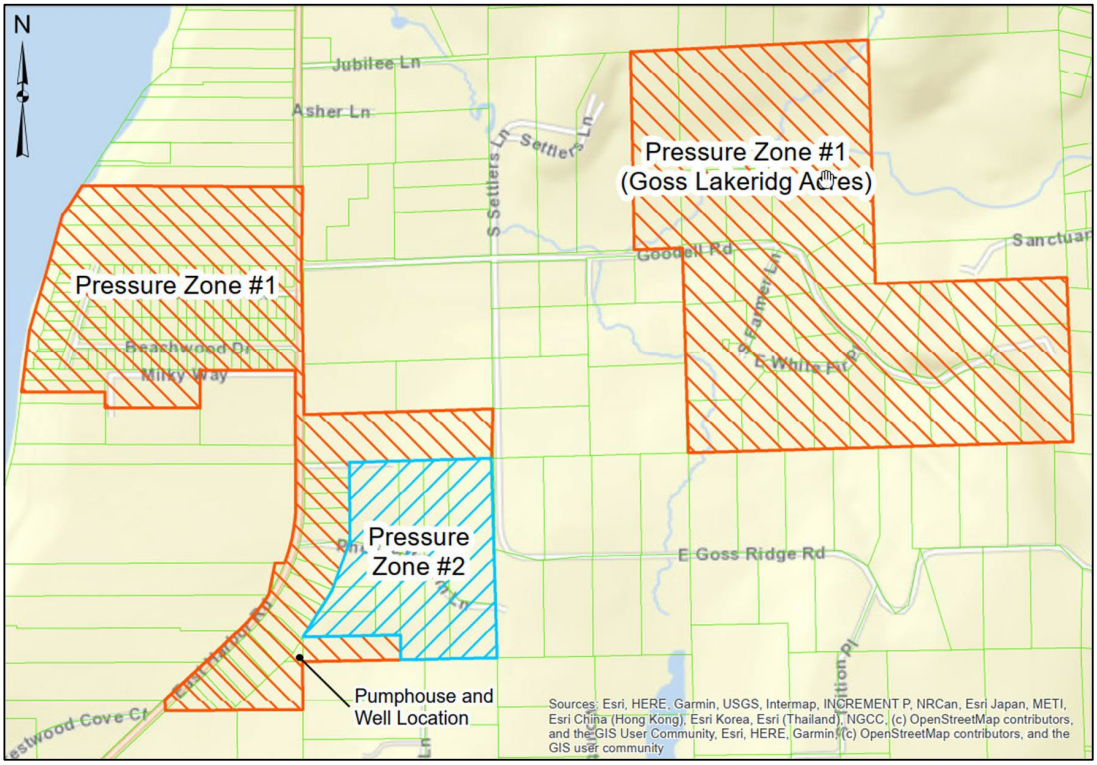


Figure 2: Pressure Zone Map

1.3 Recommended Improvements

The proposed improvements are designed to address the higher priority capital improvement projects for the system as identified by the Water System Plan. These projects involve replacement of aging infrastructure which limits distribution system reliability and capacity. In addition, the improvements cover distribution system piping, system storage, system pressure, and general facility security.

1.3.1 Distribution Piping

As noted previously, the *2020 Cascadia Unified Water System Plan* states that when supplying PHD, there are portions of the distribution system that experience low service pressures along Ravenridge Drive, Harbor Sands Lane, and east along Goodell Road into Goss Lakeridge Acres. In the hydraulic model discussed in Section 5.4, the low pressures in the distribution system are resolved by installing a small section of new water main along East Harbor Road between Beachwood Drive and Harbor Sands Lane. The new main will connect the existing 4-inch line on the intersection of East Harbor Road and Beachwood Drive to the existing 6-inch main located midway between Beachwood Drive and Harbor Sands Lane 150-feet to the North.

In addition, an 8-inch watermain will be extended from the pumphouse down an existing easement between Island County parcels R22902-150-5110 and R22902-142-5030 to East Harbor Road. This line will extend approximately 350-feet northwest where it will cross under East Harbor Road and connect to

the existing 4-inch water main located on the west side of this road. This section of pipe will replace an old 4-inch water main and is sized to support future system improvements, including fire flow capacity, if desired, at a later date.

1.3.2 System Storage

The existing reservoir is a 40,000-gallon octagonal concrete reservoir installed in 1972. This reservoir has reached its useful life expectancy and is leaking from the corners. The existing reservoir will be removed and replaced with a storage reservoir sized to provide for the system's anticipated future storage needs for a maximum capacity 193 Equivalent Residential Units (ERUs). The proposed reservoir has a storage capacity of 79,400-gallons with dimensions of 26-feet diameter by 20-feet of height.

During construction temporary storage will be installed to support system operations. Demolition of the old reservoir and construction of the new reservoir will be staged to reduce the timeframe for the temporary storage, and to allow for the temporary storage to be in use outside of the season where the system experiences peak demands. During reservoir replacement, consumers will be notified of the reduced storage capacity and they will be encouraged to limit water usage during construction.

1.3.3 Pumphouse and Booster Pump Replacement

The existing pumphouse is in poor condition and has an inadequate layout to properly service the installed equipment. The existing pumphouse will be demolished and replaced. The new pumphouse will be sized to locate the booster pump system(s), associated hydropneumatic tanks, and controls.

The current booster pumps and pressure tanks have exceeded their useful life and no longer provide reliable service to the system. New booster pump systems will be installed to support current and future anticipated system demands in accordance with growth expectations estimates provided in the Water System Plan. There are two separate booster pump systems, one for the lower pressure zone, Pressure Zone #1, which includes the majority of the system's connections, and a second for the upper pressure zone, Pressure Zone #2. Both systems are designed to meet the Peak Hour Demand (PHD) corresponding to the area and service connections that each system serves. The booster system for Pressure Zone #1 is also designed to provide adequate capacity to provide residential fire flow. The existing pumphouse and equipment will continue to operate throughout construction.

2 PLANNING CONSIDERATIONS

No additional management responsibilities will be necessary because the project is an in-kind replacement of an existing reservoir. Cascadia Water, the owner of CAL Waterworks, owns the parcel where the new reservoir and pumphouse will be constructed. There are no known legal considerations that would affect the proposal.

The proposed new reservoir and pumphouse will comply with the setbacks required by Island County. Per the Island County municipal code, a reservoir must be located with at least 0.5 feet of setback for every 1 foot of reservoir height above ground-level. The proposed 20-foot-tall reservoir results in a setback requirement of 10' feet. A building permit with Island County is required for the reservoir construction. A building permit will be obtained by the installation contractor prior to the start of construction activities. The building permit will require a site plan, tank and building construction details and supporting structural engineering calculations.

Construction of the project is proposed to start in Fall of 2022. Operational costs of the proposed change to the system are negligible. Maintenance should continue as usual and should consist of periodic cleaning and inspection of the reservoir.

The replaced reservoir has been sized to accommodate the system's maximum capacity of 193 connections, as noted in the 2020 Cascadia Water System Plan. No increase in system capacity is being requested with this project, however, the System is planning on expanding in the future, therefore, the reservoir has been designed to have the capacity for future expansion.

3 DESIGN CRITERIA

3.1 Water System Design Values

Water usage design values were taken from the latest approved capacity analysis for CAL Waterworks approved in 2018 (DOH Submittal No. 18-0101). The water usage data in that analysis was based on 3 years of data.

3.1.1 Average Day Demand

The annual average day demand (ADD) was 175 gpd/ERU for this period. The maximum summer (June-September) ADD value is approximately 250 gpd/ERU. For a conservative analysis, the maximum summer ADD of 250 gpd/ERU was used as the system ADD.

3.1.2 Maximum Day Demand

Maximum day demand (MDD) is ideally determined by meter readings and is the largest single-day usage of water based upon production. The maximum day demand (MDD) could not be determined from actual water use data due to lack of daily source meter readings. Therefore, the meter readings for each system were analyzed to determine a maximum monthly average day demand (MMADD). The MMADD is then multiplied by a peaking factor to determine MDD per the DOH Water System Design Manual (Design Manual) Section 3.4.1. The highest (maximum) monthly average day demand (MADD) reading is 293 gpd/ERU. The MDD used in the analysis is determined from the MADD and equates to 500 gpd/ERU.

3.1.3 Peak Hour Demand

The Peak Hour Demand (PHD) was found using Equation 3-1 from the DOH *Water System Design Manual*, 2019 edition (referred to as the "Manual" throughout this report). The equation uses the MDD and the number of potential connections to determine the PHD flowrate.

$$\text{PHD} = \frac{\text{MDD}}{1440}((\text{C})(\text{N}) + \text{F}) + 18$$

Where:
PHD = Peak Hour Demand (gpm)
MDD = 530 gpd/ERU
C = coefficient based on system size (see Table 1)
N = number of potential connections
F = coefficient based on system size (see Table 1)

The coefficients that are utilized in the above formula are dependent upon the number of connections served. The coefficients used are listed below in Table 1.

Table 1: Peak Hour Demand Calculation Coefficients

Range of ERUs	C	F
15 – 50	3.0	0
51 – 100	2.5	25
101 – 250	2.0	75
251 – 500	1.8	125
> 500	1.6	225

To properly assess source capacity, water right capacity, and storage levels the full system PHD was developed. However, booster pumps for the separate pressure zones are based on the PHD corresponding to the potential number of service connections in each zone. Therefore, the values for PHD that were used in the development of the proposed improvements are shown in Table 2.

Table 2: Peak Hour Demand Design Values

Area	ERUs	C	F	PHD (gpm)
Existing System [a]	114	2.0	75	123
Future System [b]	193	2.0	75	178
Future Pressure Zone 1 [c]	150	3.0	0	148
Future Pressure Zone 2 [d]	10	2.0	75	28

[a] Used for sizing of temporary storage requirements
[a] Used for sizing of the proposed reservoir
[a] Used for sizing of booster pumps for Pressure Zone 1
[a] Used for sizing of booster pumps for Pressure Zone 2

4 RESERVOIR DESIGN CALCULATIONS

4.1 Reservoir Sizing

The system design parameters from Section 3 were used to support the reservoir sizing. Reservoir sizing was completed according to DOH guidance in the *Water System Design Manual*, 2019 edition (Design Manual) to ensure that the system would have adequate storage capacity to meet the needs of currently approved connection as well as anticipated future needs. With limited space on the system

owned parcel, it will be necessary to remove the existing reservoir to install the new one. During this process, temporary storage will need to be provided. Design calculations for the temporary storage, based on current connections, and the proposed reservoir, based on future projections are included in Appendix C. The five following storage components were considered in the design process:

1. Operational Storage (OS)
2. Equalizing Storage (ES)
3. Dead Storage (DS)
4. Standby Storage (SB)
5. Fire Suppression Storage (FSS)

The proposed reservoir consists of reinforced circular concrete with a diameter of 26 feet and a height of 20 feet. This results in a total storage capacity of approximately 79,400 gallons (V_R) and 3,970 gallons of storage per foot of reservoir height (V_f). Temporary storage will consist of two hydraulically connected 5,000 gallon polyethylene tanks with a total storage capacity of 10,000-gallons. Each of the temporary storage reservoirs is 10-feet in diameter and has an effective height of 8.66 feet.

4.1.1 Operational Storage

Operational storage (OS) is the height difference between the water levels in the reservoir where the well pumps are turned on and off. Adequate operational storage will prevent excess cycling of the well pumps by minimizing the number of times they need to start. 1-foot of elevation difference will be provided between the well pump on and off signals. Therefore, the operation storage is calculated as follows:

Proposed Reservoir:

$$\text{OS} = 0.5\text{ ft} \cdot 3{,}970\text{ gal/ft} = 1{,}990\text{ gallons}$$

Temporary Storage:

$$\text{OS} = 0.5\text{ ft} \cdot 1{,}150\text{ gal/ft} = 580\text{ gallons}$$

Each of the CAL sources alternates in filling the reservoir, unless levels fall continue to fall, at which point the lag pump is activated. In typical operations, at a fill rate of 45 gpm, the 1,990 gallons of OS will allow the well pumps to stay on for a minimum of 44 minutes during filling operations. This volume is adequate to provide the required pump protection.

With the temporary storage reservoirs, the 580 gallons of OS will create fill times of approximately 13 minutes which also provides adequate pump protection.

4.1.2 Equalizing Storage

Equalizing storage (ES) is the volume of water that is needed to meet the peak demand period for the water system. Equalizing storage was calculated using equation 7-1 from the DOH *Water System Design Manual*, 2019 edition as follows:

$$\text{ES} = (\text{PHD} - Q_s)(150\text{ minutes})$$

Where:

PHD = Peak Hour Demand
Q_s = Downstream system limiting capacity (90 gpm)

The proposed reservoir is designed to have the sufficient storage to support the anticipated system maximum capacity of 193 ERUs. The ES for the temporary storage was based on the current number of system connection (114 ERUs) including those from the Goss Lakeridge Acres distribution system. The PHD values associated with each scenario are found in Table 2.

Proposed Reservoir:

$$\text{ES} = (178 \text{ gpm} - 90 \text{ gpm}) \cdot (150 \text{ minutes}) = 13{,}210 \text{ gallons (or 3.3 ft of storage)}$$

Temporary Storage:

$$\text{ES} = (123 \text{ gpm} - 90 \text{ gpm}) \cdot (150 \text{ minutes}) = 4{,}950 \text{ gallons (or 4.3 ft of storage)}$$

4.1.3 Dead Storage

Dead storage (DS) is the unusable volume at the top (TDS) and bottom (BDS) of the reservoir. 6 inches of freeboard will be provided at the top of the proposed temporary storage reservoir(s). The reservoir outlet will be raised 6 inches above the bottom of the reservoir to prevent silt and other material that may collect in the reservoir from entering the distribution system. In addition, the booster pump low-level shut off will be set an additional 6 inches above the reservoir outlet, resulting in 1 foot of BDS. Therefore, dead storage values can be calculated as follows:

Proposed Reservoir:

$$\text{TDS} = 0.5 \text{ ft} \times 3{,}970 \text{ gal/ft} = 1{,}985 \text{ gallons (or 0.5 ft of storage)}$$
$$\text{BDS} = 1.0 \text{ ft} \times 3{,}970 \text{ gal/ft} = 3{,}970 \text{ gallons (or 1.0 ft of storage)}$$
$$\text{DS} = \text{TDS} + \text{BDS} = 5{,}960 \text{ gal (or 1.5 ft of storage)}$$

Temporary Storage:

$$\text{TDS} = 1.0 \text{ ft} \times 1{,}150 \text{ gal/ft} = 1{,}150 \text{ gal (or 1.0 ft of storage)}$$
$$\text{BDS} = 1.0 \text{ ft} \times 1{,}150 \text{ gal/ft} = 1{,}150 \text{ gal (or 1.0 ft of storage)}$$
$$\text{DS} = \text{TDS} + \text{BDS} = 2{,}230 \text{ gal (or 2.0 ft of storage)}$$

4.1.4 Standby Storage

Standby storage (SB) is the volume of water available to supply the system in case of source supply issues. The minimum recommended standby storage volume is 200 gallons per ERU. This results in a recommended standby storage volume of 38,600 gallons based on the system's maximum capacity of 193 ERUs. The temporary storage will provide minimal standby storage volume. The timing for use the temporary storage will be outside of peak seasonal demands for the system.

The standby storage provided by the both the proposed reservoir and temporary storage can be calculated as the remaining volume after operational storage, equalizing storage, and dead storage are accounted for. The provided standby storage is calculated as follows:

Proposed Reservoir:

$$\text{SB}_{\text{recommended}} = 200(\text{ERUs}) = 200(193) = 38{,}600 \text{ gallons}$$
$$\text{SB}_{\text{provided}} = \text{V}_\text{R} - (\text{OS} + \text{ES} + \text{DS}) = 79{,}430 - (1{,}990 + 13{,}210 + 5{,}960) = 58{,}480 \text{ gal}\textit{lons}$$

Temporary Storage:

$$\text{SB}_{\text{provided}} = \text{V}_\text{R} - (\text{OS} + \text{ES} + \text{DS}) = 10{,}000 - (580 + 4{,}950 + 2{,}230) = 2{,}250 \text{ gallons}$$

4.1.5 Fire Suppression Storage

Currently, CAL Waterworks is not required to provide fire flow. However, system improvements are being sized so that the system will be able to support fire flow in the future. Fire suppression storage

(FSS) requirements are set by Island County (IC). IC residential fire flow requirements are 500 gpm for 30 minutes, which equates to 15,000 gallons of required storage volume. Fire suppression storage may be nested with standby storage. The FSS storage requirements are satisfied, since the provided standby storage exceeds the fire flow requirements. The storage volumes provided by the proposed reservoirs are summarize in Table 3.

Table 3: Storage Components

	Proposed Reservoir		Temporary Storage	
Storage Component	**Volume (gallons)**	**Equivalent Height (feet)**	**Volume (gallons)**	**Equivalent Height (feet)**
Top Dead Storage	1,990	0.5	1,150	1.0
Operational Storage	1,990	0.5	580	0.5
Equalizing Storage	13,210	3.3	4,950	4.3
Standby Storage	58,480	14.7	2,250	1.9
Bottom Dead Storage	3,970	1.0	1,150	1.0
Total	**79,400**	**20.0**	**10,000**	**8.7**

4.2 Reservoir Floats and Piping Levels

The proposed reservoir will be constructed with a finished floor at the surrounding grade. The height of the proposed reservoir overflow, inlet, outlet, and drain lines are provided in Table 4, and are reported relative-to the finished floor of the proposed reservoir.

Table 4: Proposed Reservoir Piping Levels

	Proposed Reservoir	Temporary Storage
Piping Component	**Height* (feet)**	**Height* (feet)**
Inlet from Wells (Pipe Invert)	19.67	9.0
Overflow (Pipe Invert)	19.50	8.5
Outlet (Suction Line)	0.50	0.5
Drain	0	0

** All measurements occur from the floor of the proposed reservoir.*

Reservoir set points for lead and lag well pump on/off levels, low-level alarm, high-level alarm, and booster pump shut off levels are provided in Table 5**.**

Table 5: Reservoir Set Points

	Proposed Reservoir	Temporary Storage
Reservoir Control Set Points	**Height* (feet)**	**Height* (feet)**
High Level Alarm	19.5	8.2
Well Pumps Off	19.0	8
Lead Well Pump On	18.5	7.5
Lag Well Pump On	18.0	7
Low Level Alarm	10.0	5.0
Booster Pump Shut Off	1.0	1.0

** All measurements occur from the floor of the proposed reservoir.*

4.3 Water Age

According to the DOH *Water System Design Manual*, 2019 edition on page 196, "long detention times in reservoirs can lead to loss of disinfectant residual, microbial growth, sediment accumulation, formation of disinfection byproducts, taste and odor problems, and other water quality issues." It is recommended that a complete turnover of water in a storage reservoir occur at least every three to five days to minimize these problems. The following calculation was used to estimate the average water age in the proposed reservoir. The calculation uses the existing number of connections of 115 ERUs (N) and the lowest ADD that the system has experienced (144 gpd/ERU).

$$\text{Water Age} = \frac{V_R - \text{TDS}}{\text{ADD} \cdot \text{N}} = \frac{79{,}400\ \text{gal} - 3{,}970\ \text{gal}}{144\ \text{gpd/ERU} \cdot 115\ \text{ERUs}} \cong 4.5\ \text{days}$$

The water age was estimated to be about 4.5 days which is acceptable. Water age is not expected to cause any complications with the proposed reservoir.

5 BOOSTER PUMP SYSTEM DESIGN CALCULATIONS

5.1 Booster Pump Design & Requirements

The guidelines for sizing a closed system booster pump station are described in section 8.1.2 of the Design Manual. The System's demands and flow rates are summarized in Section 3.1 of this report. System demands are calculated based on the approved number connections.

Per section 8.1.2 of the Design Manual, the booster stations are required satisfy to meet the following scenarios:

1. Supply the system Peak Hour Demand (PHD) while providing at least 30-psi to all service connections.
2. While not currently required to provide fire flow, the pumps have been designed to meet future fire flow demands. The Design Manual requires Fire Flow (FF) during Maximum Day Demand (MDD) while supplying at least 20-psi to all service locations within the distribution system. In this scenario, the largest pump supplying the supplying pressure zone of the distribution system is assumed to be out of service. This is discussed in further detail in Section 5.4.3 of this report.

5.2 Pump Settings and & System Pressures

The booster pumps for Pressure Zone #1 will be replaced with four (4) 10 hp Grundfos CR 32-2 A-G-A-E-HQQE booster pumps. The pumps have been sized to provide for existing PHD while having some flexibility to provide for future demands on the system. Cumulatively, the four pumps would be capable of providing residential fire flow requirements and MDD with the largest pump out of service. The four booster pumps will operate on an alternating lead/lag/lag/lag configuration where the starting and lag pumps will alternate with each pump-start. The proposed pressure settings are summarized in Table 6 and pump curves are included in Appendix D.

The booster pumps for Pressure Zone #2 will be replaced with two (2) 3 hp Grundfos CR 5-9-3ph booster pumps. Each pump provides a flow rate of 31 gpm at 95 psi and 39 gpm at 85 psi. These pumps will also operate on an alternating lead/lag configuration.

The pressure settings for each booster pump station were analyzed in a hydraulic model discussed in Section 5.4. The proposed pressure settings are summarized in Table 6 and pump curves are included in Appendix D.

Table 6: Booster Pump Pressure Settings

Pressure Zone #1 (4) 10 hp Grundfos CR 32-3-2-3ph	
Pump Position	**On/Off Pressure Setting**
Lead Pump	60/75 psi
Lag #1	55/70 psi
Lag #2	50/65 psi
Lag #3	45/60 psi
Pressure Zone #2 (2) 3 hp Grundfos CR 5-9-3ph	
Pump Position	**On/Off Pressure Setting**
Lead Pump	85/95 psi
Lag	75/85 psi

5.3 Pressure Tanks

New bladder tanks will be provided for each pressure zone. The minimum pressure tank storage for each booster pump system was found using Equation 9-1 from the Design Manual:

Design Manual Equation 9-1:

$$T \geq \frac{(R)(Q_p)}{(N_C)(V_B)}$$

Where:

$R = \frac{15(P_1 + 14.7)(P_2 + 14.7)}{(P_1 - P_2)/(P_2 + 9.7)}$

T = Total number of pressure tanks (gallons)

P_1 = Pump-Off pressure for water system operation (psi)

P_2 = Pump-On pressure for water system operation (psi)

N_c = Number of pump operating cycles per hour (6 cycles per alternating pump)

Q_p = Pump delivery capacity at the midpoint of the selected pressure range (gpm)

The lead pump for Pressure Zone #1 has on/off pressure settings of 60-psi and 75-psi. Q_P was found to be 135 gpm at 67.5 psi. The number of pump cycles per hour, N_C,was found to be 24 total cycles per hour, or 6 cycles per hour per alternating pump. Using 317-gallon Amtrol WX-454C bladder tanks, the minimum number of bladder tanks is 2. The pressure tanks should have an acceptance volume of 158 gallons which would equate to minimum pump run time of 1 minute. This meets minimum run time recommendations form pump manufacturers.

The lead pump for Pressure Zone #2 has on/off pressure settings of 85-psi and 95-psi. Q_P was found to be 34 gpm at 90 psi. The number of pump cycles per hour N_C was found to be 12 total cycles per hour, or 6 cycles per hour per alternating pump. Also using 264-gallon Amtrol WX-453C bladder tanks, the minimum number of bladder tanks is 2. The pressure tanks should have an acceptance volume of 158 gallons which would equate to minimum pump run time of 1 minute. This meets minimum run time recommendations form pump manufacturers.

5.4 Hydraulic Modeling

A hydraulic model was created using the software EPA-NET to simulate the proposed system to ensure adequate flow and pressure during operation and to verify that the proposed booster pumps meet the estimate demands. The following three scenarios were simulated using the hydraulic model:

1. PHD scenario (see scenario 1 in Table 7);
2. MDD plus FF scenario (see scenario 2 in Table 7), and
3. A static water pressure scenario with high pressure settings and no demand.

The criteria that were used to size the booster pump systems and the assumptions made in each modeling scenario are described in Table 7. All scenarios model the system with the improvements proposed in this project, including the proposed loop in the distribution system discuss in Section 1.3.1 and the proposed reservoir.

Table 7: Hydraulic Modeling Scenarios, Requirements, and Assumptions

Scenario	Demand Condition	Pressure Requirements	Scenario Assumptions
1	Peak Hour Demand	> 30 psi	• Equalizing Storage Depleted • Pressure Tanks at the Lead Pump "On" setting
2	Fire Flow + Maximum Day Demand	> 20 psi	• Largest Pump Out of Service • Equalizing & Fire Suppression Storage Depleted • Pressure Tanks at the 2nd Lag Pump "On" setting
3	Static Water Pressure	< 80 psi*	• All pumps off • Reservoir at bottom of Top Dead Storage • Pressure tanks at Lead Pump "Off" setting

5.4.1 Scenario #1: Peak Hour Demand

The PHD scenario was modelled to verify whether the proposed booster pumps systems and pressure settings can provide the PHD and a minimum pressure 30 psi at all service locations. For this scenario, the storage reservoir is assumed to have the equalizing storage depleted and the pressure tanks are assumed to be at the Lead Pump "On" setting for both pressure zones, or 55 psi and 85 psi for Pressure Zones #1 and #2 respectively. A single pump is adequate to supply PHD for each zone, so lead pump settings are used. The System's two pressure zones operate independently in the proposed

configuration; therefore, each pressure zone was assumed to be at its estimate peak hour demand of 148 gpm and 29 gpm, respectively, as summarized in Section 3.1.3.

In the PHD modelling scenario, it was found that the pressure at all locations throughout the distribution system meet the minimum required pressure of 30 psi. In Pressure Zone #1, the lowest resulting service pressure was found to be 34 psi. In Pressure Zone #2, the lowest resulting pressure was found to be 40 psi.

5.4.2 Scenario #2: Static Water Pressure

For scenario 2, the static water pressure scenario, the pumps were turned off, and the reservoir and pressure tanks were set to their maximum levels. In Pressure Zones #1 and #2, the maximum pressure on the distribution system was found to be 80 psi and 95 psi. With the maximum water pressure within the Pressure Zone #2 exceeding 80-psi, it is recommended that the identified service connections with elevated pressures be provided with an individual pressure reducing valve.

5.4.3 Scenario #3: Fire-Flow

In order for the distribution system to provide fire flow in the future, it will be necessary to perform additional improvements to the system consisting of water main replacement along East Harbor Road. However, the currently proposed improvements have been sized to be capable of providing fire flow in the future. Scenario 3, the fire-flow scenario, the MDD of 58 gpm was distributed across the entire system. The fire-flow (FF) of 500 gpm was applied to one node in the distribution system. The Equalizing Storage and Fire Suppression Storage was assumed to be depleted, resulting in water level of 11 ft in the proposed reservoir.

As noted previously, the replacement of 4-inch water mains along East Harbor Road with minimum 6-inch water mains will be required for these future improvements. These improvements are noted in the Capital Improvement Project in the *2020 Cascadia Unified Water System Plan* for the medium to long term and are not proposed as a part of this project.

6 OPERATION AND MAINTENANCE CONSIDERATIONS

The system is owned and operated by Cascadia Water. The proposed work is replacement of existing equipment and features, so the changes to the system operation and maintenance is not significantly affected. No or minimal water quality changes are expected from the replacement of the reservoir. The system's Operation and Maintenance (O&M) plan should be updated to include the manufacturer's recommended procedures for the new booster pumps, bladder tanks, floats, controls, and other new equipment. Maintenance should continue as usual and should consist of periodic cleaning and inspection of the reservoir and line flushing. Operational costs of the reservoir are not expected to change significantly.

Appendix A: System Information

Water Facility Inventory

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

WATER FACILITIES INVENTORY (WFI) FORM

ONE FORM PER SYSTEM

Quarter: 2
Updated: 05/05/2020
Printed: 2/2/2022
WFI Printed For: On-Demand
Submission Reason: Owner Update

RETURN TO: Central Services - WFI, PO Box 47822, Olympia, WA, 98504-7822

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
31040 6	CAL WATERWORKS	ISLAND	A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS

CULLEY J. LEHMAN [MANAGER]
PO BOX 549
FREELAND, WA 98249

7. OWNER NAME & MAILING ADDRESS

CASCADIA WATER, LLC MANAGER
CULLEY J. LEHMAN
PO BOX 549
FREELAND, WA 98249

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 18181 SR 525
CITY FREELAND STATE WA ZIP 98249

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 220 NW SECOND AVENUE
CITY PORTLAND STATE OR ZIP 97209

9. 24 HOUR PRIMARY CONTACT INFORMATION		10. OWNER CONTACT INFORMATION	
Primary Contact Daytime Phone: (360) 331-7388		Owner Daytime Phone: (360) 331-7388	
Primary Contact Mobile/Cell Phone: (360) 661-7781		Owner Mobile/Cell Phone: (360) 661-7781	
Primary Contact Evening Phone: (xxx)-xxx-xxxx		Owner Evening Phone:	
Fax:	E-mail: xxxxxxxxxxxxxxxxxxx	Fax:	E-mail: xxxxxxxxxxxxxxxxxxx

11. SATELLITE MANAGEMENT AGENCY - SMA (check only one)

- [x] Not applicable (Skip to #12)
- [ ] Owned and Managed
- [ ] Managed Only
- [ ] Owned Only

SMA NAME: _____ SMA Number:

12. WATER SYSTEM CHARACTERISTICS (mark all that apply)

- [ ] Agricultural
- [ ] Commercial / Business
- [ ] Day Care
- [ ] Food Service/Food Permit
- [ ] 1,000 or more person event for 2 or more days per year
- [ ] Hospital/Clinic
- [ ] Industrial
- [ ] Licensed Residential Facility
- [ ] Lodging
- [ ] Recreational / RV Park
- [x] Residential
- [ ] School
- [ ] Temporary Farm Worker
- [ ] Other (church, fire station, etc.): _____

13. WATER SYSTEM OWNERSHIP (mark only one)

- [ ] Association
- [ ] City / Town
- [ ] County
- [ ] Federal
- [x] Investor
- [ ] Private
- [ ] Special District
- [ ] State

14. STORAGE CAPACITY (gallons)

41,200

15	16	17	18 SOURCE CATEGORY										19 USE			20	21 TREATMENT						22	23	24 SOURCE LOCATION			
Source Number	SOURCE NAME LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456 IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE	INTERTIE SYSTEM ID NUMBER	WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN SPRINGFIELD	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	PERMANENT	SEASONAL	EMERGENCY	SOURCE METERED	NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	DEPTH TO FIRST OPEN TERVAL IN FEET	CAPACITY (GALLONS PER MINUTE)	1/4, 1/4 SECTION	SECTION NUMBER	TOWNSHIP	RANGE
S01	AGA928 WELL 1		X										X			Y	X						173	45	NW SW	01	29N	02E
S02	AGA927 WELL 2		X										X			Y	X						174	45	NE SE	02	29N	02E

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
31040 6	CAL WATERWORKS	ISLAND	A	Comm

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)		99	120
A. Full Time Single Family Residences (Occupied 180 days or more per year)	99		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	0		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	0		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	0		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	0	0	0
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	1	1	1
28. TOTAL SERVICE CONNECTIONS		100	121

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 235

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?												
B. How many days per month are they present?												

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students, daycare children and/or employees are present each month that are NOT alreay included in the residential population?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1	1	1	1	1	1	1	1	1	1	1	1

34. NITRATE SCHEDULE	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS
(One Sample per source by time period)			

35. Reason for Submitting WFI:

☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other _____

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: _____ **DATE:** _____

PRINT NAME: _____ **TITLE:** _____

Well Logs

I/Fo/--- Ck""" 19/02-U2

FHe Original and First Copy with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Applir.:•tlon No.

Permit No

OWNER: Name W B. WATERWORKS #2 Address P.O. Box 55 [illegible]

(2) LOCATION OF WELL: count, ... :t;'5MA1iJ $ NE ¼ SE ¼ Sec 2 T 29 N., R 25 W.M.

!!earlna: and distance from section or subdivi:.1on corner I A./' - :S--DW the SE Corner of Sec 2

(3) PROPOSED USE: Domestic O ' Jndwtdal O Municipal;/ Irrigation D Test Well D Other D

(4) TYPE OF WORK: Owne,'s numbe, of well ,# '1 (If m than one)....

New well)'!J Method: Dug D Bored O
Deepened D Cable D Driven 0
Reconditioned ☐ Rotary Jef Jetted D

DIMENSIONS: Diameter of well 6 inches.
Drilled 185 ft. Depth of completed well 179 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: . 4'.." Diam. „om ....0.....ft. to ./'Ji.. ft.
Threaded D ..... " Diam. from . .. ft. to .....ft.
WeldedjJ ..... "Diam.from . ft. to .. ft.

Perforations: Ye11 ☐ No/
Type of perforator used.....
SIZE of perforations .... . tn. by In.
.... perforations from . .. . ft.. to . .....ft.
..... perforations from ..... ft. to ....ft.
.... perforationB from . . ft, to ..... ft.

Screens: YesJlf No☐
Manuf■ctwcu'■ Name..... ,K.... . .
TYpe...$111'4".....fi. .. •.....W,.. "!IIW, N -.-.....;;;;;.....
Diam.....f,:... Slot 11lz:e .. / ... from ./.7.'!'f..... ft. to ../.n..... ft.
Diam. ..... Slot slz:e ..... from . ..... ft. to.....ft.

Gravel packed: Yes☐ No,f!{" s1z:e of gravel:
Gravel placed from , . ft. to . . ft.

Surf::= •:•;/;..,No ;;1-pth.? ". ..N o
Did any strata contain unusable water? Yes D ZJ
Type of water?..... ..... Depth of strata.
Method of sealing strata off.

7) PUMP: Manufacturer's Name STA-RITE
Type: Submersible HP 2

(8) WATER LEVELS: : i;s r:: e; eY!! ...../...f.O..tt.
Static level . .._/.H:.S:.. ..b .. ..ft. below top of well Date....J.:::'. . -..;C"":";-/
Artesian pres11ure . ..... lbs. per square Inch Date.....
Artesian water ill controlled by.. (Cap, valve, etc.)

(9) WELL TESTS• Drawdown Is amount water level 11 • lowered below etatlc level /Ji C.
Was a pump teat made? Yes No D If yes, by whom1.0..'f:.W....."II.M/J.. 1
Yield: .30 fal./mln. with 2 'L. "tt. drawdown after 1.1: hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
15 Sec	150-8	2 Min.	148-8		
30 Sec.	149-9	3 Min.	148'6		
1 Min.	149-2	4 Min.	148'6		

Date of test 3/11/84
Bailer test 20 gal./min. with 2½ ft. drawdown after 2½ hrs.
Artesian flow.....g.p.m. Date.....
Temperature of water..... Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: Describe bz, color, character, size of material and structure, and show thtckne..., of aQuifen and the kind and nature o/ the material tn each sirotum penetrated w!th at lea.st one entrz, for ea.ch change of formatton.

MATERIAL	FROM	TO
- .S/];",JW.L) ,; W_. m. ,.ii,,_ - - .•		l'il
-C:..b./(J fiiiAJJ Rd_AI --	I L I@_ dEP_	/...-0 /,11/. J8'S-..

Work ... rtod.....'.3.:.lP..... 10.BI Compl•ted .....3:::: ..... 1o'i'f

WELL DRILLER'S STATEMENT:

Thia well waa drilled under my jurisdiction and this report is true to the best of my knowledge and beli f.

NAME ...u.?t.. (Penon, fliV or corporation) ...LL.1k& (Type or print).....

Address.../JIJ..i.J.....£-r-/J. .t..£K.,R.Q1

[Slgned)••• _//...L.. (Well o·rllle,J .....Ji

l.Jcense No.. fji.(,,..'i.. Dale 1/-:;,- ft. ,19

(USE ADDITIONAL SHICJ:TS IF NECESSARY)

ECY 050-1-20

',,.51-fl't1t'1). P

STATE OF **WASHINGTON**
DEPARTMENT OF ECOWGY

WELL LOG

Record by Driller (deceased)

Source Well Report

Location State of WASHINGTON

County Island

Area -

Map

NE ¼ SE ¼ sec 2 T 29 N, R 2 E W

Diagram of Section

Drilling Co A. Nelson (deceased)

Address

Method of Drilling Date , 19

Owner American Pacific Corp

Address 1800 Westlake Ave N. Seattle Wa 98109

Land surface, datum 165 ft above / below

SWL .14 7' Date Aug 63 , 19 Dims 6" x 178'

COMPLETION	Domestic MATERIAL	From (feet)	To (feet)
	Clay, sand & hardpan	0	130
	Gravel & sand, w/ water	130	178
	Screen, Bronze 6" Slot size -10	/	178
	Pump: Reda Submersible 5 HP		
	Pump Test: Windley Drillers 40 gpm w/ 2' DD @ 4hrs		

(rl"ll.11-.cribe dt1ll..l1 e til:J: roi:r.ioli:e:v likraU:, butp-.aHIJlhl 8 l:lt!Cit!Be&r'l! m p11-renithel:llillllll
Ir maw u1l .at-er- rm:e: eo !!-l-l-'lt.l:i :and ret.01d uit.Je l-!!""il i rep G1Vll! i:Li;p h• 1tl f t
be[ow E md--bm'i'oll.Oll" d11.tum un 11- 1101,cnn"i: mcl,ntoed **Gc]11,be vnth** 1:1t1aturra:ph.li(! l?(ll11.mn
1f fomnbk FulliiWtt\i::]OJJ: of makNsial lle.t IL co.em 11-erlo1;51t.J(IRB **ijct'ltlllnij** '8ic)

Torn'llllll sheets

8E9
Permit No.

OWNER:

LOCATION- 'W'BLLf

PROPOSED USE: Dome.ii\ic O lndus:trial ☐ Munl«;,il)al ☐
lrriJatlon CJ Te t. Wc:lJ 0 Other 0

TrPE OF WORK: owner.s m1mber of w H
Ne wel•l Met.hod: DU.f ☐ De>rell 0
Deepened O Cable ☐ Drlven O
Re-conditioned☐ Rotary O JetUd 0

po) WELL LOG:

Formation: De•criber.i9. "of0t', •b-e oJ tn.Rl"1'ior and atru,ctvr . ond

- DIMENSIONS: Diameter of w J.'l Depth. ot completed WeJL

fr CONSTRUCTION DETAILS:

Casing installed:..... Diam. t,o,n - ft. to tt.
adedQ Diam. trom - ft, \o ft.
WoldedQ Dt.aM. trom f\.. tc> ft.

Perfuntions: Y•• ☐ No ☐

T>•l)ot *ot* perloratior used--
SIZE *ol.* rtorattona in. by in.
P'Cl'loradons lrmn -- tt. io ft.
pe,rlOl'atlona trom - ft. to ft.
orations tram it. to n.

Screens: Yes ☐ No ☐
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☐ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☐ No ☐ To what depth? ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

PUMP: Manufacturer's Name
Type: H.P.

WATER LEVELS: Land-surface elevation above mean sea level
ft. below top of well Date
pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
gal./min. with ft. drawdown after hrs.
"
"

rary data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

of test
gal./min. with ft. drawdown after hrs.
g.p.m. Date
re of water Was a chemical analysis made? Yes ☐ No ☐

Work started 19 Completed 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME AL NELSON (Deceased)
(Person, firm, or corporation) (Type or print)

Address (No longer in business)

[Signed]
(Well Driller)

License No. Date 19

(USE ADDITIONAL SHEETS IF NECESSARY)

FREELAND

ID. 480138/22308001

8E9

WELL DATA - HARBOR SANDS

WELL #1

Well Driller: Al Nelson, Pump & Motor Service
Oak Harbor, Washington

Well Casing: 6" Dia.

Static Level: ~~85~~ 147 ft. below surface.

Drilled in the summer of 1963

Screens: 5 feet of # 10 slotted screen

Well Log: The driller did not have a log of the well as it had appearently been lost or misplaced. From memory of the driller the log and capacity data is as follows:

0 - 130 feet: sand, clay & hardpan at various levels

130 - 178 feet: gravel and sand

Static level: ~~85~~ 147 feet

The well was bailed at approximatly 70 gpm with a sustained period of pumping. The driller stated the recovery was so fast that when dipping the well, static level was attained.

The driller estimated the capacity of the well to be between 300 to 500 GPM and stated this well to be the best he had drilled on South Whidbey.

An existing 3 HP Gould submersible is existing in the well which may be replaced with a 5 HP submersible.

Static level 147 ft
(Stat) 40 gpm with 2' - 1" draw down
in 4 hrs formation ~~dead~~ drew down 1½"
and recovery lacked 1+" after pump stopped.
Well seems to be about 178 deep, making
about 26 ft of water above screen. ✓
believe one could pump 80 gpm safely.

Water Rights

:s.....NO. 7 til-(Rev. ij-70).

CERTIP'ICAT.RECORD No.........................:.::............., PAGE No t.::9..QQ$2C

STATE OF WASHINGTON, COUNTY OF••••.•••.•.•.t. .! . ...-...........................

CERTIFICATE OF GROUND WATER RIGHT

(Issued in accordance with the provisions of Chapter 263, Laws of Washlngton for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology thereunder.)

Tms Is To CERTIFY That...........·...-·--·············.,---- BIC/\N. J>ACIVICC()l\P. -····-··-·-···················-··-..........

of... ...E11.{l_J;.tl.i.:....W.1 .h.tru;;t.Q.n...................., *has made proof*

to the satisfaction of the Department of Ecology of a right to the use of the public ground waters of the State of Washington from...11.J:1.elJ..

located within......,...---····........................., ...Gnv.o.rnJllinlt...Lot.....3...

Sec...........2. ...., *Twp*......2.9._ ...N ., R.....2...IL....W.M.,............................_- .... , ———

*for the purpose(*IC) *of*..::. 1!:rl.t)!....doms.tic ....aup.ply.._...

under and specifically subject to provisions contained in Ground Water Permit No.....G 1. .i10il32.P..........-····-

issued by the Department of Ecology and that said right to the use of said ground waters has been perfected in accordance with the laws of Washington, and is hereby confirmed by the Department of Ecology and entered of record in Volume.......... .... *at page*./... Ol-.Oi!OJ2C ....; *that the priority of the right hereby confirmed dates from* .....Decemh.ar...-lli1·····l91.l. ....; *that the quantity of ground water under the right hereby confirmed for the aforesaid purposes,* is *limited to an amount actually beneficially used for said purposes, and shall not* exceed....S.5....g.allous ....p:ar....uu.nu.te,.....27 ....5.t:. f..:iet .. t ..:y.oar,......con.t1uuoualy ...J; .-·.

c;o;mwuJ.c.y.$ -tJ.c ...su.pply................- .... —----- -................... — - ----·.....................--•··..··..····........................

A description of the lands to which such ground water right is appurtenant is as follows:

That poction of SecJ. 1 and 2, T. 29 N., a. 2 r.. W.M., de9i::ribed as follm-1.: contnenc1Q8 at the northwest cor-:1er of thf\ iSW\ of aaid Sec. 1; thence eut alone the iu,rtb line of said NKf\SW 20.0 feet to the easterly margin of the East Harbor County Road !>eing the true point of beginnJ.ng; thence contl1lue along the north line of l1aid NW\SWlc, 310.0 feeta thence SCM.Jth 419.01 feet; t:bence eeuth 47°12'07" we1t 559.29 feet; thence east 456.28 feet to the eaterly urgin of the E..t Harbo-r county loadJ t-ltence northeuterly along the eutarly M!'gin of the 1ald But bor County Road, 1998 feet, IDOi'• or 1•••• to the t..rue point of ba1lnailng5 ALSO: the plat of Harbor Saade,. Divlai.on No. 1, within. Sec. 2, T. 29 N., a. 2 I. W.M.

The right to use of water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390 and 90.44.020.

This certificate of ground water right is specifically subject to relinquishment for nonuse of water as **provided in RCW 90.14.180.**

Given under my hand and seal of this office at Olympia, Washington, this............**.26th**...............*day of*.............................July.., *19*.....*12*....

JOHN A. BIGGS, *Director*
Department of Ecology

Engineering Data
OK...../¢t.<!../;k..

by..........

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

(2)

PERMIT

TO APPROPRIATE PUBLIC WA IERS OFTI-IE STATEOF WASHINGTON

☐ Surface Water . :=,:=: 1 ': 3' 19n.

Ground Water [illegible] ef [illegible] laY11 o(Wubin11ooror [illegible]

U flC.ndffUU ihctt.J.o. W Lho Niu .and n101a1 ionaor lh5 Depuf tnl of &::01oay.)

PIUOIUTY OAn	APPLICATION NUMBtll.	PEAlo1tTNUMDetl	CtalmlTCATS NUMDe&&
June I', 1994	Gl-27478	Gl-27478P	

HAMS
CAL Waterworks (contact: Terry Lehman)

AllORI,SS (mtfET)	tCTT'I)	(STATE)	(Zlrcoom
P. 0. Box549	Freeland	WA	98249.

77,e applicMI Is pursuant 10 th, R.,port d/ Examlnallon which "4, bttn accepted by 1h, npplicont, h,uby grtJJ11td a pirmlt 10 appropriate 1h, /o/lowln1 public woteo of the Stat, of Washington, subj,ct to a/sting rights and to th, limitatio111 and·pro,isions ,., htrtin.

PUBLIC WATERS TO BE APPROPRIATED

SOUTCE
Well Field (2wells)
TIUDUT/Jt Of (IPSUBEACE WATER\SJ

MA.X.IMU,-ICUD FttrrEKS D	Mlll(IMUM OAU:0,'IS PU' MINIIT	MAXIMUM ACRE' 'EUTIIR IEAJI.
	35 (l)	26.5 (2)

UANTITY, TYPE OF USE, PERIOD OF USE
Municipal, Continuous

Cl) *The combined instantaneous quanti of Gl-00032C and GJ-27478 shall 1101 aceed 90 gpm. The quantity of 35 gpm issued f9r this water right is considered additive to the existing waler righl certificate, Gl-00032C.*

Cll *The combined a'nnual quantity ofGJ-00032C and GJ-27478 shall 1101 excud54.0 acre/_u_t.The quantity o/26.5 acie-feetper year issued for this water right is considered additive to the existing water right cutlflcatt, GJ-00032C.*

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OFDIVERSION-WITIIDRAW-'L
1325 feet north and lO feet west of the southeast corner of Section 2, Township 29N, Range 2E, W.M.

LOCATED WITHIN (SMALLEST LWAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANOE. (E. OR W.) W.M.	W.R.I A	COUHTY
NE¼SE¼	2	29	2E	6	Island

WT | BLOCK | RECORDEDPLATIEDPROPERTY Of'(Gov!!NAMEOFfi.ATOI<AODmoo,

LEGAL DF.SCRIPTION OF PROPERTY.'ON WHICH WATER IS TO BE USED

Area Served by the CAL Waterworks Water System as indicated in their approved 199j Water-System Plan. future changes to this place of use, if approved 'by the Washington Stale Department of Health via a water system plan update under chapter 43.20.RCW, OR if approved by local legislative authority in accordance with procedures adopted pursuant to chapter 70.116 RCW, wiil supersede the 1993 place of use.

(2)

DESCRIPTION OF PR0POSED WORKS

The current water system consists of two 6-inch diameter wells. Well #I (ID AGA928) is 178 feet deep and well #2 (ID AGA927) is 179 feet deep. Both wells are equipped with a 3.0 h.p. submersible pump, access port, and meter. Storage structures include three 315-gallon pressure tanks, one 30-gallon pressure tank, and a 40,000-gallon concrete reservoir tank. It is pr(!posed that the two wells will alternate in operation, with an electrode in the reservoir activating the alternating switch. The two wells are considered a well field and can adjust their pumping rates and quantities, as long as their *combined* instantaneous and annual quantities do not exceed 90 gpm and 54 acre-feet per year, respectively". Well #1 and weli"#2 were drilled in 1963 by Al Nelson and in 1985 by B & W Drilling, respectively.

DEVELOPMENT SCHEDUL'E

IIECIL'.,IT.Orerr LI-Y-IIUS OATe	COMJI'L6'T"I;. PA016CTUYTtU.S: DATE:	WAT>.IT Y:JITOFUU.USS' IIYTIUS IMTE:
Begun	September I, 2024	September I, 2029

PROVISIONS

Well ConslrucUpn: All.water wells constructed within the Stale shall meet the minimum standards for well construction and maintenance as.provided uiicler chapter t 8,104 RCW, Washington Water W. U.Constru_Glion Ac.t pf.:19_7.l, and Chapter 173-160 WAC, Minimum Sr;indards for Construction and Maintenance of Wells.

Water Level Monltoring: In o,:der *to* protect the ground water re&olircc, static water level in the wen shall be mc un:d.gu3rterly each year. Ecology shall be notified if water levels drop below normal seasonal declines. The w:itcr level dar a shall be maintained and made available to Ecology upon-reques1.

Installation and maintenance ofan access port as described in WAC 173-160-291 is required on any additional wells drilled under this water right. An air-line and gauge may be installed in addition to the access port.

Water Use: An approved measuring device shall be install a_nd maintained for each diversion/withdrawal of the sources identified by this water right in accordance wi!h the rule "Requirements for Measuring and Reporting Water_ Use," Chapter 173-173 WAC.

Water use datn shall betecorded weekly Data shall be m inlained by the property owner and promptly submitted to Ecology upo request. Recording and retention of data by the watet right h_older arc required to inform the waler users about how much water is used, whcn"lhc water is used and 10 assist users in efficient water.management.

Chapter 173-173 WAC describes the requirements for data accuracy, device installation and operation, and information reporting. It also allows a water user to pe/ition Ecology for modifications to some of the requirements. Installation, operation and maintenance requirements are enclosed as a document entitled "Water Measurement Device Installation and Operation Requirements".

Department of Ecology personnel, upon presentation of proper credentials, shall have access at r onable limes, to the records of water use that are kepi to meet the above conditions, and to inspect at reasonable limes any measuring device used to meet the above conditions.

Water Conservation: Issuance of this wa!er right is subject 10 the implementation of the minimum requirements established in the Con.1crvatlon Planning Requirements, O11idellne nd Requirements for Public Water Systems Regaiding w ter Use**Reporting,** Demand Forecas1ing Methodology, and C9;n5ervp1ion Programs, July 1994, and as revised.

Under RtW 90.03.005 and 90.54.020(6), conservation and improved water use efficiency m st be emphasized in the management of the states water resources, and must be considered as a potential new source of water. Accordingly, as part of the terms of this water right, the applicant shall prepare and implement a waler conservation plan approved by Department of Hea!lh. The standards for such a plan may be obtained from either the Department of Health or the Department of Ecology.

Sea Water Intrusion: Permittee or certificate holder and its successor(s) shall provide data on hlorjdc, con.duc!Mty and hardness concentrations for the well(s) authorized by this permit o c,ertificate with analysis performed by a state accredited laboratory. Accreditation information may be obtained from Ecol_qgy's Quality Assurance Program at (360) 895-4649. Sampling shall occur in April-and September of each year, with a copy of the laboratory results for both sampling events submitted by October I.S of the same year, to thel)epartment of Ecology, Northwest Regional Office, Bellevue; Washington.

If pumping from any well.authorized by this water ri ght_causes chloride concentrations to show an Increasing trend, immediate action sholl be required 10 prevent pumping concerilrations from increasing, as"is consistent with the water quality anti-degrndat.ion policy WAC 173-200-030. These actions include, but are not limited lo reducing the instantaneous withdrawal rate (gpm) of the well, lowering the annunl quantity removed from the well. \!rilling additional w_ells, installing more storage capacity, or revising the pumping schedule. *I(* chloride concentrations continue to increase, even after corrective measures "{e taken, th permit holder shall relinquish the option lo perfect additional allocated quantities regardless of the stage of development.

Waler AllocaUon: The applicant is advised that the certificate will issue for only that_quantity of water that has been withdrawn and applied 10 actual beneficial use. Such quantity applied to actual beneficial use shall not exc the quantity specified in this report of exam and will be calculated on the basis of the best information available to Ecology, including metering data and/or water duty analysis. The applicant is advised that the quantity *of* waler allocated by this permit may be reduced at the time of final certification to relleci system capacity and actual usage.

A water right certificate shall not be issued until a final investigation has been made.

This p_ermit shall be subject lo cancellation should the permillee fail to comply _with the above development schedule and/or to give notice to the Department of Ecology on forms provided by that Department documenting such compliance.

Given under my hand and the seal of this office at Bellevue, Washington,

this __ _ l... '--l... ,d.ay of November, 2004.

ENGINEERING DEPARTMENT OF ECOLOGY STATE OF WASHINGTON PERMIT

D==2 fEc ogy (_
By ... fl s:3
Daniel L. Swenson, Section Supervisor, Water Resources

Appendix B: Water Use Data

WATER USAGE DATA

2016

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	60	88,397	661,210	127	
February					
March	61	81,652	610,757	115	
April					
May	61	112,311	840,086	158	
June					
July	62	140,252	1,049,085	194	
August					
September	61	98,466	736,526	139	
October					
November	61	93,621	700,285	132	
December					
SYSTEM TOTAL	**366**	**614,699**	**4,597,949**	**144**	

2017

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	93,791	701,557	137	5.8%
February					
March	61	104,081	778,526	147	21.5%
April					
May	61	107,511	804,182	152	-4.5%
June					
July	62	193,033	1,443,887	268	27.3%
August					
September	61	109,579	819,651	154	10.1%
October					
November	61	88,718	663,611	125	-5.5%
December					
SYSTEM TOTAL	**365**	**696,713**	**5,211,413**	**164**	**11.8%**

2018

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	158,050	1,182,214	230	40.7%
February					
March	61	118,006	882,685	166	11.8%
April					
May	61	101,473	759,018	143	-6.0%
June					
July	62	158,229	1,183,553	219	-22.0%
August					
September	61	116,200	869,176	164	5.7%
October					
November	61	97,176	726,876	137	8.7%
December					
SYSTEM TOTAL	**365**	**749,134**	**5,603,522**	**176**	**7.0%**

2019

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	73,170	547,312	107	-116.0%
February					
March	61	108,674	812,882	153	-8.6%
April					
May	61	139,476	1,043,280	197	27.2%
June					
July	62	149,123	1,115,440	207	-6.1%
August					
September	n/a	n/a	n/a	n/a	n/a
October					
November	n/a	n/a	n/a	n/a	n/a
December					
SYSTEM TOTAL	**243**	**470,443**	**3,518,914**	**166**	**-13.9%**

Month	2016	2017	2018	2019
January				
February	661,210	701,557	1,182,214	547,312
March				
April	610,757	778,526	882,685	812,882
May				
June	840,086	804,182	759,018	1,043,280
July				
August	1,049,085	1,443,887	1,183,553	1,115,440
September				
October	736,526	819,651	869,176	n/a
November				
December	700,285	663,611	726,876	n/a
Total	4,597,949	5,211,413	5,603,522	3,518,914
ADD	127	144	155	146
Summer usage	1,889,171	2,248,069	1,942,571	2,158,721
ADD (Summer*)	155	185	160	177
max usage	1,049,085	1,443,887	1,183,553	1,115,440
MADD (Summer*)	194	268	230	207

* May through August

2020

	S01		S02			Total	Gallons
Date	Reading	Cu. Ft.	Reading	Cu. Ft.	Days	Gallons	per Day
1/28/2020	205,155	0	35,924	0	-	0	-
1/31/2020	213,899	8,744	35,924	0	3	65,405	21,802
2/3/2020	221,055	7,156	35,924	0	3	53,527	17,842
2/11/2020	244,949	23,894	35,924	0	8	178,727	22,341
2/14/2020	253,492	8,543	35,924	0	3	63,902	21,301
2/18/2020	265,874	12,382	35,924	0	4	92,617	23,154
2/21/2020	274,559	8,685	35,924	0	3	64,964	21,655
2/25/2020	287,370	12,811	35,924	0	4	95,826	23,957
2/28/2020	295,908	8,538	35,924	0	3	63,864	21,288
3/3/2020	308,541	12,633	35,924	0	4	94,495	23,624
3/6/2020	317,197	8,656	35,924	0	3	64,747	21,582
3/10/2020	330,488	13,291	35,924	0	4	99,417	24,854
3/13/2020	337,970	7,482	35,924	0	3	55,965	18,655
3/20/2020	361,382	23,412	35,924	0	7	175,122	25,017
3/23/2020	371,384	10,002	35,924	0	3	74,815	24,938
3/27/2020	384,681	13,297	35,924	0	4	99,462	24,865
3/31/2020	398,426	13,745	35,924	0	4	102,813	25,703
4/3/2020	408,657	10,231	35,924	0	3	76,528	25,509
4/6/2020	419,303	10,646	35,924	0	3	79,632	26,544
4/9/2020	432,575	13,272	35,924	0	3	99,275	33,092
4/13/2020	451,099	18,524	35,924	0	4	138,560	34,640
4/17/2020	470,435	19,336	35,924	0	4	144,633	36,158

Date	S01 Reading	S01 Cu. Ft.	S02 Reading	S02 Cu. Ft.	Days	Total Gallons	Gallons per Day	
4/20/2020	481,305	10,870	35,924	0	3	81,308	27,103	
4/29/2020	496,944	15,639	35,924	0	9	116,980	12,998	
5/4/2020	529,874	32,930	35,924	0	5	246,316	-	Replace meter
5/11/2020	9,110	9,110	35,924	0	7	68,143	9,735	
5/15/2020	18,472	9,362	35,924	0	4	70,028	17,507	
5/21/2020	32,871	14,399	35,924	0	6	107,705	17,951	
5/29/2020	51,209	18,338	35,924	0	8	137,168	17,146	
6/1/2020	58,997	7,788	35,924	0	3	58,254	19,418	
6/8/2020	74,823	15,826	35,924	0	7	118,378	16,911	
6/29/2020	122,826	48,003	35,924	0	21	359,062	17,098	
7/3/2020	131,190	8,364	35,924	0	4	62,563	15,641	
7/10/2020	145,777	14,587	35,924	0	7	109,111	15,587	
7/17/2020	163,251	17,474	35,924	0	7	130,706	18,672	
7/21/2020	172,525	9,274	35,924	0	4	69,370	17,342	
7/23/2020	177,197	4,672	35,924	0	2	34,947	17,473	
7/31/2020	197,922	20,725	35,924	0	8	155,023	19,378	
8/6/2020	213,483	15,561	35,924	0	6	116,396	19,399	
8/14/2020	230,526	17,043	35,924	0	8	127,482	15,935	
8/17/2020	232,689	2,163	35,924	0	3	16,179	5,393	
8/20/2020	239,781	7,092	35,924	0	3	53,048	17,683	
8/31/2020	256,480	16,699	35,924	0	11	124,909	11,355	
9/14/2020	290,457	33,977	35,924	0	14	254,148	18,153	
9/18/2020	297,531	7,074	35,924	0	4	52,914	13,228	
9/22/2020	304,900	7,369	35,924	0	4	55,120	13,780	
9/25/2020	308,744	3,844	35,924	0	3	28,753	9,584	
9/28/2020	314,408	5,664	35,924	0	3	42,367	14,122	
10/12/2020	336,302	21,894	35,924	0	14	163,767	11,698	
10/16/2020	341,945	5,643	35,924	0	4	42,210	10,552	
10/26/2020	357,308	15,363	35,924	0	10	114,915	11,492	
11/2/2020	367,566	10,258	35,924	0	7	76,730	10,961	
11/10/2020	380,413	12,847	35,924	0	8	96,096	12,012	
11/23/2020	400,400	19,987	35,924	0	13	149,503	11,500	
11/30/2020	412,727	12,327	35,924	0	7	92,206	13,172	
12/8/2020	425,839	13,112	35,924	0	8	98,078	12,260	
12/14/2020	436,456	10,617	35,924	0	6	79,415	13,236	
						MDD	**36,158**	

Appendix C: Storage Calculations

STORAGE CAPACITY CALCULATIONS

System: Cal Waterworks
ID No.: 31040-6
Location: Whidbey Island, Washington

Demands	
N (ERUs)	193
ADD (gpd/ERU)	250
MDD (gpd/ERU)	530
PHD (gpm)	188

Sources	
Source ID	**Delivery Rate (gpm)**
Well 1	45
Well 2	45
0	0
0	0
Q_s =	90
Q_s =	90 *water right limited*
Q_L =	45 *largest source*

Reservoirs						
Reservoir ID	**Diameter (ft)**	**Area (ft^2)**	**Height (ft)**	**Base Elevation (ft)**	**Volume (gal)**	**VF (gal/ft)**
Proposed Reservoir	26	530.9	20	145	79,427	3,971
				Total	79,427	3,971

Top Dead Storage (TDS)	
Depth (ft)	**Volume (gal)**
1.0	3,971

Operational Storage (OS)	
Depth (ft)	**Volume (gal)**
0.5	1,986

Required Equalizing Storage (ES)			
PHD (gpm)	**Q_s (gpm)**	**Volume (gal)**	**Depth (ft)**
188	90	14,651	3.7

*ES = (PHD-Q_s)*150*

Recommended Standby Storage (SB)			
Recommended SB per Connection (gal/ERU)	**N (ERUs)**	**Rcommended SB Volume (gal)**	**Depth (ft)**
200	193	38,600	9.7

SB_{TMS} = (200)(N)

Available Standby Storage (SB)			
ADD (gal/ERU)	**N (ERUs)**	**Volume (gal)**	**Depth (ft)**
294	193	56,833	14.3

SB = Total Storage Volume -TDS-OS -ES-BDS

STORAGE CAPACITY CALCULATIONS

System: Cal Waterworks
ID No.: 31040-6
Location: Whidbey Island, Washington

Fire Suppression Storage (FSS)		
Fire Flow (gpm)	**t_m (min)**	**Volume (gal)**
500	30	15,000

FSS = FFt_m*

Where: FF = Required fire flow rate (gpm)
t_m = Duration of FF rate (minutes)

Bottom Dead Storage (BDS)	
Depth (ft)	**Volume (gal)**
0.5	1,986

Available Storage Summary		
Component	**Volume (gal)**	**Depth of Storage Component (ft)**
TDS	3,971	1.0
OS	1,986	0.5
ES	14,651	3.7
SB/FSS	56,833	14.3
BDS	1,986	0.5
Total	79,427	20.0

Is the available SB/FSS...	
greater than recommended SB?	greater than required FSS?
yes	yes

TEMPORARY STORAGE CAPACITY CALCULATIONS

System: Cal Waterworks
ID No.: 31040-6
Location: Whidbey Island, Washington

Demands	
N (ERUs)	114
ADD (gpd/ERU)	250
MDD (gpd/ERU)	530
PHD (gpm)	130

Sources	
Source ID	**Delivery Rate (gpm)**
Well 1	45
Well 2	45
0	0
0	0
Q_s =	90
Q_s =	90 *water right limited*
Q_L =	45 *largest source*

Reservoirs						
Reservoir ID	**Diameter (ft)**	**Area (ft^2)**	**Height (ft)**	**Base Elevation (ft)**	**Volume (gal)**	**VF (gal/ft)**
Temp Storage Tank #1	9.25	67.2	10	145	5,027	503
Temp Storage Tank #2	9.25	67.2	10	145	5,027	503
				Total	10,053	1,005

Top Dead Storage (TDS)	
Depth (ft)	**Volume (gal)**
1.0	1,005

Operational Storage (OS)	
Depth (ft)	**Volume (gal)**
0.5	503

Required Equalizing Storage (ES)			
PHD (gpm)	**Q_s (gpm)**	**Volume (gal)**	**Depth (ft)**
130	90	5,928	5.9

*ES = (PHD-Q_s)*150 or Zero*

Available Standby Storage (SB)			
ADD (gal/ERU)	**N (ERUs)**	**Volume (gal)**	**Depth (ft)**
19	114	2,114	2.1

SB = Total Storage Volume -TDS-OS -ES-BDS

TEMPORARY STORAGE CAPACITY CALCULATIONS

System: Cal Waterworks
ID No.: 31040-6
Location: Whidbey Island, Washington

Bottom Dead Storage (BDS)	
Depth (ft)	**Volume (gal)**
0.5	503

Available Storage Summary		
Component	**Volume (gal)**	**Depth of Storage Component (ft)**
TDS	1,005	1.0
OS	503	0.5
ES	5,928	5.9
SB/FSS	2,114	2.1
BDS	503	0.5
Total	10,053	10.0

Bladder Tank Sizing: Pressure Zone #1

Variable	Value	Unit
P_1	75	psi
P_2	60	psi
Q_p	126	gpm
*N_c	24	cycles/hr
V_t	317	gal
R	96.1	

**For 4 alternating pumps.*

	Description
P_1 =	*Pump off pressure*
P_2 =	*Pump on pressure*
R =	*= 15 * (P1+14.7)(P2+14.7)/((P1-P2)(P2+9.7))*
Q_p =	*Pump Delivery capacity (gpm) at midpoint of on pump curve between P1 and P2*
N_c =	*Number of operating cycles per hour. Max number of pump motor starts per hour recommended by manufacturer. Without this information, this should be no more than 6 cycles/hour per alternating pump*
V_t =	*Gross volume of an individual bladder tank (gal)*
T_s =	*The number of bladder tanks. (See equation 9-1 from DOH Water system Design Manual, or equation 5-2 from Group B Design Manual)*

Equation 9-1: $T \geq \frac{(R)(Q_p)}{(N_c)(V_t)}$

T_s =	2 tanks

Bladder Tank Sizing: Pressure Zone #2

Variable	Value	Unit
P_1	95	psi
P_2	85	psi
Q_p	34	gpm
N_c	12	cycles/hr
V_t	264	gal
R	173.2	

**Edit yellow cells only*

Description

P_1 = *Pump off pressure*

P_2 = *Pump on pressure*

R = *= 15 * (P1+14.7)(P2+14.7)/((P1-P2)(P2+9.7))*

Q_p = *Pump Delivery capacity (gpm) at midpoint of on pump curve between P1 and P2*

N_c = *Number of operating cycles per hour. Max number of pump motor starts per hour recommended by manufacturer. Without this information, this should be no more than 6 cycles/hour per alternating pump*

V_t = *Gross volume of an individual bladder tank (gal)*

T_s = *The number of bladder tanks. (See equation 9-1 from DOH Water system Design Manual, or equation 5-2 from Group B Design Manual)*

Equation 9-1: $T \geq \frac{(R)(Q_p)}{(N_c)(V_B)}$

T_s =	2 tanks

Appendix D: Equipment Information

GRUNDFOS

Submittal Data

PROJECT:	UNIT TAG:	QUANTITY:
	TYPE OF SERVICE:	
REPRESENTATIVE:	SUBMITTED BY:	DATE:
ENGINEER:	APPROVED BY:	DATE:
CONTRACTOR:	ORDER NO.:	DATE:

Note! Product picture may differ from actual product

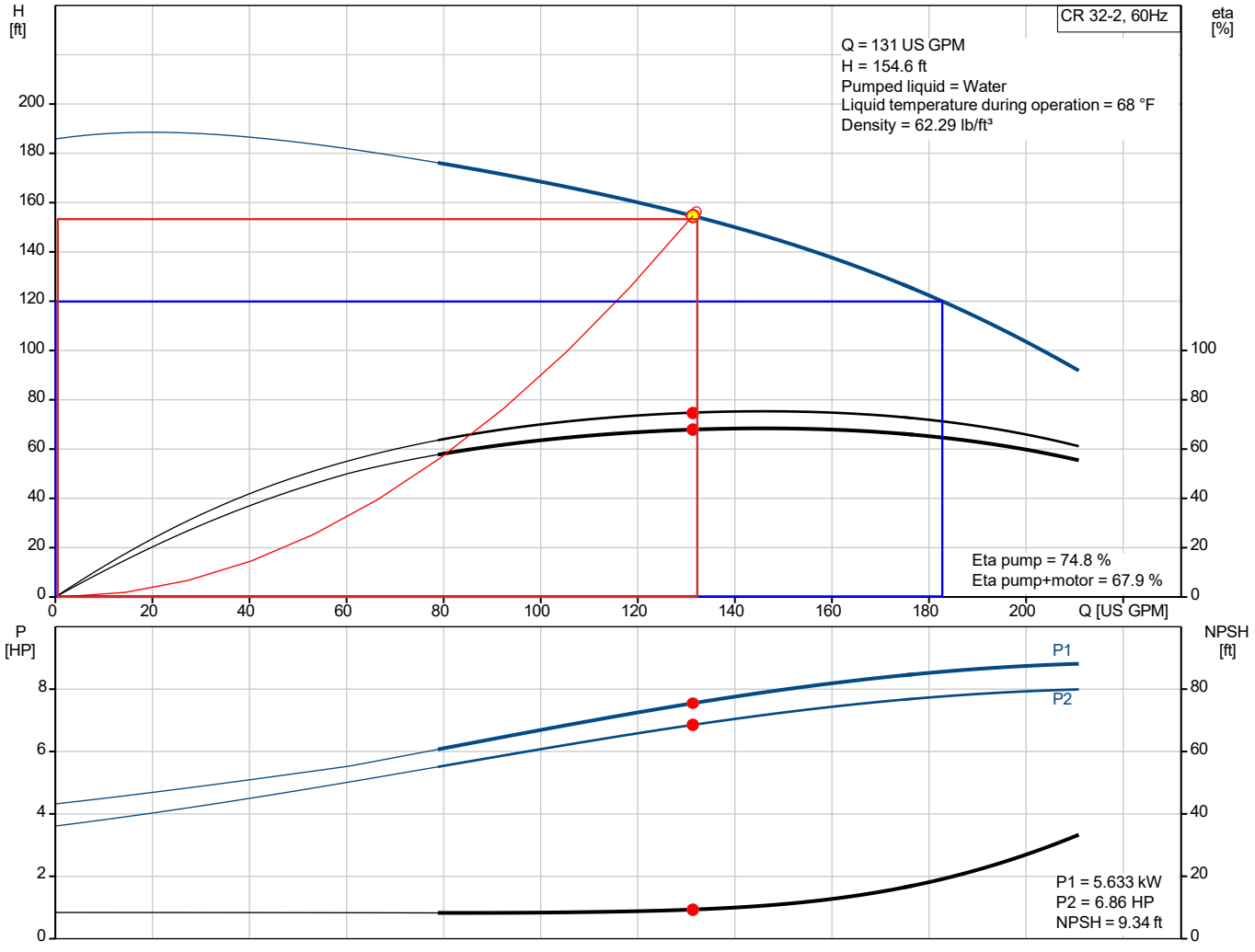
CR 32-2 A-G-A-E-HQQE

Vertical, multistage centrifugal pump with suction and discharge ports on the same level. The pump head and base are in cast iron - all other wetted parts are in stainless steel (EN 1.4301)

Conditions of Service	
Flow:	131 US GPM
Head:	154.6 ft
Efficiency:	67.9 %
Liquid:	Water
Temperature:	68 °F
NPSH required:	9.34 ft
Specific Gravity:	1.000

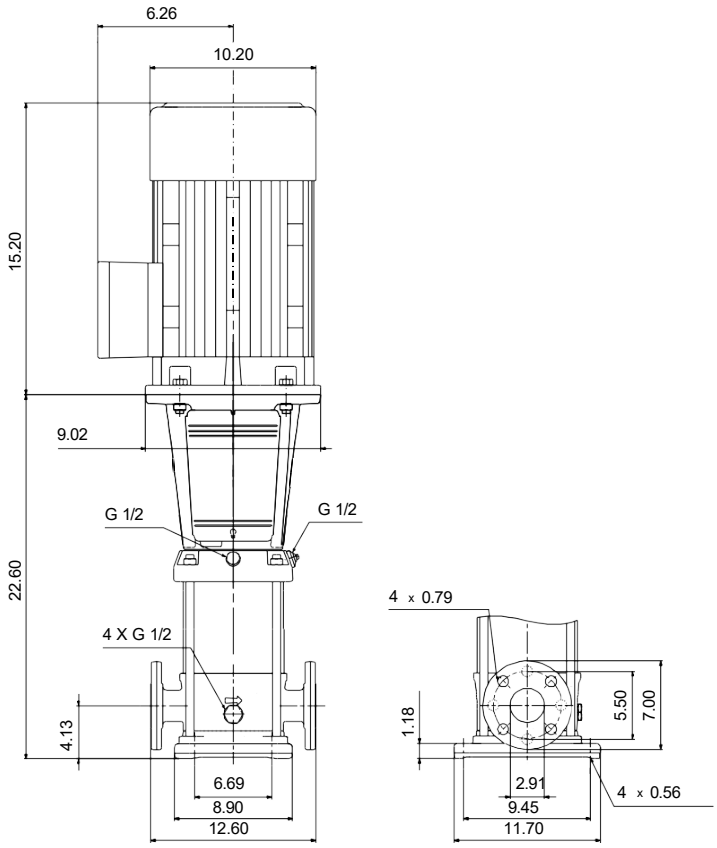
Pump Data	
Max pressure at stated temp:	232 psi / 250 °F
Liquid temperature range:	-22 .. 248 °F
Maximum ambient temperature:	140 °F
Shaft seal:	HQQE
Product number:	97743827

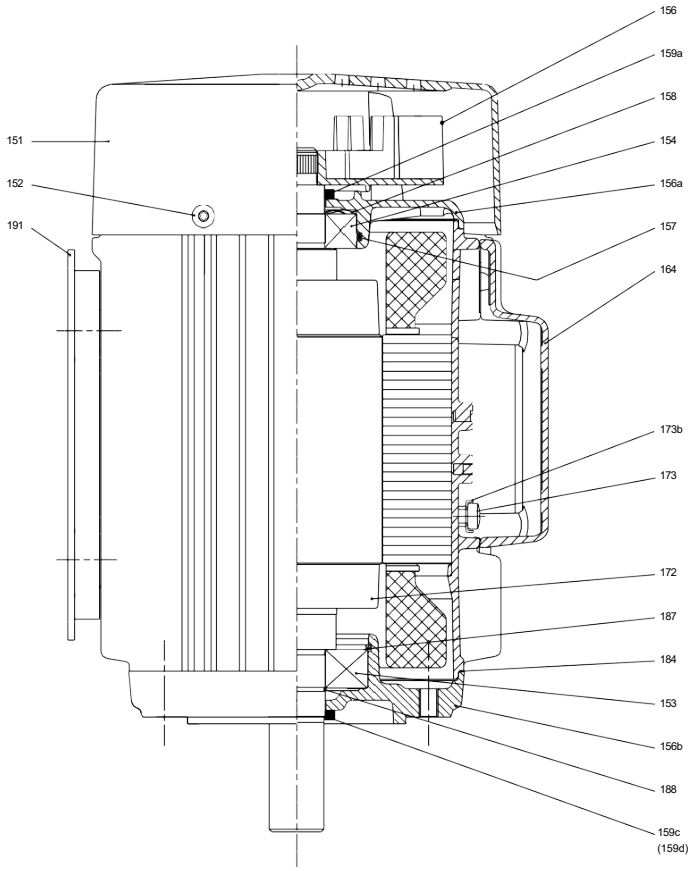
Motor Data	
Rated power - P2:	10 HP
Rated voltage:	208-230YY/460Y V
Mains frequency:	60 Hz
Enclosure class:	55 Dust/Jetting
Insulation class:	F
Motor protection:	PTC
Motor type:	132FA
Eta 1/1:	90.0-90.2 %



GRUNDFOS

Submittal Data





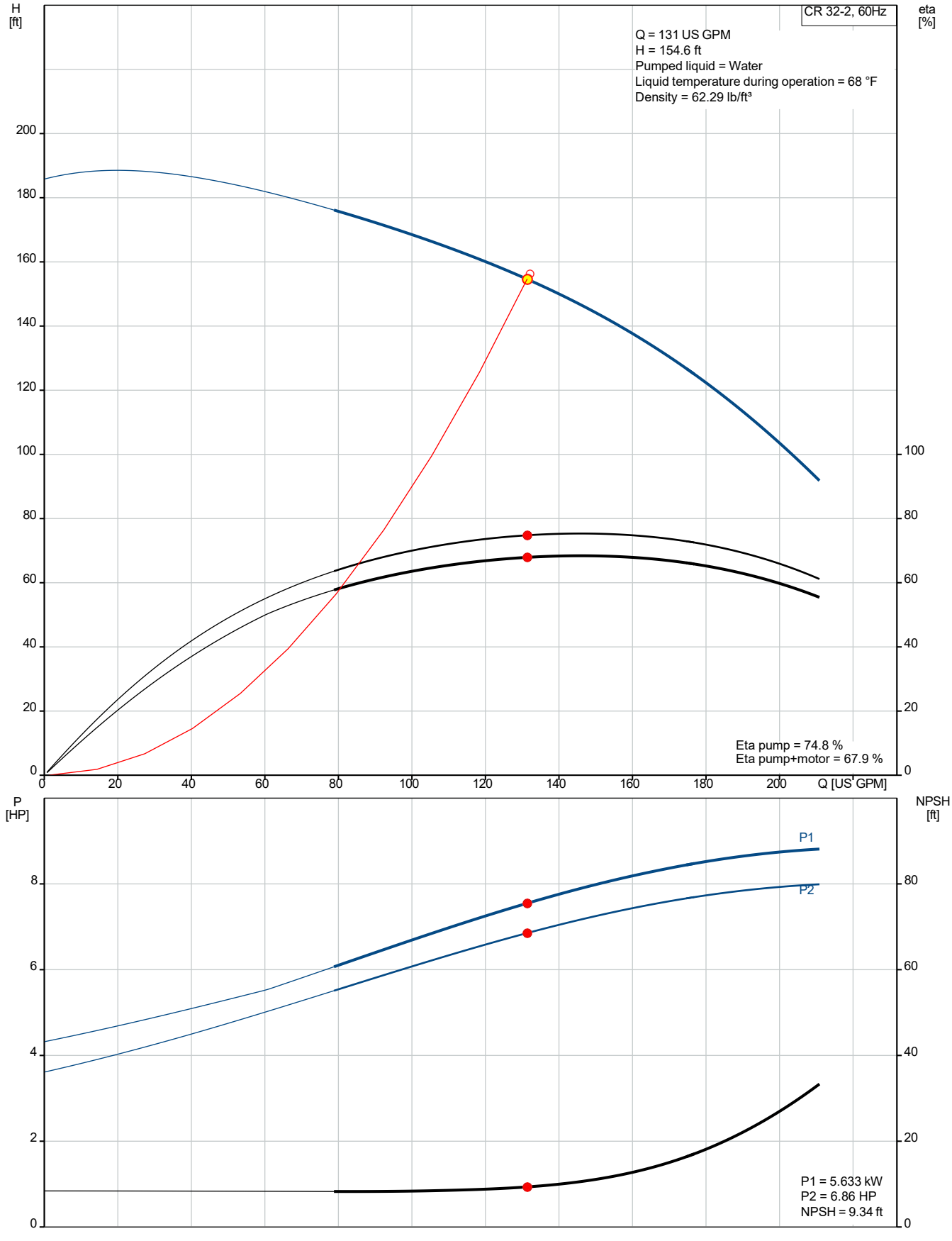
Materials:

Base:	Cast iron
Base:	EN 1563 EN-GJS-500-7
Base:	ASTM A536 80-55-06
Impeller:	Stainless steel
Impeller:	AISI 304
Impeller:	EN 1.4301
Material code:	A
Code for rubber:	E

Company name:
Created by:
Phone:

Date: 02/06/2022

97743827 CR 32-2 A-G-A-E-HQQE 60 Hz

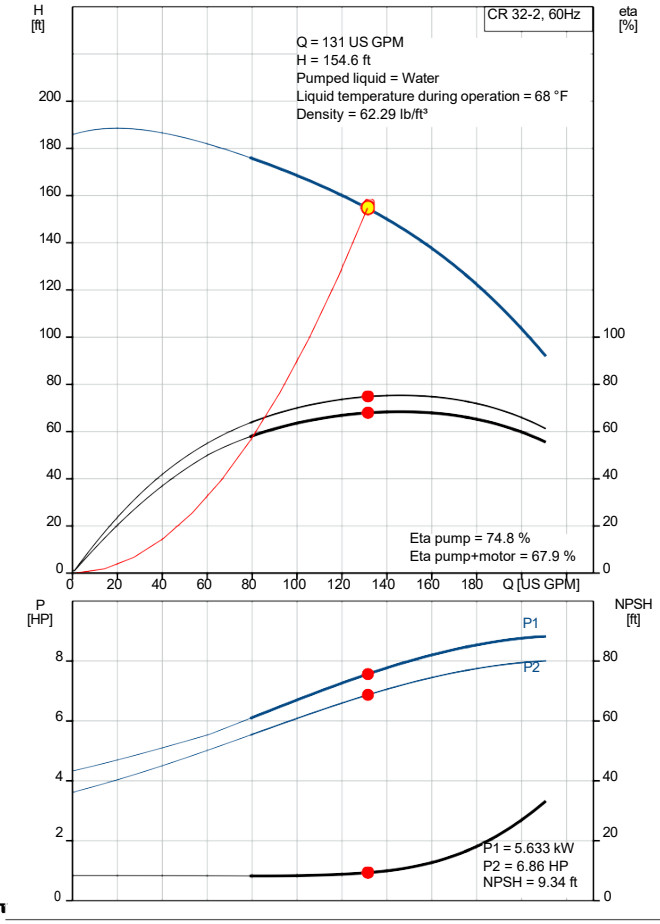


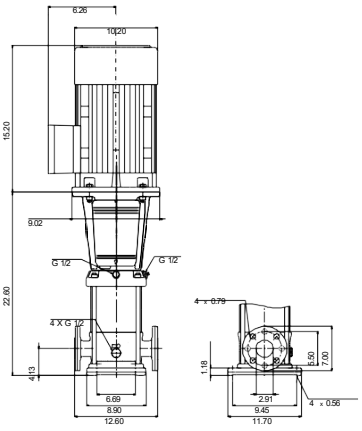
GRUNDFOS

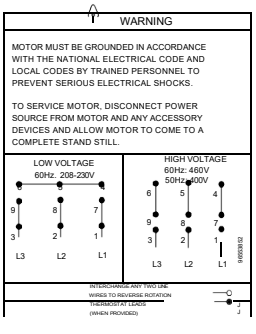
Company name:
Created by:
Phone:

Date: 02/06/2022

Description	Value
General information:	
Product name:	CR 32-2 A-G-A-E-HQQE
Product No:	97743827
EAN number:	5710623601090
Price:	
Technical:	
Pump speed on which pump data are based:	3467 rpm
Actual calculated flow:	131 US GPM
Resulting head of the pump:	154.6 ft
Maximum head:	183.4 ft
Actual impeller diameter:	4.66 in
Stages:	2
Impellers:	2
Number of reduced-diameter impellers:	0
Low NPSH:	N
Pump orientation:	Vertical
Shaft seal arrangement:	Single
Code for shaft seal:	HQQE
Approvals:	CURUS
Approvals for drinking water:	NSF/ANSI 61
Curve tolerance:	ISO9906:2012 3B
Pump version:	A
Model:	B
Cooling:	TEFC
Materials:	
Base:	Cast iron
Base:	EN 1563 EN-GJS-500-7
Base:	ASTM A536 80-55-06
Impeller:	Stainless steel
Impeller:	EN 1.4301
Impeller:	AISI 304
Material code:	A
Code for rubber:	E
Bearing:	SIC
Support bearing:	Graflon
Installation:	
t max amb:	140 °F
Maximum operating pressure:	232.06 psi
Max pressure at stated temp:	232 psi / 250 °F
Max pressure at stated temp:	232 psi / -22 °F
Type of connection:	ANSI
Size of inlet connection:	2 1/2 inch
Size of outlet connection:	2 1/2 inch
Pressure rating for connection:	PN 16
Flange rating inlet:	150 lb
Flange size for motor:	213TC
Connect code:	G
Liquid:	
Pumped liquid:	Water
Liquid temperature range:	-22 .. 248 °F
Selected liquid temperature:	68 °F
Density:	62.29 lb/ft³
Electrical data:	
Motor standard:	NEMA
Motor type:	132FA
IE Efficiency class:	NEMA Premium / IE3 60Hz
Rated power - P2:	10 HP
Power (P2) required by pump:	10 HP
Mains frequency:	60 Hz
Rated voltage:	3 x 208-230YY/460Y V
Service factor:	1.15
Rated current:	26,5-24,6/12,4 A
Starting current:	680-900 %
Full load SF current:	30,5-28,3/14,3 A
Cos phi - power factor:	0.87







GRUNDFOS

Company name:
Created by:
Phone:

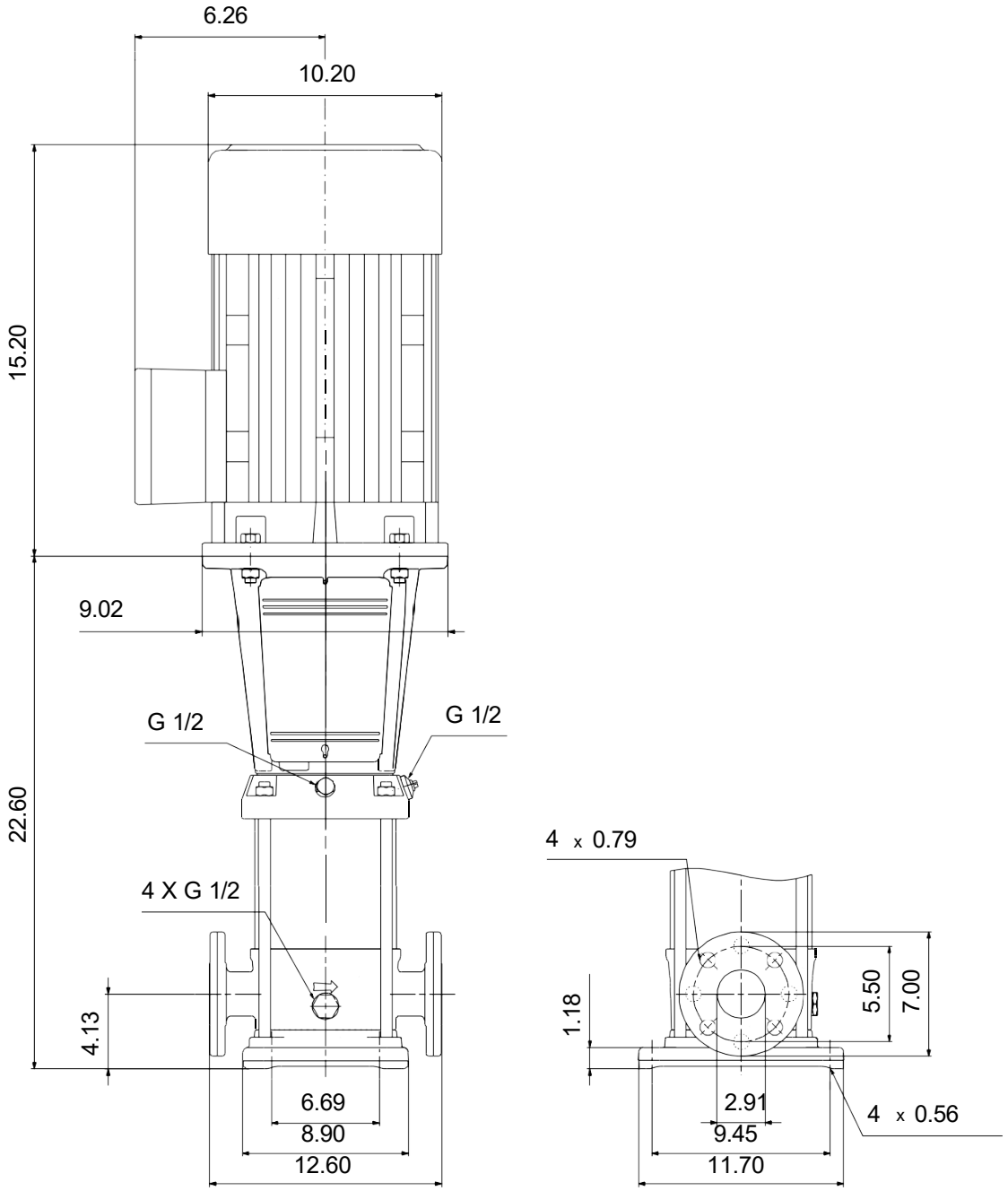
Date: 02/06/2022

Description	Value
Rated speed:	3480-3500 rpm
Efficiency:	IE3 90,2%
Motor efficiency at full load:	90.0-90.2 %
Motor efficiency at 3/4 load:	90.8 %
Motor efficiency at 1/2 load:	90.8 %
Number of poles:	2
Enclosure class (IEC 34-5):	55 Dust/Jetting
Insulation class (IEC 85):	F
Built-in motor protection:	PTC
Motor No:	85903410
Controls:	
Frequency converter:	NONE
Others:	
DOE Pump Energy Index CL:	0.87
Net weight:	231 lb
Gross weight:	249 lb
Shipping volume:	10.9 ft³
Sales region:	Namreg

Company name:
Created by:
Phone:

Date: 02/06/2022

97743827 CR 32-2 A-G-A-E-HQQE 60 Hz



Note! All units are in [in] unless others are stated.
Disclaimer: This simplified dimensional drawing does not show all details.

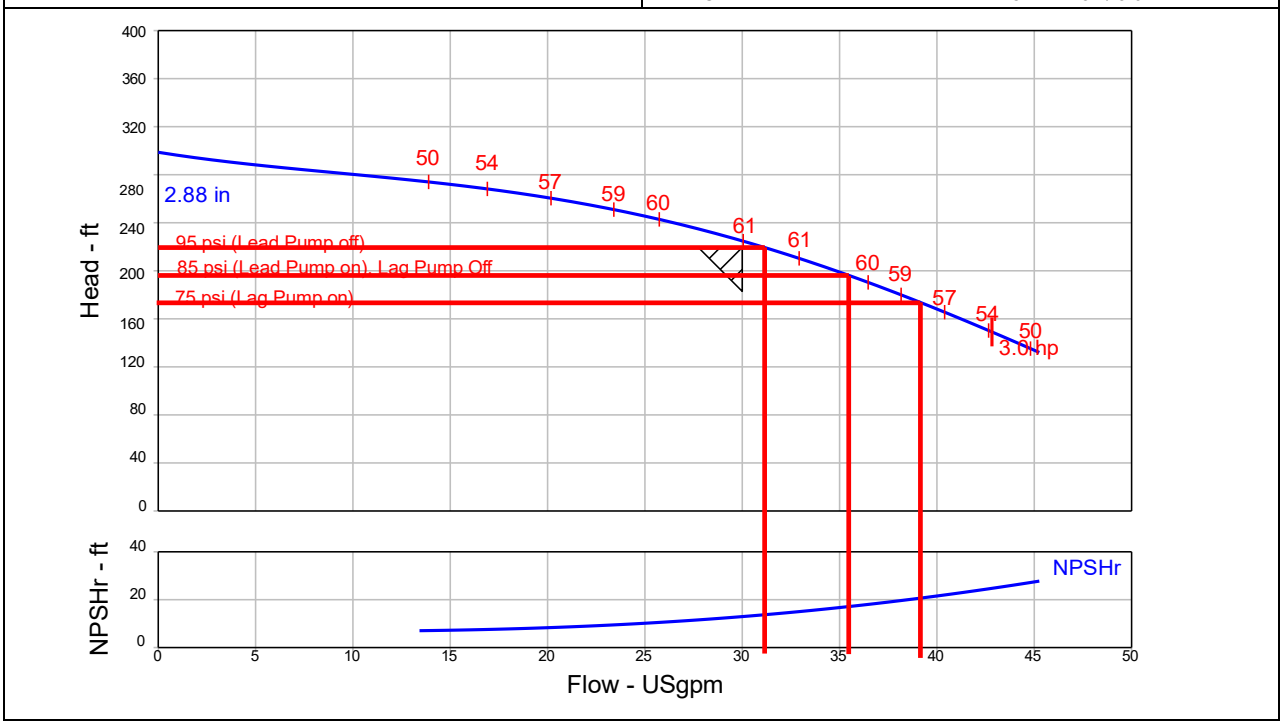
GRUNDFOS

Grundfos Quotation System 21.5.1

Pump Performance Datasheet

Customer	:	Quote Number / ID	1319687
Customer ref. / PO	:	Model	: CR 5-9-3ph
Tag Number	001	Stages	9
Service	:	Based on curve number	: CR 5-9_3Phase Rev June_2020
Quantity	1	Basic model number	: -
		Date last saved	: 02/09/2022 10:16 AM

Operating Conditions		Liquid	
Flow, rated	: 30.00 USgpm	Liquid type	: Cold Water
Differential head / pressure, rated (requested)	: 219.4 ft	Additional liquid description	:
Differential head / pressure, rated (actual)	: 224.9 ft	Temperature, max	: 68.00 deg F
Suction pressure, rated / max	: 0.00 / 0.00 psi.g	Fluid density, rated / max	: 1.000 / 1.000 SG
NPSH available, rated	: Ample	Viscosity, rated	: 1.00 cP
Site Supply Frequency	: 60 Hz	Vapor pressure, rated	: 0.34 psi.a
Performance		**Material**	
Speed, rated	: 3461 rpm	Material selected	: Standard - Cast Iron / 304 Stainless Steel
Efficiency	: 61.00 %	**Pressure Data**	
NPSH required / margin required	: 12.93 / 0.00 ft	Maximum working pressure	: 129.3 psi.g
nq (imp. eye flow) / S (imp. eye flow)	: 35 / 52 Metric units	Maximum allowable working pressure	: N/A
MCSF	: 3.15 USgpm	Maximum allowable suction pressure	: N/A
Head, maximum, rated diameter	: 298.7 ft	Hydrostatic test pressure	: N/A
Head rise to shutoff	: 32.81 %	**Driver & Power Data (@Max density)**	
Flow, best eff. point	: 31.52 USgpm	Motor sizing specification	: Max power (non-overloading)
Flow ratio, rated / BEP	: 95.19 %	Margin over specification	: 0.00 %
Diameter ratio (rated / max)	: 100.00 %	Service factor	: 1.15 (used)
Head ratio (rated dia / max dia)	: 100.00 %	Power, hydraulic	: 1.70 hp
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 0.99 / 1.00	Rated power (based on duty point)	: 2.79 hp
Selection status	: Acceptable	Max power (non-overloading)	: 3.08 hp
Energy Indexes		Motor rating	: 3.00 hp / 2.24 kW (Fixed)
PEI (CL)	: Out of scope	KVA Code	: -
ER (CL)	: Out of scope	Rated Current new	: 8.12 - 7.34 / 3.67 A



GRUNDFOS

SUBMITTAL

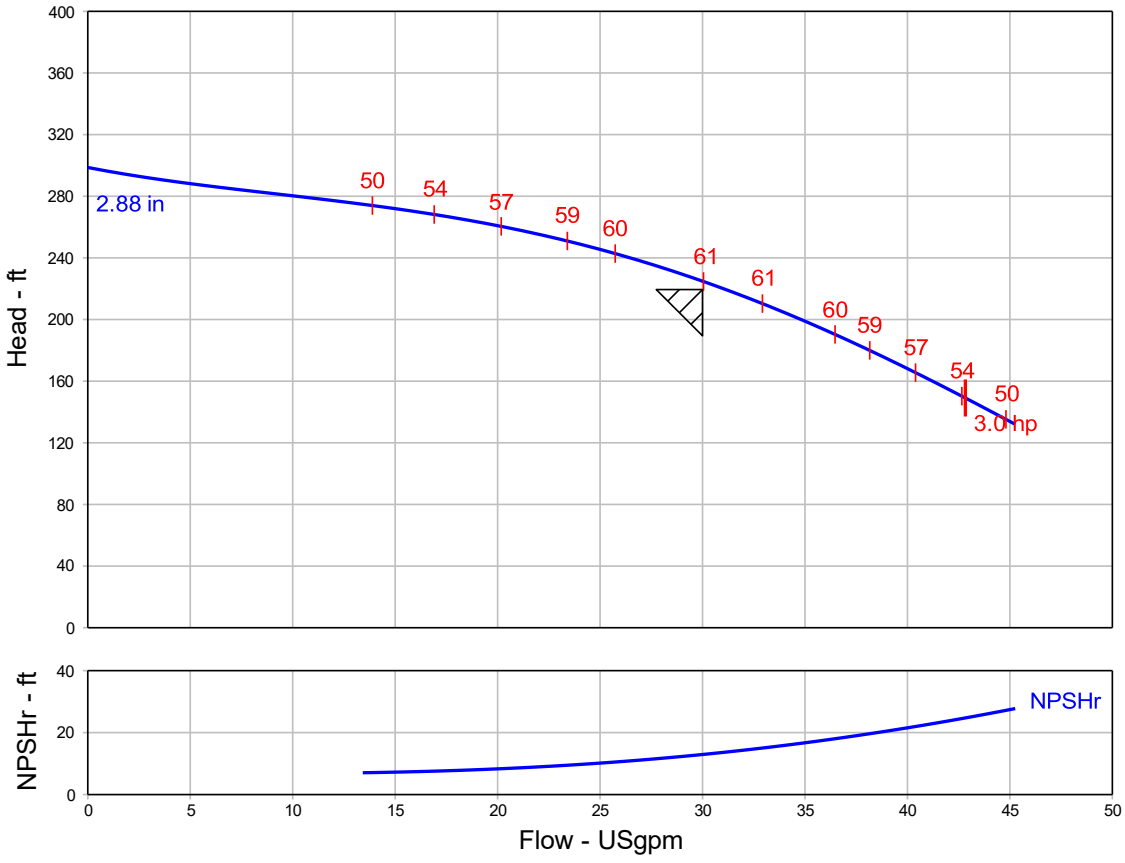
Grundfos Series CR - Multi-stage, Vertical In-Line Pump

QUOTE NUMBER / ID 1319687	**UNIT TAG 001**	**QUANTITY 1**
	SERVICE	
REPRESENTATIVE	**SUBMITTED BY**	**DATE**
ENGINEER	**APPROVED BY**	**DATE**
CONTRACTOR	**ORDER #**	**DATE**

CR 5-9-3ph
3461 rpm

Part Number 99916787

Conditions of Service		Pump Data		Motor Data	
Flow	30.00 USgpm	Stages	9	Motor HP	3 HP
Head	219.4 ft	Stages Reduced	0	BHP	2.79 HP
Liquid	Cold Water	Pipe Connection	ANSI Flanged	Enclosure	TEFC
Temperature	68.00 deg F	Efficiency	61 %	Voltage	208-230/460 V
NPSHr	12.93 ft	Suction	1.25 in.	Phase	3 Phase
Viscosity	1.00 cP	Discharge	1.25 in.	Cycle	60
Specific Gravity	1.000 SG	Shaft Seal Type	HQQE (EPDM)		
		NSF 61 Approval	Yes		
		PEI (CL)	Out of Scope		
		ER (CL)	Out of Scope		

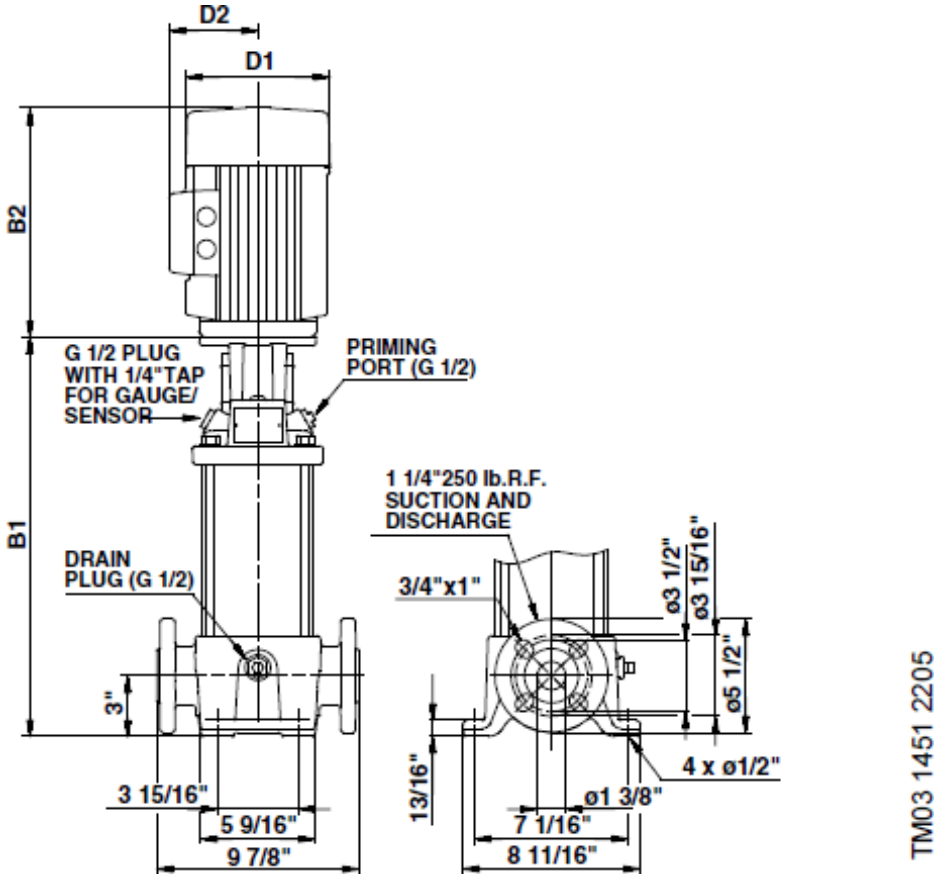


GRUNDFOS

SUBMITTAL

QUOTE NUMBER / ID 1319687 **UNIT TAG 001** **CR 5-9-3ph**

Grundfos Series CR - Multi-stage, Vertical In-Line Pump



NOT FOR CONSTRUCTION, unless certified and referenced on order

Units	B1	B1 + B2	D1	D2	Weight
inches	20.51	34.23	9.45	6.69	121 lbs

GRUNDFOS

Grundfos Quotation System 21.5.1

Pump Performance - Additional Data

Project name	001	Tag Number	001
Consulting engineer	:	Service	:
Customer	:	Model	: CR 5-9-3ph
Customer ref. / PO	:	Quantity	1
Quote Number / ID	1319687	Quoted By (Sales Office)	: PUMPTECH INC
Date last saved	: 02/09/2022 10:16 AM	Quoted By (Sales Engineer)	: Zachary Pitchford
Stages	9	Speed, rated	: 3461 rpm

Performance Data		Stage, Speed and Solids Limits	
Head, maximum diameter, rated flow	: 224.9 ft	Stages, maximum	9
Head, minimum diameter, rated flow	: 224.9 ft	Stages, minimum	9
Head, maximum, rated diameter	: 298.7 ft	Pump speed limit, maximum	: 3600 rpm
Efficiency adjustment factor, total	: 1.00	Pump speed limit, minimum	: 3400 rpm
Power adjustment, total	: 0.00 hp	Curve speed limit, maximum	: 3600 rpm
Head adjustment factor, total	: 1.00	Curve speed limit, minimum	: 100 rpm
Flow adjustment factor, total	: 1.00	Variable speed limit, minimum	: 100 rpm
NPSHR adjustment factor, total	: 1.00	Solids diameter limit	: 0.01 in
NPSH margin dictated by pump supplier	: 0.00 ft	**Energy Indexes**	
NPSH margin dictated by user	: 0.00 ft	ER (CL)	: Out of scope
NPSH margin used (added to 'required' values)	: 0.00 ft	PEI (CL)	: Out of scope
Mechanical Limits		**Typical Driver Data**	
Torque, rated power, rated speed	: 0.08 hp/100 rpm	Driver speed, full load	: 3450 rpm
Torque, maximum power, rated speed	: 0.09 hp/100 rpm	Driver speed, rated load	: 3460 rpm
Torque, driver power, full load speed	: 0.09 hp/100 rpm	Driver efficiency, 100% load	: 86.50 %
Torque, driver power, rated speed	: 0.09 hp/100 rpm	Driver efficiency, 75% load	: 86.20 %
Torque, pump shaft limit	: -	Driver efficiency, 50% load	: 83.80 %
Radial load, worst case	: -		
Radial load limit	: -		
Impeller peripheral speed, rated	: -		
Impeller peripheral speed limit	: -		

Various Performance Data	Flow (USgpm)	Head (ft)	Efficiency (%)	NPSHr (ft)	Power (hp)
Shutoff, rated diameter	0.00	298.7	-	-	1.15
Shutoff, maximum diameter	0.00	298.7	-	-	1.15
MCSF	3.15	291.6	17.99	6.93	1.29
Rated flow, minimum diameter	30.00	224.9	61.00	-	2.79
Rated flow, maximum diameter	30.00	224.9	61.00	-	2.79
BEP flow, rated diameter	31.52	217.6	61.08	13.97	2.83
120% rated flow, rated diameter	36.00	193.1	60.21	17.59	2.91
End of curve, rated diameter	45.26	132.0	48.99	27.76	3.08
End of curve, minimum diameter	45.26	132.0	48.99	27.76	3.08
End of curve, maximum diameter	45.26	132.0	48.99	27.76	3.08
Maximum value, rated diameter	-	298.7	61.08	-	3.08
Maximum value, maximum diameter	-	-	61.08	-	3.08

System differential pressure	@ Density, rated	@ Density, max
Differential pressure, rated flow, rated diameter (psi)	97.33	97.33
Differential pressure, shutoff, rated diameter (psi)	129.3	129.3
Differential pressure, shutoff, maximum diameter (psi)	129.3	129.3

Discharge pressure	@ Suction pressure, rated	@ Suction pressure, max	@ Suction pressure, rated	@ Suction pressure, max
Discharge pressure, rated flow, rated diameter (psi.g)	97.33	97.33	97.33	97.33
Discharge pressure, shutoff, rated diameter (psi.g)	129.3	129.3	129.3	129.3
Discharge pressure, shutoff, maximum diameter (psi.g)	129.3	129.3	129.3	129.3

Ratios			
Maximum flow / rated flow, rated diameter	: 150.87 %	Head rated diameter / head minimum diameter, rated flow	: 100.00 %

Construction			
Motor Phase & Voltage	: Three Phase, 208-230/460V	NSF 61 for Drinking Water?	: No
Motor Enclosure	: TEFC	Shaft Seal	: HQQE (EPDM)
Connection Code	: G - ANSI Flange		

AMTROL

WELLXTROL

Commercial Pump Systems Tanks

188 AntiLegionella

Antimicrobial

Turbulator

DeepDrawn

AMTROL

WELL-X-TROL

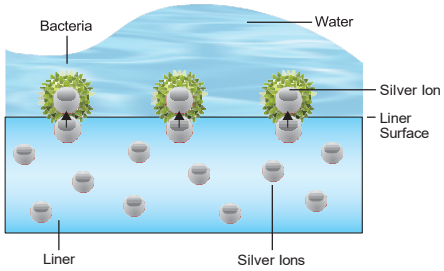
Amtrol pre-charged, potable water pressure tanks are engineered to reduce surge and ensure minimum pump run time in municipal well systems and pump applications. Available in diaphragm, full and partial acceptance bladder designs, all Well-X-Trol tanks are made in the USA at our ISO 9001:2015 certified facilities. All ASME tanks meet Section VIII, Division I standards.

Deep Drawn Construction

- Deep drawing doubles dome strength.
- Requires half the welds vs. head & shell.
- Integral diaphragm design features a unique hoop ring and groove configuration that securely locks together the diaphragm, liner and domes.
- Small footprint fits tight mechanical rooms.
- End-mounted charging valve for easy air adjustments on in-line models.

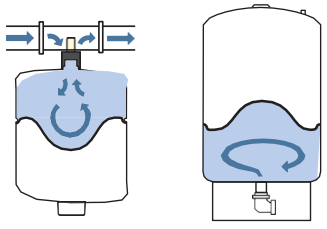
Patented Anti-Legionella Liner

- Safe, Silver-Ion technology targets active microorganisms to neutralize bacteria on contact.
- Compound is molded into the liner.
- Protection lasts the life of the tank.

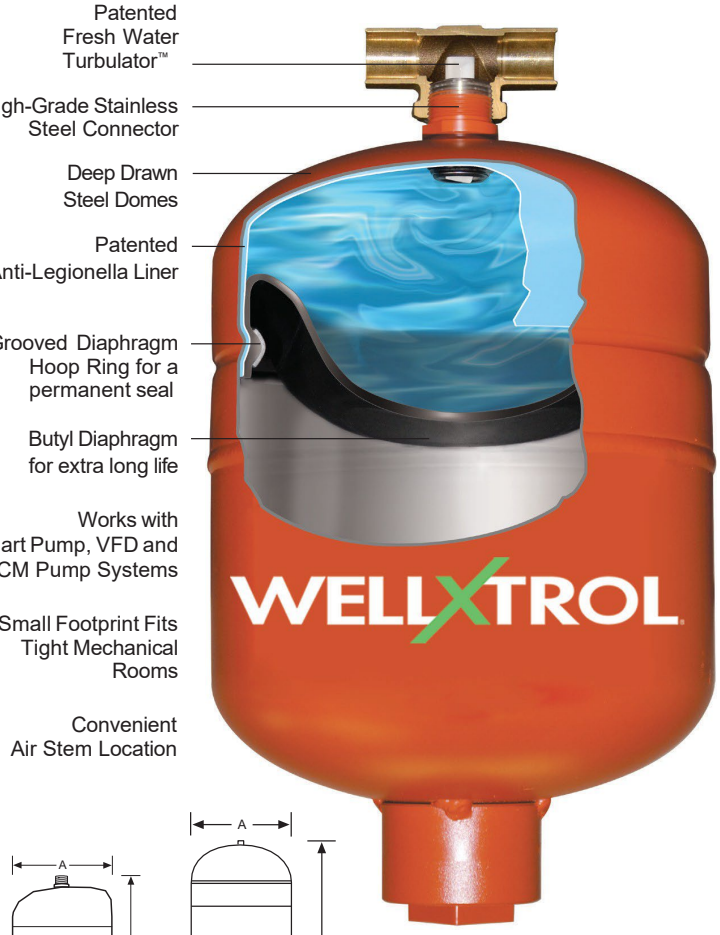


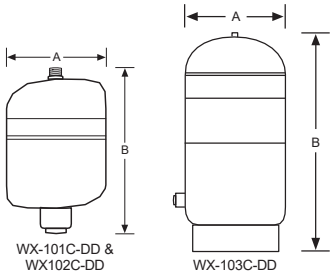
Patented Fresh Water Turbulator™

- Agitates incoming water to remove debris.
- Helps extend the life of the tank.
- Eliminates stagnant water in VFD Systems.



188 AntiLegionella Antimicrobial Turbulator





ASME Deep Drawn Diaphragm Series Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Length (Inches)	System Conn.[1] NPTM (Inches)	Shipping Weight (lbs.) Max. Working Pressure		
						100 PSI	150 PSI	175 PSI
WX-101C-DD	2.0	0.9	8	14	¾	10	10	12
WX-102C-DD	6.4	3.2	12	18	¾	26	26	28
WX-103C-DD	8.6	3.2	12	22	¾	36	36	38

[1]*Stainless Steel System Connection.*
Maximum Operating Temperature: 200°F. Factory Pre-charge: 25 PSIG.

Commercial Water Systems Tanks

Head & Shell Contruction Diaphragm Models

- Industry's thickest butyl diaphragm for extra long life.
- Patented Anti-Legionella liner neutralizes bacteria on contact.
- Tested to JIS Z 2801 for reduction of Legionella, staphylococcus and E. coli.
- Follows ASHRAE 188 Anti-Legionella guidelines.
- Patented Turbulator™ prevents sediment buildup.
- NSF/ANSI/CAN STD 61.

ASME Diaphragm Series Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Length (Inches)	System Conn.[1] NPTF (Inches)	Shipping Weight (lbs.) Max. Working Pressure				
						125 PSI	150 PSI	175 PSI	250 PSI	300 PSI
WX-401C	18	11	16	31	1	77	96	110	126	133
WX-402C	25	11	16	40	1	93	113	125	145	160
WX-403C	34	11	16	49	1	115	120	145	183	200
WX-404C	68	34	24	48	1¼	227	232	313	411	432
WX-405C	90	34	24	59	1¼	252	255	384	433	460
WX-406C	110	34	24	70	1¼	286	335	402	475	500
WX-407C	132	46	30	57	1¼	436	450	510	570	625

[1]*Malleable Iron System Connection.*
Maximum Operating Temperature: 200°F. Factory Pre-charge: 25 PSIG.

Guardian CP® Digital Pump Control

Protects Submersible and Jet Pumps from Costly Damage

- E1 Rapid Cycle: Alerts user before pump damage occurs.
- E2 Low Water Cutoff: Shuts off pump when pressure drops below 10 psig. Pump automatically restarts every 60 minutes.
- E3 Improper Voltage: Shuts off pump until proper voltage is detected.

Operates as a Pump Control and a Pressure Gauge

- Adjustable from 10 to 80 psig, in 1 psig increments.
- Digital LED display accurately shows current system pressure.

10 psig Differential Produces City-Like Water Pressure

- Tight differential setting (10 psig) narrows pressure fluctuations.
- Typical setting (20 psig) can be programmed with digital accuracy.
- Maximum 55 psig differential provides maximum flexibility.

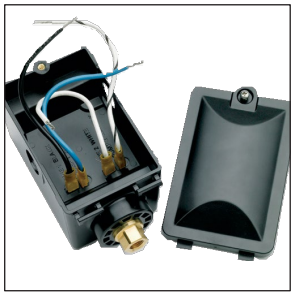
Built Tough for Reliable Performance

- Durable NEMA 3 enclosure for indoor and outdoor applications.
- UL listed for pumps up to 2 HP; can be used with motor controllers.
- Protected against line voltage noise and external interference.

Easy to Install on New or Existing Systems

- Familiar 4-wire configuration with pre-stripped leads.
- Offset conduit holes provide added wiring space.
- Automatically recognizes 115 or 230VAC systems.
- Digital LED display can rotate 180º for easy viewing.

2-Year Warranty



Access cover is sealed against moisture and bugs.

Spins on–no special fittings. LED display rotates 180°.

Commercial Water Systems Tanks

Full Acceptance Bladder Models

- Larger sizes for high flow systems.
- Replaceable bladder; full acceptance design.
- Industry's thickest heavy duty butyl bladder.
- NSF/ANSI/CAN STD 61.

ASME Full Acceptance Bladder Series Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Height (Inches)	System Conn.[1] NPTF (Inches)	Shipping Weight (lbs.) Max. Working Pressure				
						125 PSI	150 PSI	175 PSI	250 PSI	300 PSI
WX-447C	53	53	24	45	2	263	289	368	420	462
WX-448C	80	80	24	59	2	315	338	430	492	540
WX-449C	106	106	24	73	2	319	350	440	507	557
WX-450C	132	132	24	87	2	351	392	454	570	627
WX-451C	158	158	30	73	2	493	587	680	813	894
WX-452C	211	211	30	91	2	602	627	694	1,007	1,107
WX-453C	264	264	36	86	3	676	752	846	1,095	1,204
WX-454C	317	317	36	98	3	762	840	959	1,264	1,390
WX-455C	370	370	36	110	3	843	930	1,060	1,350	1,485
WX-456C	422	422	48	82	3	1,154	1,418	1,655	1,700	1,826
WX-457C	528	528	48	97	3	1,331	1,500	1,870	2,231	2,450
WX-458C	660	660	60	84	4	1,450	1,740	2,030	2,320	2,750
WX-459C	792	792	60	99	4	2,169	2,385	3,036	3,470	3,690
WX-460C	925	925	60	107	4	2,300	2,530	3,220	3,680	3,910
WX-461C	1,056	1,056	60	121	4	2,638	2,900	3,695	4,220	4,485
WX-462C	1,320	1,320	72	104	4	3,500	3,850	4,900	5,600	5,950
WX-463C	1,980	1,980	72	140	4	4,100	4,510	5,740	6,560	6,970

[1]*Malleable Iron System Connection.*
Maximum Operating Temperature: 240°F. Factory Pre-charge: 25 PSIG.

Partial Acceptance Bladder Models

- Replaceable bladder; partial acceptance design.
- Industry's thickest heavy duty butyl bladder.
- Available in compact sizes for limited space.

ASME Partial Acceptance Bladder Series Specifications

Model Number	Tank Volume (Gallons)	Max. Accept. Volume (Gallons)	A Diameter (Inches)	B Height (Inches)	System Conn.[1] NPTF (Inches)	Shipping Weight (lbs.) Max. Working Pressure
						125 PSI
WX-35CL	10	10	10	37	1¼	69
WX-50CL	13	11	12	37	1¼	76
WX-85CL	22	11	16	35	1¼	92
WX-100CL	26	11	16	39	1¼	98
WX-130CL	34	27	20	35	1½	136
WX-165CL	44	27	20	40	1½	146
WX-200CL	53	27	24	41	1½	198
WX-300CL	80	27	24	56	1½	236
WX-400CL	106	53	24	69	2	282
WX-500CL	132	53	24	83	2	316
WX-600CL	158	53	30	67	2	450

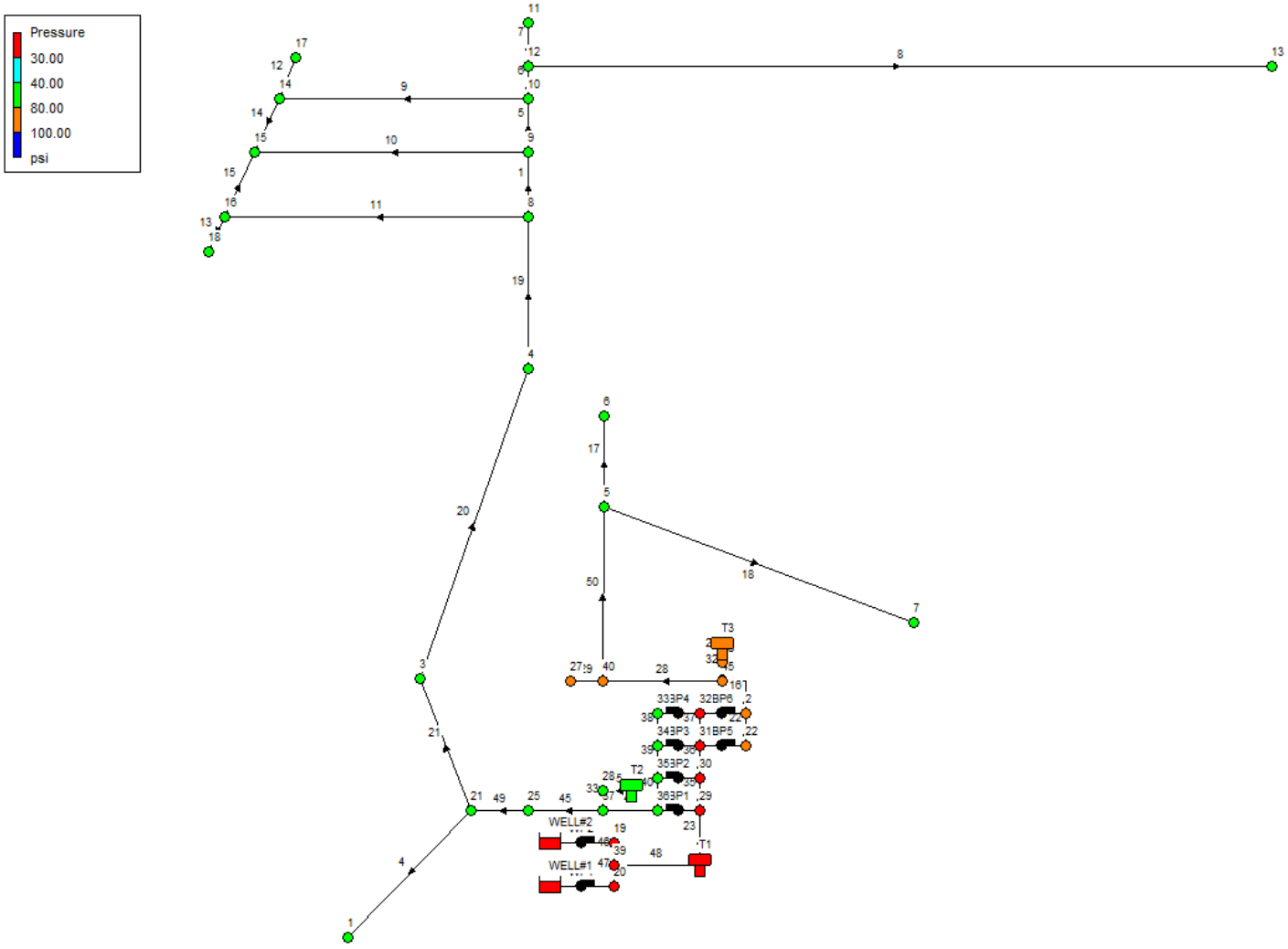
[1]*Malleable Iron System Connection.*
Maximum Operating Temperature: 240°F. Factory Pre-charge: 25 PSIG

WORTHINGTON INDUSTRIES
1400 Division Road, West Warwick, RI 02893 USA
T: 800.426.8765 **www.amtrol.com**

Turbulator DeepDrawn
188 AntiLegionella LOW-LEAD

Appendix E: Hydraulic Model

CAL Waterworks: Scenario 1 - Peak Hour Demand



EPANET 2

CAL Waterworks: Scenario 1 - Peak Hour Demand

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 1	130	8	303.65	75.24
Junc 3	137	0	300.15	70.69
Junc 5	155	9	329.33	75.54
Junc 6	150	11	327.95	77.10
Junc 7	230	9	327.55	42.27
Junc 8	145	0	275.38	56.49
Junc 9	150	0	275.16	54.23
Junc 10	150	0	275.06	54.19
Junc 11	130	4	274.81	62.75
Junc 12	150	0	275.02	54.17
Junc 13	135	40	274.59	60.48
Junc 14	125	20	270.07	62.86
Junc 15	125	39	270.06	62.85
Junc 16	125	20	270.06	62.85
Junc 17	125	10	270.01	62.83
Junc 18	122	12	269.99	64.12
Junc 19	150	0	164.80	6.41
Junc 20	150	0	164.80	6.41
Junc 29	150	0	164.80	6.41
Junc 30	150	0	164.80	6.41
Junc 31	150	0	164.80	6.41
Junc 32	150	0	164.80	6.41
Junc 33	150	0	305.30	67.29
Junc 34	150	0	305.30	67.29
Junc 35	150	0	305.30	67.29

CAL Waterworks: Scenario 1 - Peak Hour Demand

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 36	150	0	305.30	67.29
Junc 37	150	0	305.30	67.29
Junc 39	150	0	164.80	6.41
Junc 4	143	0	285.81	61.88
Junc 21	150	1	304.84	67.09
Junc 25	150	0	305.28	67.28
Junc 27	150	0	345.98	84.92
Junc 40	150	0	345.98	84.92
Junc 45	150	0	346.37	85.09
Junc 2	150	0	347.00	85.36
Junc 22	150	0	347.63	85.63
Junc 28	150	0	309.57	69.14
Junc 38	150	0	346.36	85.08
Resvr WELL#2	1	#N/A	1.00	0.00
Resvr WELL#1	-1	#N/A	-1.00	0.00
Tank T1	150	#N/A	164.80	6.41
Tank T2	150	#N/A	311.70	70.06
Tank T3	150	#N/A	346.35	85.08

CAL Waterworks: Scenario 1 - Peak Hour Demand

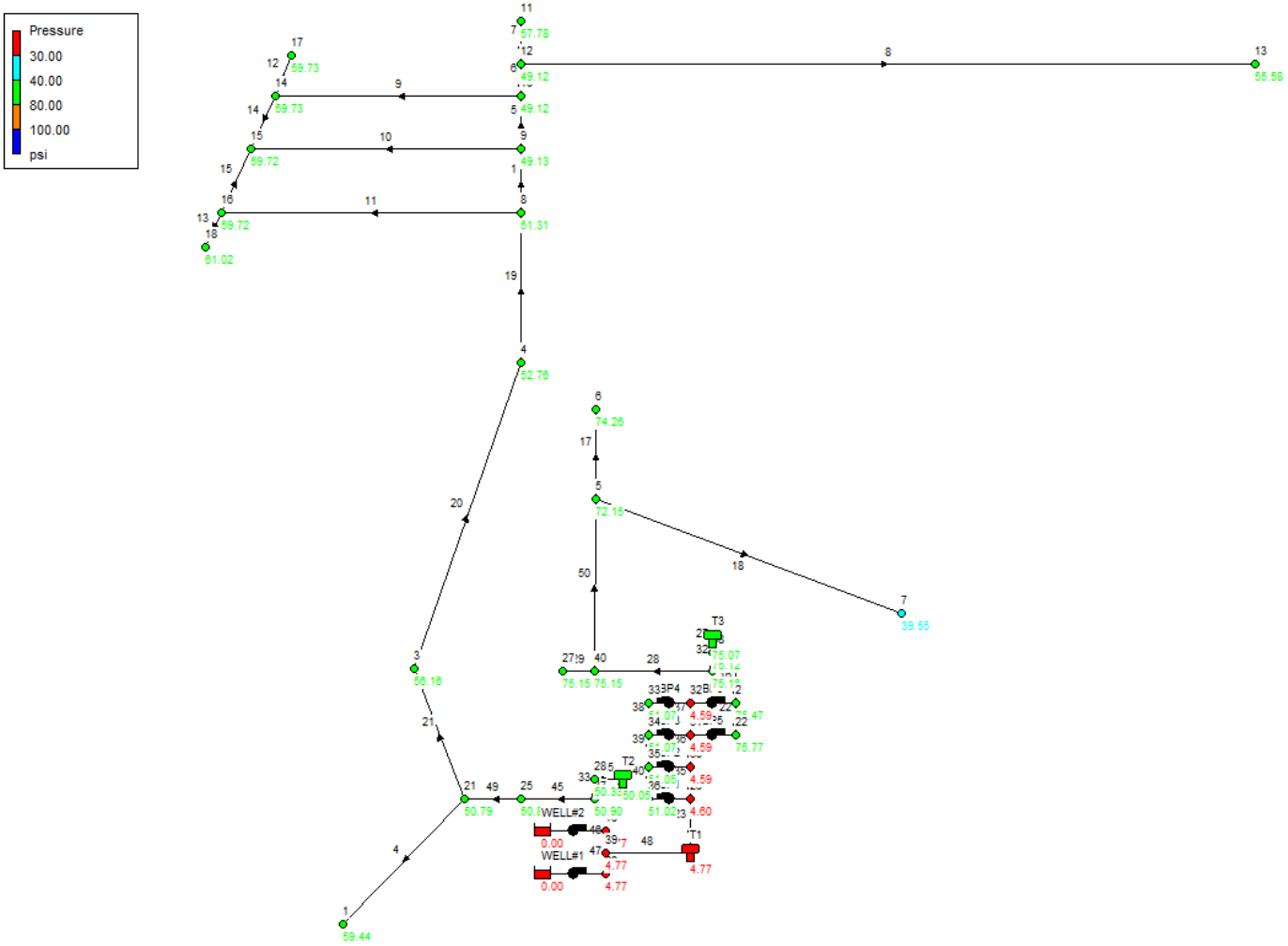
Network Table - Links

Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 5	175	6	77.78	0.57
Pipe 6	180	6	44.00	0.20
Pipe 7	420	2	4.00	0.49
Pipe 8	2610	6	40.00	0.17
Pipe 9	1400	3	33.78	3.56
Pipe 10	1450	3	33.54	3.52
Pipe 11	1500	3	33.69	3.55
Pipe 12	150	3	10.00	0.37
Pipe 13	130	3	12.00	0.52
Pipe 14	180	3	3.78	0.06
Pipe 15	180	3	-1.69	0.01
Pipe 17	430	2	11.00	3.22
Pipe 18	800	2	9.00	2.22
Pipe 35	5	8	37.71	0.04
Pipe 36	10	8	37.72	0.04
Pipe 37	5	8	0.00	0.00
Pipe 38	5	6	0.00	0.00
Pipe 39	10	6	0.00	0.00
Pipe 40	5	6	0.00	0.00
Pipe 41	10	6	0.00	0.00
Pipe 46	149	4	0.00	0.00
Pipe 47	151	4	0.00	0.00
Pipe 48	100	4	0.00	0.00
Pipe 19	800	4	-145.00	13.04
Pipe 20	1100	4	-145.00	13.04

CAL Waterworks: Scenario 1 - Peak Hour Demand

Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 33	10	2	-154.00	426.56
Pipe 4	670	2	8.00	1.78
Pipe 21	360	4	145.00	13.04
Pipe 23	50	8	37.71	0.04
Pipe 28	20	2	29.00	19.37
Pipe 29	10	2	0.00	0.00
Pipe 32	5	2	-8.72	2.09
Pipe 45	10	6	154.00	2.02
Pipe 49	30	4	154.00	14.58
Pipe 50	860	2	29.00	19.37
Pipe 1	200	6	111.31	1.11
Pipe 16	20	2	37.72	31.51
Pipe 22	20	2	37.72	31.51
Pipe 25	5	2	154.00	426.56
Pipe 27	5	2	8.72	2.09
Pump WP2	#N/A	#N/A	0.00	0.00
Pump WP1	#N/A	#N/A	0.00	0.00
Pump BP6	#N/A	#N/A	0.00	0.00
Pump BP5	#N/A	#N/A	37.72	-182.83
Pump BP1	#N/A	#N/A	0.00	0.00
Pump BP2	#N/A	#N/A	0.00	0.00
Pump BP3	#N/A	#N/A	0.00	0.00
Pump BP4	#N/A	#N/A	0.00	0.00

CAL Waterworks: Scenario 2 - Fire Flow + Maximum Day Demand



CAL Waterworks: Scenario 2 - Fire Flow + Maximum Day Demand

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 1	130	1	267.19	59.44
Junc 3	137	0	266.60	56.16
Junc 5	155	3	321.52	72.15
Junc 6	150	3	321.39	74.26
Junc 7	230	3	321.29	39.55
Junc 8	145	0	263.41	51.31
Junc 9	150	0	263.38	49.13
Junc 10	150	0	263.36	49.12
Junc 11	130	1	263.34	57.78
Junc 12	150	0	263.36	49.12
Junc 13	135	17	263.27	55.58
Junc 14	125	5	262.85	59.73
Junc 15	125	14	262.84	59.72
Junc 16	125	5	262.84	59.72
Junc 17	125	1	262.85	59.73
Junc 18	122	5	262.82	61.02
Junc 19	150	0	161.00	4.77
Junc 20	150	0	161.00	4.77
Junc 29	150	0	160.62	4.60
Junc 30	150	0	160.60	4.59
Junc 31	150	0	160.59	4.59
Junc 32	150	0	160.59	4.59
Junc 33	150	0	267.86	51.07
Junc 34	150	0	267.86	51.07
Junc 35	150	0	267.82	51.05

CAL Waterworks: Scenario 2 - Fire Flow + Maximum Day Demand

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 36	150	0	267.75	51.02
Junc 37	150	0	267.48	50.90
Junc 39	150	0	161.00	4.77
Junc 4	143	0	264.75	52.76
Junc 21	150	1	267.21	50.79
Junc 25	150	500	267.26	50.81
Junc 27	150	0	323.43	75.15
Junc 40	150	0	323.43	75.15
Junc 45	150	0	323.47	75.16
Junc 2	150	0	324.17	75.47
Junc 22	150	0	324.88	75.77
Junc 28	150	0	266.16	50.33
Junc 38	150	0	323.36	75.12
Resvr WELL#2	1	#N/A	1.00	0.00
Resvr WELL#1	-1	#N/A	-1.00	0.00
Tank T1	150	#N/A	161.00	4.77
Tank T2	150	#N/A	265.50	50.05
Tank T3	150	#N/A	323.25	75.07

CAL Waterworks: Scenario 2 - Fire Flow + Maximum Day Demand

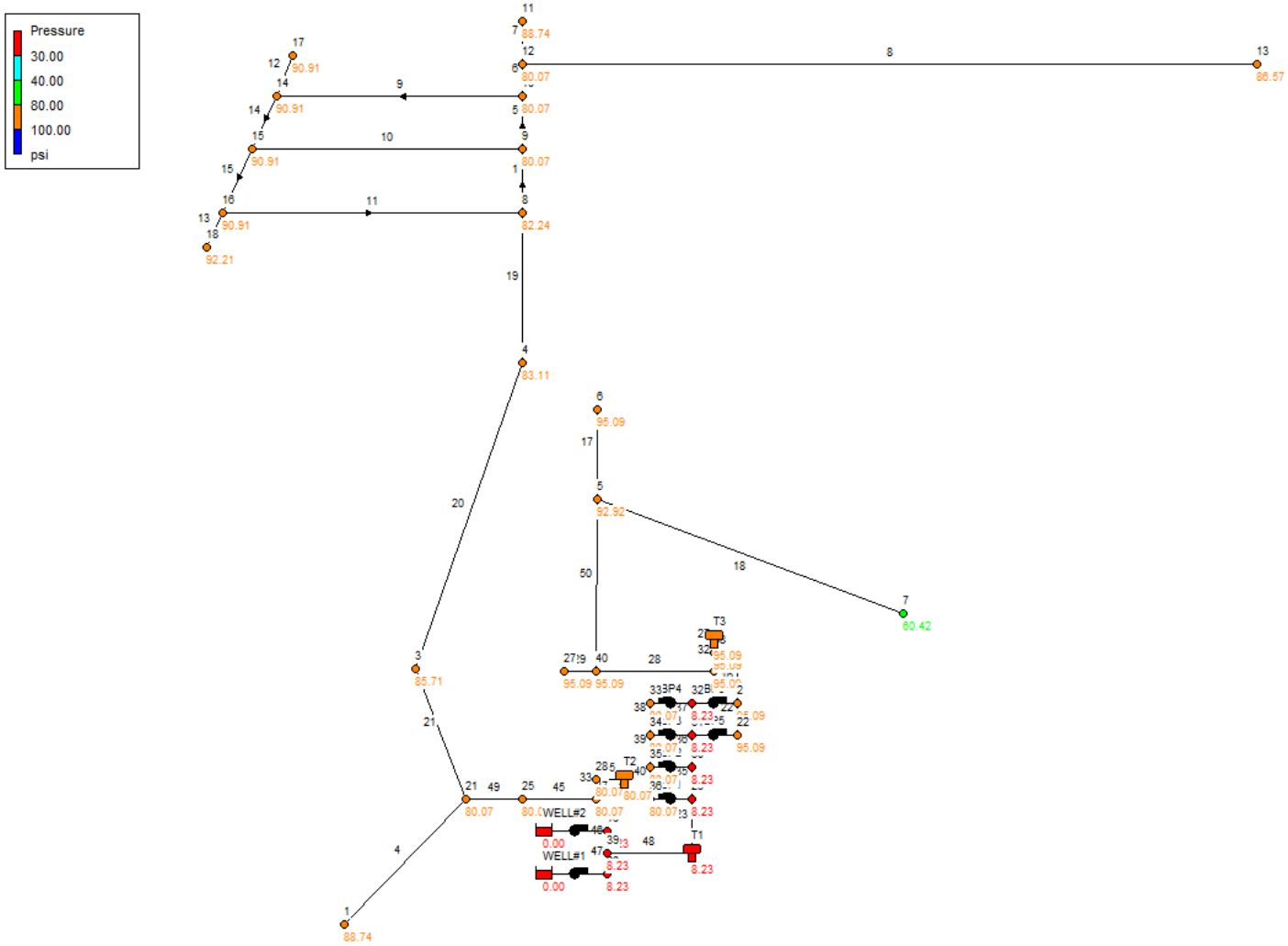
Network Table - Links

Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 5	175	6	27.91	0.09
Pipe 6	180	6	18.00	0.04
Pipe 7	420	2	1.00	0.04
Pipe 8	2610	6	17.00	0.03
Pipe 9	1400	3	9.91	0.37
Pipe 10	1450	3	9.99	0.37
Pipe 11	1500	3	10.10	0.38
Pipe 12	150	3	1.00	0.01
Pipe 13	130	3	5.00	0.10
Pipe 14	180	3	3.91	0.07
Pipe 15	180	3	-0.10	0.00
Pipe 17	430	2	3.00	0.29
Pipe 18	800	2	3.00	0.29
Pipe 35	5	8	461.13	3.80
Pipe 36	10	8	250.56	1.23
Pipe 37	5	8	0.00	0.00
Pipe 38	5	6	0.00	0.00
Pipe 39	10	6	210.54	3.61
Pipe 40	5	6	421.11	13.03
Pipe 41	10	6	631.72	27.62
Pipe 46	149	4	0.00	0.00
Pipe 47	151	4	0.00	0.00
Pipe 48	100	4	0.00	0.00
Pipe 19	800	4	-48.00	1.68
Pipe 20	1100	4	-48.00	1.68

CAL Waterworks: Scenario 2 - Fire Flow + Maximum Day Demand

Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 33	10	2	81.72	131.90
Pipe 4	670	2	1.00	0.04
Pipe 21	360	4	48.00	1.68
Pipe 23	50	8	671.74	7.62
Pipe 28	20	2	9.00	2.22
Pipe 29	10	2	0.00	0.00
Pipe 32	5	2	-31.02	21.94
Pipe 45	10	6	550.00	21.37
Pipe 49	30	4	50.00	1.81
Pipe 50	860	2	9.00	2.22
Pipe 1	200	6	37.90	0.15
Pipe 16	20	2	40.02	35.17
Pipe 22	20	2	40.02	35.17
Pipe 25	5	2	-81.72	131.90
Pipe 27	5	2	31.02	21.94
Pump WP2	#N/A	#N/A	0.00	0.00
Pump WP1	#N/A	#N/A	0.00	0.00
Pump BP6	#N/A	#N/A	0.00	0.00
Pump BP5	#N/A	#N/A	40.02	-164.29
Pump BP1	#N/A	#N/A	210.61	-107.14
Pump BP2	#N/A	#N/A	210.57	-107.22
Pump BP3	#N/A	#N/A	210.54	-107.27
Pump BP4	#N/A	#N/A	0.00	0.00

CAL Waterworks: Scenario 3 - Static Water Pressure



CAL Waterworks: Scenario 3 - Static Water Pressure

Network Table - Nodes

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 1	130	0	334.80	88.74
Junc 3	137	0	334.80	85.71
Junc 5	155	0	369.45	92.92
Junc 6	150	0	369.45	95.09
Junc 7	230	0	369.45	60.42
Junc 8	145	0	334.80	82.24
Junc 9	150	0	334.80	80.07
Junc 10	150	0	334.80	80.07
Junc 11	130	0	334.80	88.74
Junc 12	150	0	334.80	80.07
Junc 13	135	0	334.80	86.57
Junc 14	125	0	334.80	90.91
Junc 15	125	0	334.80	90.91
Junc 16	125	0	334.80	90.91
Junc 17	125	0	334.80	90.91
Junc 18	122	0	334.80	92.21
Junc 19	150	0	169.00	8.23
Junc 20	150	0	169.00	8.23
Junc 29	150	0	169.00	8.23
Junc 30	150	0	169.00	8.23
Junc 31	150	0	169.00	8.23
Junc 32	150	0	169.00	8.23
Junc 33	150	0	334.80	80.07
Junc 34	150	0	334.80	80.07
Junc 35	150	0	334.80	80.07

CAL Waterworks: Scenario 3 - Static Water Pressure

Node ID	Elevation ft	Base Demand GPM	Head ft	Pressure psi
Junc 36	150	0	334.80	80.07
Junc 37	150	0	334.80	80.07
Junc 39	150	0	169.00	8.23
Junc 4	143	0	334.80	83.11
Junc 21	150	0	334.80	80.07
Junc 25	150	0	334.80	80.07
Junc 27	150	0	369.45	95.09
Junc 40	150	0	369.45	95.09
Junc 45	150	0	369.45	95.09
Junc 2	150	0	369.45	95.09
Junc 22	150	0	369.45	95.09
Junc 28	150	0	334.80	80.07
Junc 38	150	0	369.45	95.09
Resvr WELL#2	1	#N/A	1.00	0.00
Resvr WELL#1	-1	#N/A	-1.00	0.00
Tank T1	150	#N/A	169.00	8.23
Tank T2	150	#N/A	334.80	80.07
Tank T3	150	#N/A	369.45	95.09

CAL Waterworks: Scenario 3 - Static Water Pressure

Network Table - Links

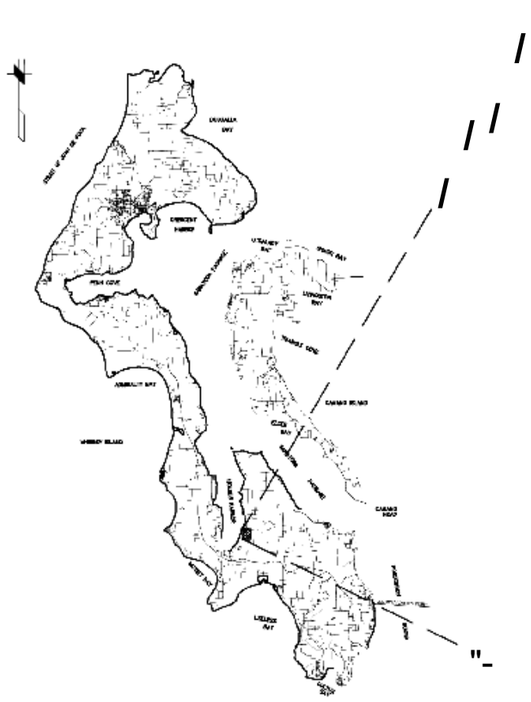
Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 5	175	6	0.06	0.00
Pipe 6	180	6	0.00	0.00
Pipe 7	420	2	0.00	0.00
Pipe 8	2610	6	0.00	0.00
Pipe 9	1400	3	0.06	0.00
Pipe 10	1450	3	0.00	0.00
Pipe 11	1500	3	-0.06	0.00
Pipe 12	150	3	0.00	0.00
Pipe 13	130	3	0.00	0.00
Pipe 14	180	3	0.06	0.00
Pipe 15	180	3	0.06	0.00
Pipe 17	430	2	0.00	0.00
Pipe 18	800	2	0.00	0.00
Pipe 35	5	8	0.00	0.00
Pipe 36	10	8	0.00	0.00
Pipe 37	5	8	0.00	0.00
Pipe 38	5	6	0.00	0.00
Pipe 39	10	6	0.00	0.00
Pipe 40	5	6	0.00	0.00
Pipe 41	10	6	0.00	0.00
Pipe 46	149	4	0.00	0.00
Pipe 47	151	4	0.00	0.00
Pipe 48	100	4	0.00	0.00
Pipe 19	800	4	0.00	0.00
Pipe 20	1100	4	0.00	0.00

CAL Waterworks: Scenario 3 - Static Water Pressure

Link ID	Length ft	Diameter in	Flow GPM	Unit Headloss ft/Kft
Pipe 33	10	2	0.00	0.00
Pipe 4	670	2	0.00	0.00
Pipe 21	360	4	0.00	0.00
Pipe 23	50	8	0.00	0.00
Pipe 28	20	2	0.00	0.00
Pipe 29	10	2	0.00	0.00
Pipe 32	5	2	0.00	0.00
Pipe 45	10	6	0.00	0.00
Pipe 49	30	4	0.00	0.00
Pipe 50	860	2	0.00	0.00
Pipe 1	200	6	0.06	0.00
Pipe 16	20	2	0.00	0.00
Pipe 22	20	2	0.00	0.00
Pipe 25	5	2	0.00	0.00
Pipe 27	5	2	0.00	0.00
Pump WP2	#N/A	#N/A	0.00	0.00
Pump WP1	#N/A	#N/A	0.00	0.00
Pump BP6	#N/A	#N/A	0.00	0.00
Pump BP5	#N/A	#N/A	0.00	0.00
Pump BP1	#N/A	#N/A	0.00	0.00
Pump BP2	#N/A	#N/A	0.00	0.00
Pump BP3	#N/A	#N/A	0.00	0.00
Pump BP4	#N/A	#N/A	0.00	0.00

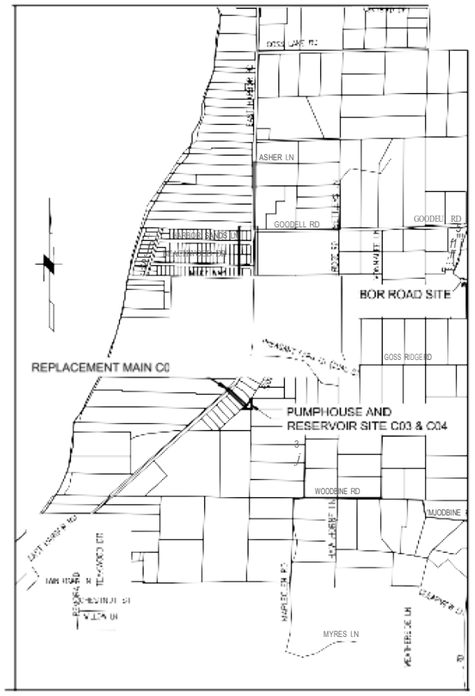
Appendix F: Construction Drawings

CAL WATERWORKS
SYSTEM IMPROVEMENTS
FREELAND, WA



1o<&o J 0:000 33000
SCALE IN FEET

ISLAND COUNTY
SCALE AS SHOWN



5<& J JJO JiOO
SCALE IN FEET

VICINITY MAP
SCALE AS SHOWN

SHEET INDEX		
SHEET NO.	PLAN NO.	SHEET TITLE
1	C01	COVER SHEET
2	CO2	NOTES & ABBREVIATIONS
3	C03	DEMO PLAN - PUMPHOUSE SITE
4	C04	IMPROVEMENT PLAN - PUMPHOUSE SITE
5	C05	PLAN & PROFILE -EASEMENT
6	C06	PLAN & PROFILE - EAST HARBOR ROAD
7	CO?	PUMPHOUSEIMPROVEMENTS
8	COS	DETAILS 1-6
9	C09	DETAILS 7-11
10	C10	RESERVOIR DETAILS

CONTACT INFORMATION:

APPLICANT:
CULLEY LEHMAN
CASCADIA WATER
PO BOX 549 FREELAND, WA 98249
PH: 360.331.7388

CIVIL ENGINEER:
ROBERT L. BENNION, P.E.
DAVIDO CONSULTING GROUP, INC.
P.O. BOX 1132
FREELAND, WA 98249
PH: 360.331.4131

SURVEYOR:
FRAZIER SURVEYING, LLC
611 SW FOUNDERS DR.
OAK HARBOR, WA 98277
PH: 360.969-3886

DCG civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

BASIS MUST NOT BE RELIED ON BY OTHERS. DCG CANNOT BE HELD LIABLE FOR UNDERGROUND FEATURES & CONDITIONS IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO

CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

C/AL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
COVER SHEET

PROJ. MANAGER	RLB
DESIGNED BY	SD
DRAWN BY:	JS
CHECKED BY:	RLB
SCALE:	AS SHOWN
DATE: 7/25/2022	REV
SHEET NUMBER	C01

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA WATER SYSTEM\SOCIAL WATERWORKS\PROJECTS\PUMPHOUSE\ENG\DRAWINGS\CAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS - SAVE DATE: 7/22/2022 6:03 PM - SHEET SET: CAL WATERWORKS SYSTEM IMPROVEMENTS_20 - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)

WATER NOTES:

1. WATER MAINS, VALVES, FITTINGS, HYDRANTS, SERVICES, AND ALL OTHER COMPONENTS SHALL BE INSTALLED AND PRESSURE TESTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE AND MUNICIPAL CONSTRUCTION, WASHINGTON STATE DEPARTMENT OF TRANSPORTATION, SECTION 7-09.
2. THE CONTRACTOR SHALL PROVIDE THE HIDE-AWAY WATER CO. AND THEIR OPERATOR, SANORA BODAMER (360) 678-5336, A MINIMUM OF 72 HOURS NOTICE OF ANY PLANNED CONNECTION TO AN EXISTING PIPELINE. THIS INCLUDES LIVE TAPS. NOTICE IS REQUIRED SO ANY DISRUPTIONS TO EXISTING SERVICES CAN BE SCHEDULED. THE CONTRACTOR SHALL NOTIFY CUSTOMERS INVOLVED OR AFFECTED OF THE WATER SERVICE INTERRUPTION 24 HOURS IN ADVANCE OF THE INTERRUPTION. THE CONTRACTOR SHALL MAKE EVERY EFFORT TO SCHEDULE WATER MAIN CONSTRUCTION WITH A MINIMUM INTERRUPTION OF WATER SERVICE.
3. IN CERTAIN SITUATIONS, THE WATER COMPANY MAY DICTATE SCHEDULING OF WATER MAIN SHUTDOWNS SO AS NOT TO IMPOSE UNNECESSARY SHUTDOWNS DURING SPECIFIC PERIODS TO EXISTING CUSTOMERS.
4. ALL WATER MAINS SHALL BE PVC SCH 80 (2" OR LESS), PVC C900, OR DI CLASS 52 PIPE AS SPECIFIED ON THE PLANS. HIGH DENSITY POLYETHYLENE (HOPE) PIPE SDR 9 MAY BE USED IN PLACE OF PVC SPECIFIED ON PLANS. HOPE PIPE SHALL BE BLACK PE 4710, MADE OF NEW RESINS, AND MEETING THE REQUIREMENTS OF ASTM 03350 CELL CLASSIFICATION OF PE445574C/E, TYPE II, GRADE PE47, AS WELL AS: ASTM F714, AWWA C901, AND AWWA C906. PROVISIONS FOR PIPE EXPANSION MUST BE ACCOUNTED FOR WHEN INSTALLING HOPE PIPING.
5. WATER MAIN FITTINGS SHALL BE DUCTILE IRON. DUCTILE IRON FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C153 AND JOINTS SHALL MEET THE REQUIREMENTS OF AWWA C111. DUCTILE IRON FITTINGS SHALL BE CEMENT MORTAR LINED, MEETING THE REQUIREMENTS OF AWWA C104. GASKETS FOR FLAT FACED OR RAISED FACED FLANGES SHALL BE 1/8-INCH THICK NEOPRENE HAVING A DUROMETER OF 60 PLUS OR MINUS 5 OR 1/16-CLOTH INSERTED. DUCTILE IRON PIPE SHALL BE INSTALLED WITH POLYETHYLENE SHEATHING FOR CORROSION PROTECTION. THE TYPE, MATERIAL, AND IDENTIFICATION MARK FOR BOLTS AND NUTS SHALL BE PROVIDED. BOLTS, NUTS, AND WASHERS USED FOR SECURING FITTINGS SHALL BE OF SIMILAR MATERIALS. STEEL BOLTS SHALL MEET THE REQUIREMENTS OF ASTM A307 OR ASTM F568 FOR CARBON STEEL OR ASTM F593 OR ASTM F738 FOR STAINLESS STEEL. NUTS SHALL MEET THE REQUIREMENTS OF ASTM A563 OR ASTM A563 FOR CARBON STEEL OR ASTM F594 OR ASTM F836 FOR STAINLESS STEEL. IRON BOLTS AND NUTS SHALL MEET THE REQUIREMENTS OF ASTM A536, GRADE 65-45-12.
6. ALL NON-METALLIC PIPE AND SERVICES SHALL BE INSTALLED WITH CONTINUOUS TRACER TAPE INSTALLED 12 TO 18 INCHES UNDER THE FINAL GROUND SURFACE. NO BREAKS OR SPLICES WILL BE ALLOWED. A CONTINUOUS LOOP SHALL BE PLACED FROM THE MAIN LINE TO THE METER BOX AND BACK TO THE MAIN LINE. THE MARKER SHALL BE PLASTIC NON-BIODEGRADABLE, METAL CORE OR BACKING WHICH CAN BE DETECTED BY A STANDARD METAL DETECTOR. TAPE SHALL BE TERRA TAPE "D" OR APPROVED EQUAL. IN ADDITION TO TRACER TAPE, INSTALL 14 GAUGE COATED COPPER WIRE, TAPED TO THE TOP OF PIPE, BROUGHT UP AND TIED OFF AT VALVE BODY.
7. THE MINIMUM COVER FOR ALL WATER MAINS FROM TOP OF PIPE TO FINISH GRADE SHALL BE 36 INCHES UNLESS OTHERWISE APPROVED BY THE ENGINEER.
8. ALL VALVES AND FITTINGS SHALL BE DUCTILE IRON WITH ANSI FLANGES OR MECHANICAL JOINT ENDS. ALL EXISTING VALVES SHALL BE OPERATED BY WATER COMPANY PERSONNEL. VALVE BOXES SHALL BE INSTALLED ON ALL BURIED VALVES. THE BOX SHALL BE OF CAST IRON, TWO-PIECE SLIP TYPE, 5-1/4 INCH SHAFT, WITH A BASE CORRESPONDING TO THE SIZE OF THE VALVE. THE COVER SHALL HAVE THE WORD "WATER" CAST IN IT. THE VALVE BOX SHALL BE TYLER UNION 6855 SERIES OR EQUAL APPROVED BY THE WATER COMPANY. THE COVER SHALL BE A TYLER UNION STANDARD DROP LID 145325 OR EQUAL APPROVED BY THE WATER COMPANY.
9. GATE VALVES, 6 INCH TO 12 INCH. THE DESIGN, MATERIALS AND WORKMANSHIP OF ALL GATE VALVES SHALL CONFORM TO, OR EXCEED THE REQUIREMENTS OF AWWA C515 LATEST REVISION. GATES VALVES SHALL BE RESILIENT SEAT NON-RISING STEM (NRS) WITH TWO INTERNAL 0-RING STEM SEALS. GATE VALVES SHALL BE MUELLER A-2361. GATE VALVES SHALL BE USED ON ALL 6 TO 12 INCH LINES.
10. VALVE BOX. ALL VALVES SHALL HAVE A STANDARD CAST IRON WATER VALVE BOX SET TO GRADE. IF VALVES ARE NOT SET IN PAVED AREA, A 3 FOOT BY 3 FOOT BY 4 INCH CONCRETE OR ASPHALT PAD SHALL BE SET AROUND EACH VALVE BOX AT FINISHED GRADE. IN AREAS WHERE VALVE BOX FALLS IN ROAD SHOULDER, THE DITCH AND SHOULDER SHALL BE GRADED BEFORE PLACING ASPHALT OR CONCRETE PAD.
11. VALVE MARKER POST. VALVE MARKER POSTS SHALL BE 4 INCH X 4 INCH REINFORCED CONCRETE OR SCHEDULE 40 STEEL POSTS 5 FEET LONG, WITH 2 FOOT MINIMUM BURY, STAMPED WITH "W" AND DISTANCE TO VALVE. POST SHALL BE PAINTED WITH 1 BASE COAT AND 2 COATS BLUE OIL BASE ENAMEL.
12. THE CONTRACTOR SHALL NOTIFY THE ENGINEER A MINIMUM OF 48 HOURS PRIOR TO PERFORMING A HYDROSTATIC PRESSURE TEST. THE PRESSURE TEST SHALL BE PERFORMED IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION 7-09.3(23).
13. THE SYSTEM IMPROVEMENTS SHALL BE DISINFECTED IN ACCORDANCE WITH WSDOT STANDARD SPECIFICATION 7-09.3(24) AND AWWA STANDARD C652. A SATISFACTORY BACTERIOLOGICAL TEST RESULT FOR A WATER SAMPLE COLLECTED FROM THE IMPROVEMENTS SHALL BE PROVIDED TO THE ENGINEER PRIOR TO RECONNECTING TO THE DISTRIBUTION SYSTEM.
14. ALL MATERIAL THAT COMES INTO CONTACT WITH DRINKING WATER SHALL BE IN ACCORDANCE WITH ANSI/NSF 61.

GENERAL NOTES:

1. THE CONTRACTOR SHALL NOTIFY THE SYSTEM A MINIMUM OF 24 HOURS PRIOR TO STARTING ANY WORK.
2. THE CONTRACTOR SHALL NOTIFY THE UNDERGROUND UTILITY LOCATE CENTER AT 1-800-424-5555 AT LEAST 48 HOURS PRIOR TO CONSTRUCTION.
3. THE CONTRACTOR SHALL PROTECT IN PLACE, ALL UTILITIES, STRUCTURES AND FEATURES, WHETHER OR NOT SHOWN ON THESE PLANS. ANY DAMAGE TO EXISTING UTILITIES OR FEATURES SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.
4. LOCATIONS OF EXISTING FEATURES AND UTILITIES AS SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND BASED ON THE BEST AVAILABLE INFORMATION. ACTUAL LOCATIONS SHALL BE DETERMINED BY THE CONTRACTOR.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS, METHODS AND SEQUENCE OF CONSTRUCTION.
6. ALL WORK SHALL CONFORM TO CURRENT APPROVED STANDARD PLANS AND WSDOT/APWA STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION.
7. THE CONTRACTOR SHALL BE REQUIRED TO KEEP ACCURATE AS-BUILT DRAWINGS AND DELIVER THIS INFORMATION TO THE OWNER FOR PREPARATION OF AS-BUIIT DRAWINGS.
8. WATER MAINS SHALL BE PROPERLY DISINFECTED, FLUSHED, AND HAVE A SATISFACTORY BACTERIOLOGICAL TEST RESULT FROM A WATER SAMPLE COLLECTED FROM THE PIPE BEFORE ENTERING SERVICE.
9. UTILITY SERVICE INTERRUPTIONS SHALL NOT EXCEED TWO HOURS.
10. 24 HOUR NOTICE SHALL BE PROVIDED TO ALL PROPERTY OWNERS/OCCUPANTS OF ANY UTILITY SERVICE OR ACCESS INTERRUPTIONS.
11. ONE LANE TRAFFIC MUST BE MAINTAINED AT ALL TIMES ON COUNTY ROADS. ROAD CLOSURES WILL NOT BE ALLOWED UNLESS EXPRESSLY AUTHORIZED AND APPROVED BY ISLAND COUNTY.
12. PROPER SIGNAGE AND FLAGGERS ARE REQUIRED PER THE MUTCD. FLAGGERS SHALL HAVE CURRENT CARDS INDICATING THAT THEY ARE QUALIFIED TO PERFORM THE REQUIRED TRAFFIC CONTROL.
13. ACCESS TO PRIVATE PROPERTY SHALL BE RESTORED DAILY.
14. STREETS SHALL BE SWEPT DAILY OR AS NEEDED.

EROSION AND SEDIMENTATION CONTROL (ESC) NOTES:

1. THE CONTRACTOR SHALL MEET ISLAND COUNTY STANDARDS AND REQUIREMENTS BY USING APPROPRIATE BEST MANAGEMENT PRACTICES (BMPS) FOR EROSION AND SEDIMENTATION CONTROL.
2. EROSION ON- AND OFF-SITE. DURING AND AFTER CONSTRUCTION, THE CONTRACTOR SHALL MINIMIZE EROSION AND SEDIMENTATION ON-SITE AND SHALL PROTECT PROPERTIES AND WATER COURSES DOWNSTREAM FROM THE SITE FROM EROSION DUE TO INCREASES IN THE VELOCITY AND PEAK FLOW RATE OF STORM WATER RUNOFF FROM THE SITE.
3. TRANSPORT OF SEDIMENT. THE CONTRACTOR SHALL PREVENT THE TRANSPORT OF SEDIMENT FROM THE SITE THROUGH MEASURES SUCH AS MULCHING, MATTING, COVERING, SILT FENCES, SEDIMENT TRAPS, SETTLING PONDS AND PROTECTIVE BERMS USING THE FOLLOWING BMPS: FILTER FENCE, STRAW BALE BARRIER, BRUSH BARRIER, GRAVEL FILTER BERM, SEDIMENT TRAP, TEMPORARY SEDIMENT POND, PRESERVING NATURAL VEGETATION, AND/OR BUFFER ZONES. TRANSPORT OF SEDIMENT ONTO PAVED SURFACES SHALL BE MINIMIZED, AND IF SEDIMENT IS TRANSPORTED ONTO A PAVED SURFACE, THE PAVED SURFACE SHALL BE CLEANED AT THE END OF EACH DAY IN ACCORDANCE WITH BMPS IN THE DRAINAGE MANUAL, OR APPROVED BY THE DIRECTOR.
4. STABILIZING EXPOSED SOIL. THE CONTRACTOR SHALL PREVENT ON-SITE EROSION BY STABILIZING ALL SOILS THAT ARE TEMPORARILY EXPOSED AND NOT BEING ACTIVELY WORKED, THROUGH SUCH METHODS AS THE INSTALLATION OF SEEDING, MULCHING, MATTING AND COVERING. CONTRACTOR SHALL APPLY ONE OR MORE OF THE FOLLOWING TEMPORARY ESC BMPS: TEMP SEEDING, MULCHING AND MATTING, CLEAR PLASTIC COVERING, AND/OR DUST CONTROL.
5. DENUDED AREAS SHALL BE STABILIZED AND SOIL STOCKPILES AS ESTABLISHED IN THE DRAINAGE MANUAL.
6. STORM DRAIN INLETS SHALL BE PROTECTED USING BMP STORM DRAIN INLET PROTECTION. THE RECOMMENDED INLET PROTECTION ALTERNATIVES ARE TRIANGULAR SILT DIKES; BIOLOGS; EXERTS (FOSS ENVIRONMENTAL); DANDY BAGS; AND, STRAW WATTLES.
7. NO MORE THAN THREE HUNDRED (300) FEET OF TRENCH MAY REMAIN OPEN AT ONE TIME. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF TRENCHES, UNLESS INCONSISTENT WITH SAFETY OR SITE CONSTRAINTS.
8. DISCHARGE FROM DEWATERING DEVICES. WATER FROM A DEWATERING DEVICE SHALL DISCHARGE INTO A SEDIMENT-RETENTION BMP.
9. MAINTENANCE AND REPAIR OF EROSION AND SEDIMENTATION CONTROL MEASURES. THE CONTRACTOR SHALL MAINTAIN AND REPAIR AS NECESSARY ALL TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROL BMPS TO ASSURE THEIR CONTINUED PERFORMANCE.
10. TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE MAINTAINED UNTIL FINAL SITE STABILIZATION.

ABBREVIATIONS:

0	DIAMETER (SYMBOL)
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWWA	AMERICAN WATER WORKS ASSOCIATION
CPEP	CORRUGATED POLYETHYLENE PIPE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DIST	DISTRIBUTION
DRN	DRAIN PIPE
EA	EACH
EX	EXISTING
FL	FLANGE
GAL	GALLON
GI	GALVANIZED IRON
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
IPT	IRON PIPE THREAD
L	LENGTH
LF	LINEAR FEET
MIN	MINIMUM
MJ	MECHANICAL JOINT
ml	MILLILITER
N/C	NORMALLY CLOSED
N/0	NORMALLY OPEN
NTS	NOTTO SCALE
PPM	PARTS PER MILLION
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
SF	SQARE FEET
SCH	SCHEDULE
SEC	SECTION
SQ	SQUARE
STD	STANDARD
STO	STORAGE
THK	THICKNESS
TYP	TYPICAL
W	WIDTH
W/	WITH
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

SURVEY LEGEND/ADDITIONAL NOTES:

EXISTING

- SANITARY SEWER MANHOLE
- CATCH BASIN
- CULVERT
- STORM DRAIN MANHOLE
- WATER METER
- FIRE HYDRANT
- GATE/GENERAL VALVE
- IRRIGATION CONTROL VALVE
- BLOW OFF
- WATER SPIGOT
- WELL HEAD
- UTILITY POLE ANCHOR
- UTILITY POLE
- LUMINAIRE
- ELECTRICAL METER
- POWER VAULT
- MAILBOX
- TELEPHONE PEDESTAL
- TELEPHONE MANHOLE
- SIGN
- TRAFFIC SIGN
- CONIFER TREE
- DECIDUOUS TREE

ABBREVIATIONS

AFN - AUDITOR'S FILE NUMBER
BLDG - EXISTING BUILDING
CB - CATCH BASIN
CL-CENTERLINE
CONC. - CONCRETE
CMP - CORRUGATED METAL PIPE
CPP - CORRUGATED PLASTIC PIPE
D/W - DRIVEWAY
DEC. - DECIDUOUS
EOA - EDGE OF ASPHALT
EOG - EDGE OF GRAVEL
EX. - EXISTING
FF - FINISHED FLOOR
FH - FIRE HYDRANT
FM - FORCE MAIN
FOG-FOGLINE
G.E. - GRATE ELEVATION
I.E. - INVERT ELEVATION
OP - OVERHEAD POWER
OT - OVERHEAD TELEPHONE
ROW- RIGHT-OF-WAY
SD - STORM DRAIN LINE
SS - SANITARY SEWER LINE
TP - TELEPHONE PEDESTAL
TV - UNDERGROUND TV
TYP. - TYPICAL
UG - UNDERGROUND GAS
UP - UNDERGROUND POWER
UT - UNDERGROUND TELEPHONE
W-WATERLINE

PROJECT LEGEND:

- EX WATERLINE
- PROPOSED WATERLINE
- EX FENCE
- PROPOSED FENCE
- STRAW WATTLES
- PROPOSED DRAIN PIPE
- EX GATE VALVE
- PROPOSED GATE VALVE
- PROPOSED MJ BEND W/ THRUST BLOCKING
- PROPOSED FL BEND
- GRAVEL
- GRASS LINED CHANNEL

LEED AP

DCG civil structural

CALL 811
2 BUSINESS DAYS BEFORE YOU DIG

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE. OTHER EXISTING FEATURES/CONDITIONS IF CONDITIONS ARE NOT AS SHOWN & IF PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
NOTES & ABBREVIATIONS

PROJ. MANAGER	RLB
DESIGNED BY	SD
DRAWN BY:	JS
CHECKED BY:	RLB
SCALE:	AS SHOWN
DATE:	7/25/2022

SHEET NUMBER
CO2

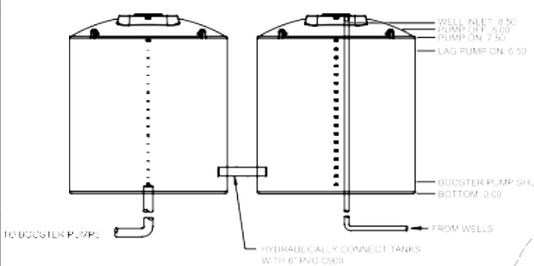
SCALE IN FEET

KEY NOTES:

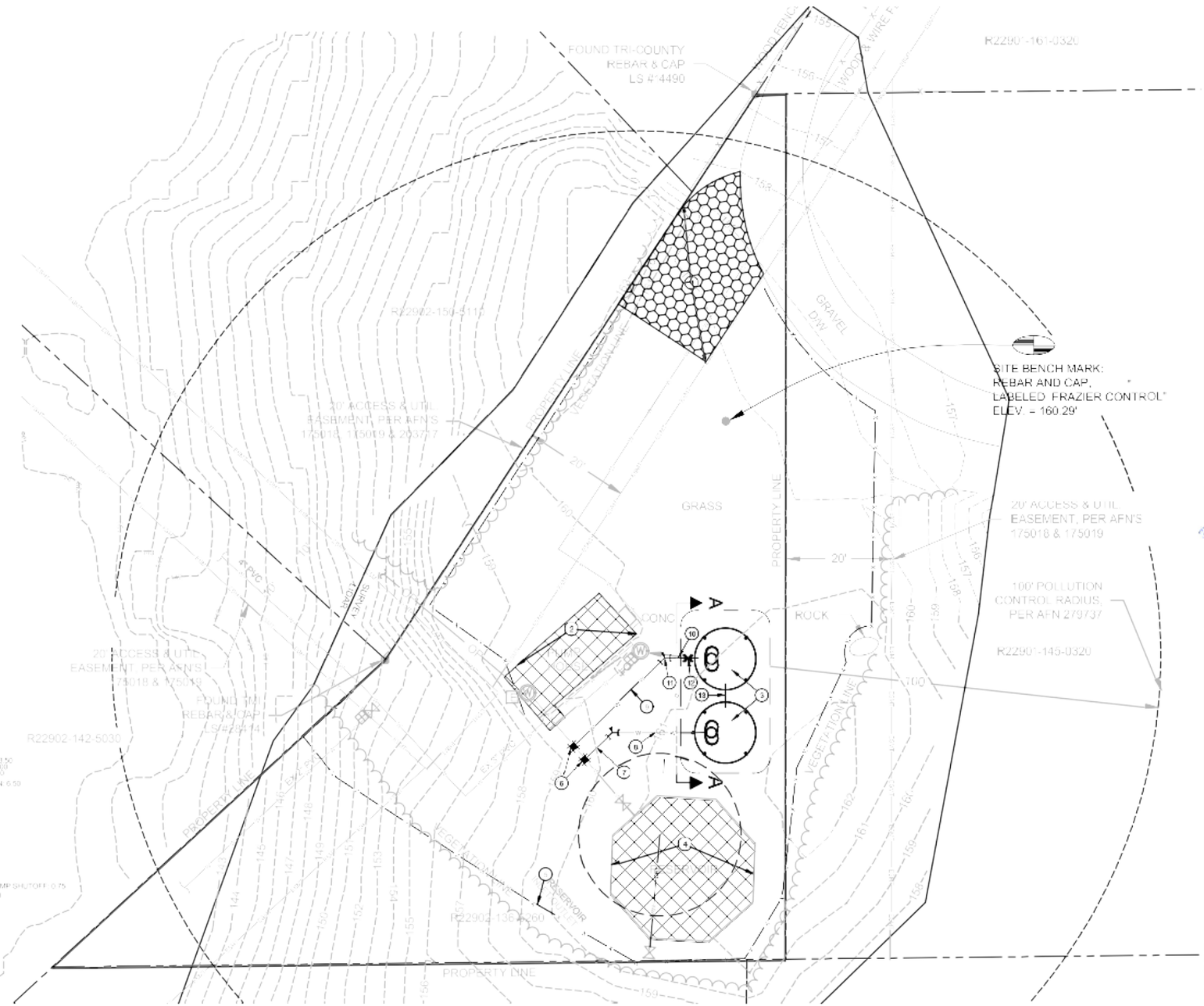
KEY	NOTE:	DETAIL/ SHEET
1	CONSTRUCTION ENTRANCE	6/C08
2	EXISTING PUMPHOUSE TO BE DEMOLISHED AFTER PROPOSED PUMPHOUSE AND COMPONENTS ARE FULL OPERATIONAL	-
3	(2) 5,000 GALLON STORABLE TANKS (MINIMUM OF 10,000 GALLONS TOTAL) WATER STORAGE TO BE PROVIDED FOR TEMPORARY STORAGE THROUGHOUT CONSTRUCTION UNTIL NEW RESERVOIR IS FULLY OPERATIONAL.	-
4	DEMOLISH EXISTING RESERVOIR AFTER DEMOLITION, BUT PRIOR TO BACKFILLING, CONTRACTOR TO CONTACT GEOTECH TO EVALUATE THE SUBGRADE SOIL BENEATH. SEE CONTACT INFO ON COVERSHEET. THEN BACKFILL WITH STRUCTURAL FILL TO MATCH EX SURROUNDING GRADE (PER GEOTECH REPORT OR UPDATED GEOTECH RECOMMENDATIONS AS NECESSARY).	-
5	SILT FENCE AS NEEDED FOR EROSION CONTROL	7/C09
6	CONNECT TO EXISTING RESERVOIR FILL LINE FROM WELL 1 AND WELL 2. COUPLERS, FITTINGS, AND ADAPTERS AS NECESSARY TO CONNECT.	-
7	TEMP RESERVOIR FILL LINE 3" I.P.S. PVC SCH	1/C08
8	TEMP RESERVOIR FILL LINE 3" I.P.S. PVC SCH (INSTALL AT THE LOWEST ELEVATION)	1/C08
9	TEMP BOOSTER PUMP SUCTION LINE 2" I.P.S. PVC SCH	1/C08
10	TEMP BOOSTER PUMP SUCTION LINE 3" I.P.S. PVC SCH	1/C08
11	(1) 6" 45° BEND W/ (1) CONCRETE THRUST BLOCK	3/C08
12	6" TEMP ISOLATION VALVE	-
13	HYDRAULICALLY CONNECT TANKS/RESERVOIRS WITH 6" PVC SCH 40 PIPE	-

PHASING NOTES:

PHASE THE CONSTRUCTION OF NEW AND TEMPORARY FACILITIES TO ALLOW THE CONTINUED OPERATION OF THE WATER SYSTEM.



TEMPORARY STORAGE CROSS-SECTION DETAIL A-A (C03)
NOT TO SCALE



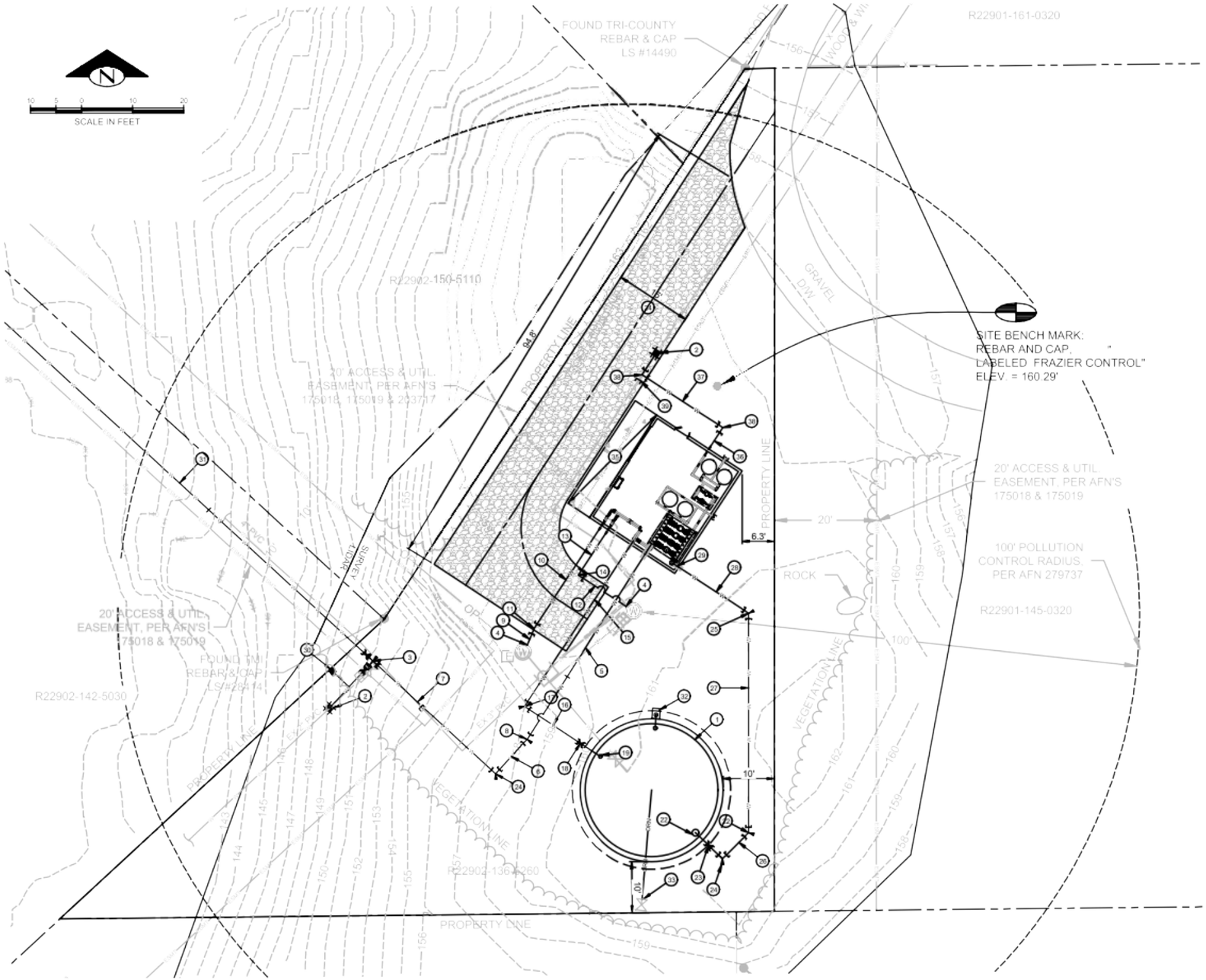
DEMO PLAN - PUMPHOUSE SITE
SCALE: AS SHOWN

CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
DEMO PLAN - PUMPHOUSE SITE

SHEET NUMBER
C03

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	PROPOSED 26-FT DIAMETER x 20-FT TALL 79,000-GALLON CONCRETE RESERVOIR STRUCTURAL PLANS AND PERMIT FROM RESERVOIR CONTRACTOR	-
2	CONNECT TO EX 2" WATER MAIN. USE COUPLERS AND ADAPTERS AS NECESSARY FOR CONNECTIONS	-
3	(1) 8" TEE (FL) (1) 8" GATE VALVE (FLxMJ) (1) 8" BLIND FLANGE w/ 2" TAP (1) 2" GATE VALVE (MJ) (1) 8" FLxMJ ADAPTER CONC THRUST BLOCKS	3,5/C08
4	CONNECT TO EXISTING LINE FROM WELL COUPLERS, FITTINGS, AND ADAPTERS AS NECESSARY TO CONNECT	-
5	44 LF 8" PVC C900 WATER MAIN	1/C08
6	9 LF 8" PVC C900 WATER MAIN	1/C08
7	33 LF 8" PVC C900 WATER MAIN	1/C08
8	8" 11.25° BEND (MJ) CONCRETE THRUST BLOCK	3/C08
9	4 LF 2" PVC SCH 80 - WELL 1 FEED LINE TO PUMPHOUSE	1/C08
10	25 LF 2" PVC SCH 80 - WELL 1 FEED LINE TO PUMPHOUSE	1/C08
11	(1) 2" 11.25° BEND (PO) - WELL 1 FEED LINE TO PUMPHOUSE	-
12	10 LF 2" PVC SCH 80 - WELL 2 FEED LINE TO PUMPHOUSE	1/C08
13	12 LF 2" PVC SCH 80 - WELL 2 FEED LINE TO PUMPHOUSE	1/C08
14	(1) 2" 90° BEND (PO) - WELL 2 FEED LINE TO PUMPHOUSE	-
15	39 LF 4" PVC C900 RESERVOIR FILL LINE	1/C08
16	12 LF 4" PVC C900 RESERVOIR FILL LINE	1/C08
17	4" 90° BEND (MJ) CONCRETE THRUST BLOCK	3/C08
18	4" GATE VALVES (MJ)	5/C08
19	NEW 4" DI RESERVOIR FILL PIPE TO BE ROUTED VERTICALLY INSIDE RESERVOIR AND FILL RESERVOIR FROM TOP. AERATION NOZZLES/MANIFOLD WITHIN EXISTING RESERVOIR WILL BE MATCHED/RE-INSTALLED IN-KIND	-
20	NOT USED	-
21	NOT USED	-
22	8" RESERVOIR OUTLET	-
23	8" GATE VALVE (MJ)	5/C08
24	8" 90° BEND (MJ) CONC THRUST BLOCKS	3/C08
25	8" 45° BEND (MJ) CONC THRUST BLOCKS	3/C08
26	7 LF 8" PVC C900 SUCTION LINE	1/C08
27	42 LF 8" PVC C900 SUCTION LINE	1/C08
28	15 LF 8" PVC C900 SUCTION LINE	1/C08
29	5 LF 8" PVC C900 SUCTION LINE	1/C08
30	INSTALL NEW 1" SERVICE METER WITH METER	8/C09
31	SEE SHEET C05 FOR WATER MAIN IN EASEMENT	-
32	SPLASH BLOCK FOR RESERVOIR OVERFLOW	-
33	CONNECT TO EXISTING DRAIN LINE AT VALVE	-
34	INSTALL 15' WIDE GRAVEL ACCESS DRIVE	9/C09
35	INSTALL 5' WIDE CONCRETE PATIO ALONG FRONT OF BUILDING	11/C09
36	5 LF 2" PVC SCH 80 WATER MAIN	1/C08
37	5 LF 2" PVC SCH 80 WATER MAIN	1/C08
38	(1) 2" 90° BEND (PO)	-
39	CAP EXITING 2" WATER MAIN	-



IMPROVEMENT PLAN - PUMPHOUSE SITE
SCALE AS SHOWN

REVISION | BY | DATE | No.

LEED AP

DCG civil structural

P.O. Box 1132
Freeland, WA 98249
P: 360.331.1131
F: 360.331.1133
www.dcgeng.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

BASIS MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX. FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

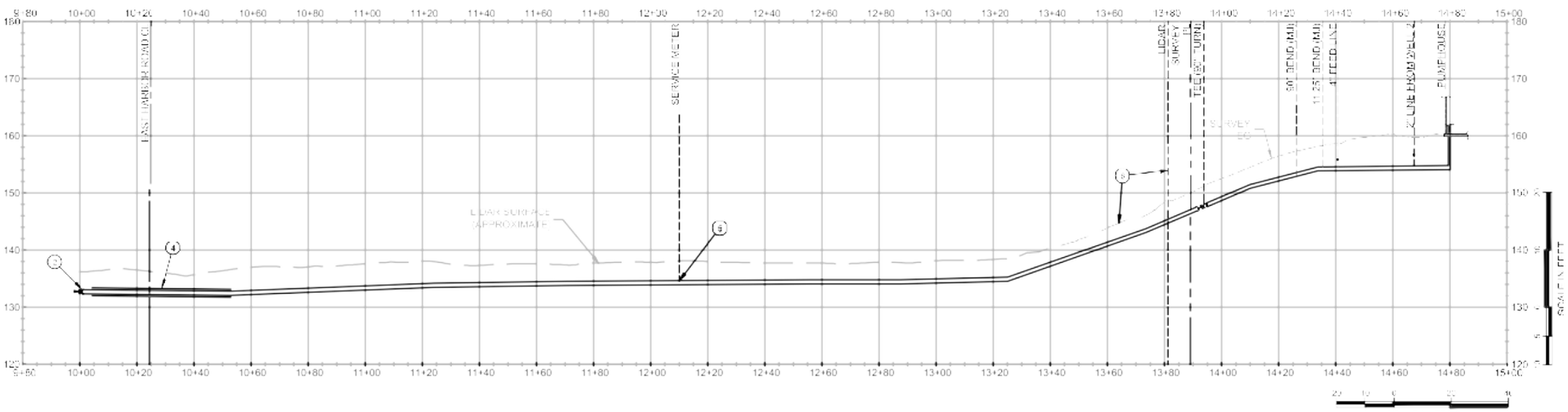
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
IMPROVEMENT PLAN - PUMPHOUSE SITE

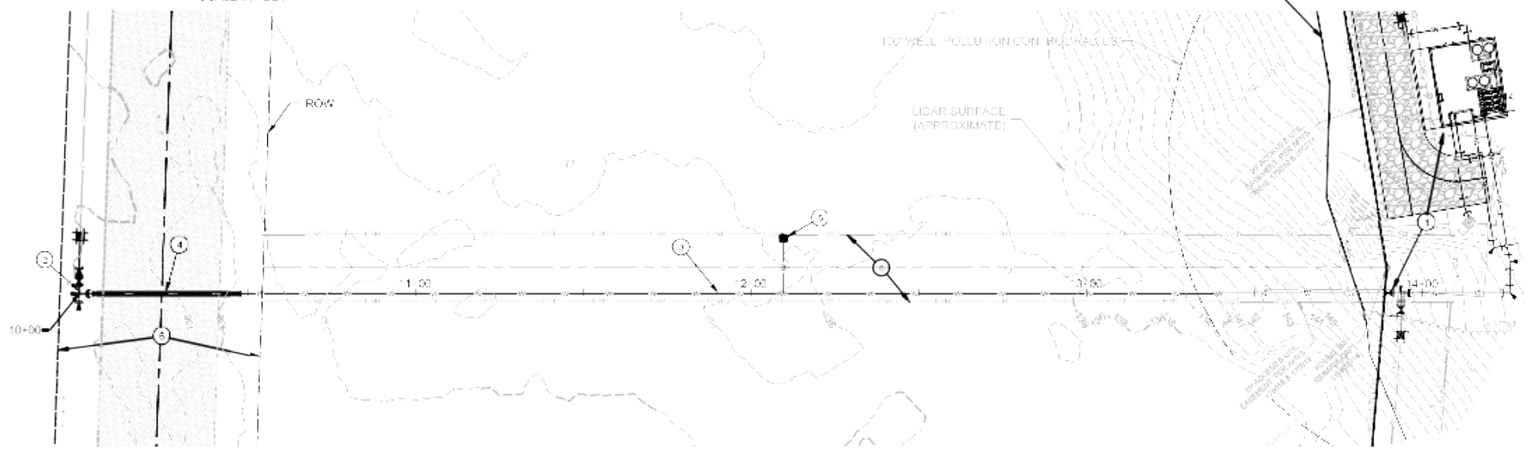
PROJ. MANAGER	RLB
DESIGNED BY	TD
DRAWN BY	JS
CHECKED BY	RLB
SCALE	AS SHOWN
DATE	7/25/2022
REV.	-
SHEET OF	OF

SHEET NUMBER
C04

CAD FILE NUMBER: P:\CLIENTS\WATER\CASCADIA\WATER SYSTEM\DCG\WATERWORKS\PROJECTS\IMPROVEMENTS\DWG\DRAWINGS\CAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS | SAVE DATE: 7/22/2022 4:03 PM | SHEET SET: CAL WATERWORKS SYSTEM IMPROVEMENTS_20 | ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



PROFILE - EASEMENT WATER REPLACEMENT
SCALE AS SHOWN



PLAN - EASEMENT WATER REPLACEMENT
SCALE AS SHOWN

KEY NOTES:

KEY	NOTE	DETAIL/ SHEET
1	SEE KEY NOTES 5 & 6 FOR CONNECTION TO UTILITY PARCEL PIPING	-
2	(1) 6" TEE, (1) 6" GATE VALVE, (1) 6" CAP, (1) 6"x4" REDUCER, (1) 4" x 6" FLANGE ADAPTER CONCRETE THRUST BLOCKS CONNECT TO EXIST WATER MAIN. USE COUPLERS AND ADAPTERS AS NECESSARY FOR CONNECTION.	-
3	INSTALL 200' OF 4" DIP WATER MAIN WITH 3' COVER DEPTH	1/C08
4	INSTALL BORE IN 8" HDPE CASING PIPE	2/C08
5	INSTALL NEW SERVICE LINE WITH METER. LOCATE AND CONNECT TO EXISTING SERVICE TO RESIDENCE	3/C08
6	UTILITIES, UTILITIES SURFACE ELEVATIONS AND STRUCTURES NOT SURVEYED OUTSIDE OF SURVEY BOUNDARY. LIDAR ELEVATIONS ARE APPROXIMATE PROTECT EXISTING UTILITIES.	-

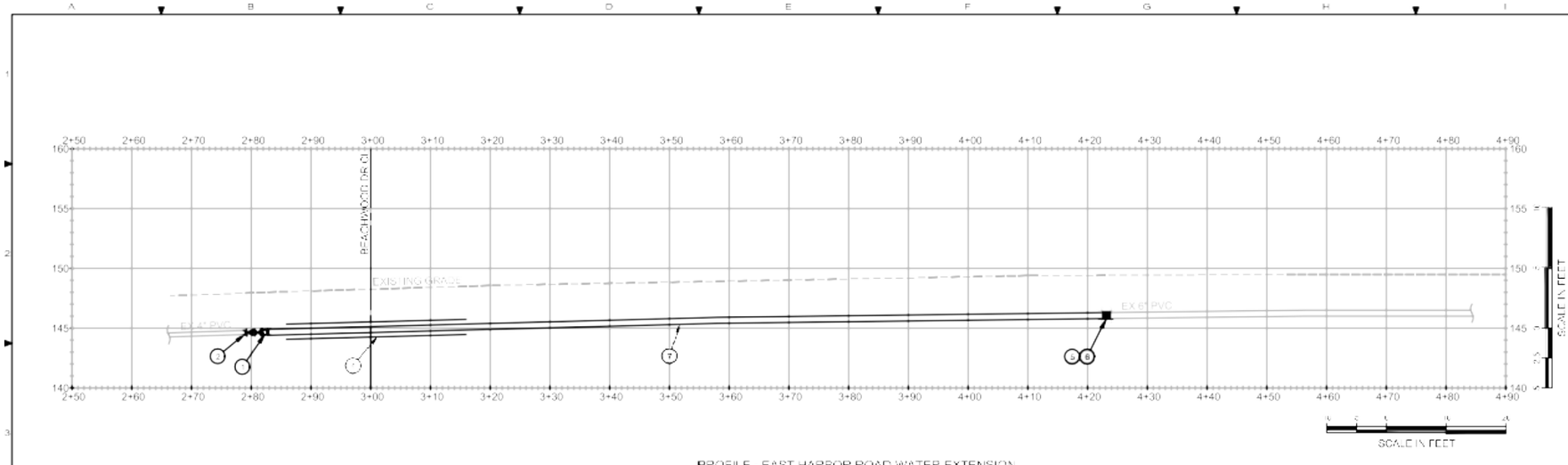
CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

CASCADIA WATER
PO BOX 549
FREELAND WA 98249

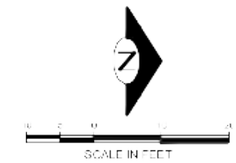
CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
PLAN & PROFILE - EASEMENT

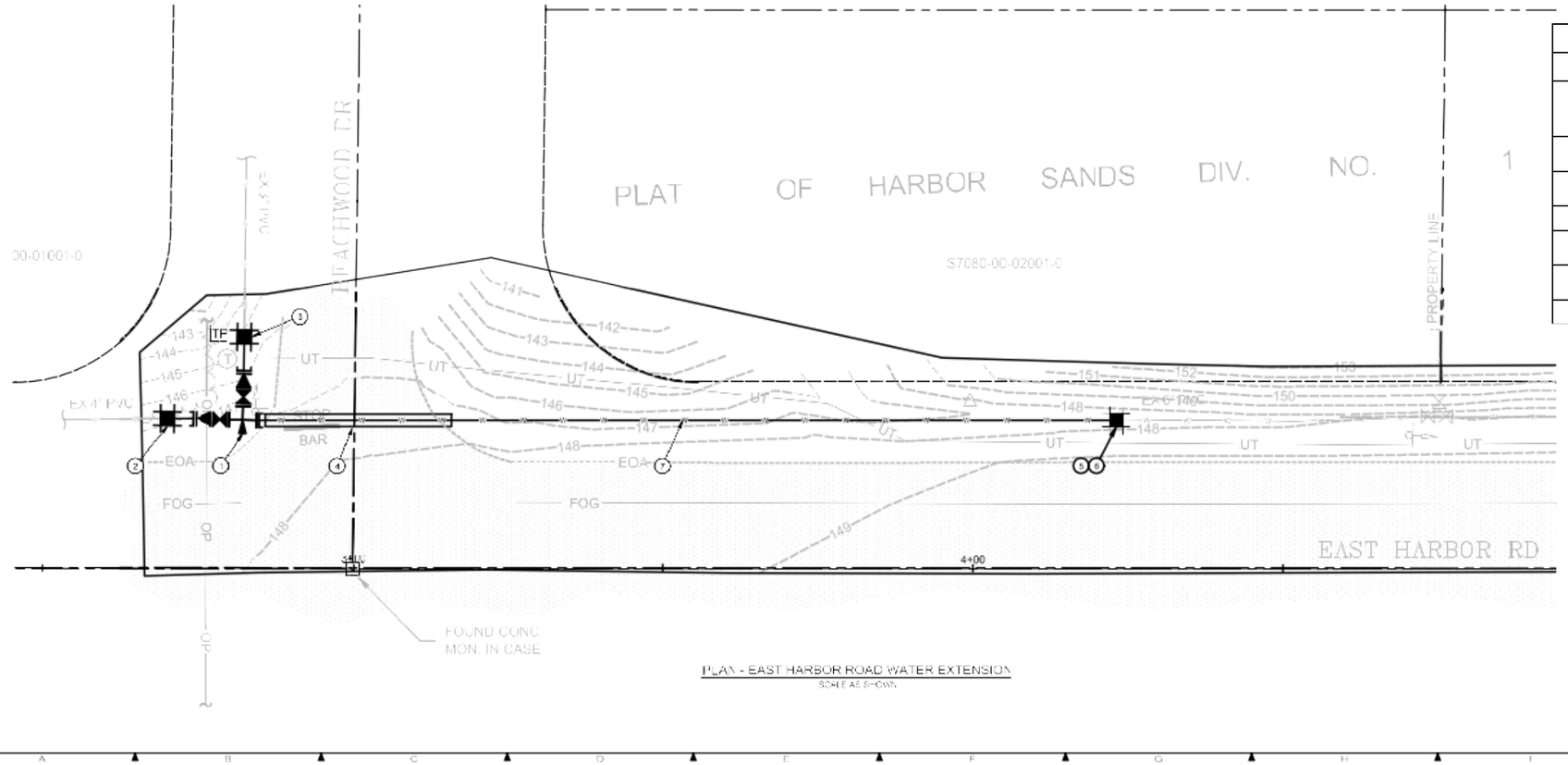
C05

CAD FILE NUMBER: P:\CLIENTS\WATER\CASCADIA\WATER SYSTEM\CAL WATERWORKS\PROJECTS\PUMPHOUSE\DRAWINGS\CAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS | SAVE DATE: 7/22/2022 6:03 PM | SHEET SET: CAL WATERWORKS SYSTEM IMPROVEMENTS_20 | ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



PROFILE - EAST HARBOR ROAD WATER EXTENSION
SCALE AS SHOWN





PLAN - EAST HARBOR ROAD WATER EXTENSION
SCALE AS SHOWN

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	(1) 6" TEE (FL) (2) 6" GATE VALVE (1) 6"x4" REDUCER (FLXFL) (1) 6"x4" REDUCER (FLXFL) CONCRETE THRUST BLOCKS	4/C08 5/C08
2	TIE INTO EX 6" WATER MAIN. USE COUPLERS AND ADAPTERS AS NECESSARY FOR CONNECTION	-
3	TIE INTO EX 6" WATER MAIN. USE COUPLERS AND ADAPTERS AS NECESSARY FOR CONNECTION	-
4	SOLE PLATE W/ PIPE/STEEL CASING PIPE	2/C08
5	APPROXIMATE WATER MAIN STUB LOCATION SHOWN, CONTRACTOR TO LOCATE IN FIELD.	-
6	TIE INTO EX 6" WATER MAIN. USE COUPLERS AND ADAPTERS AS NECESSARY FOR CONNECTION	-
7	6"x45° PVC CAP	1/4/C08

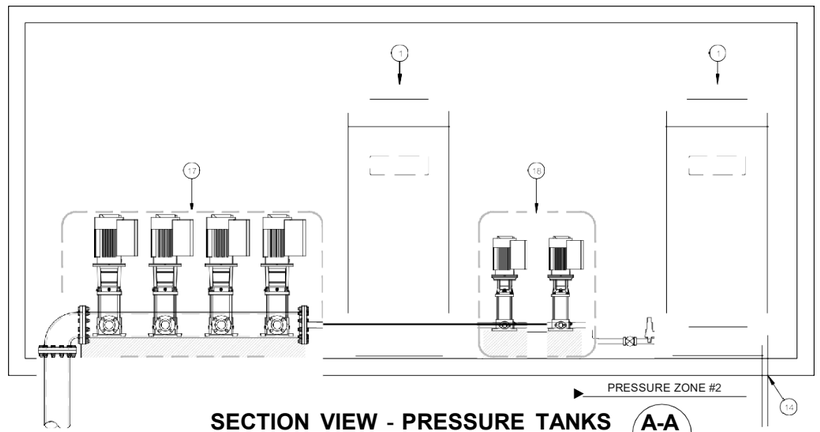
CAL 811
2 BUSINESS DAYS
BEFORE YOU DIG

CASCADIA WATER
PO BOX 549
FREELAND WA 98249

CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PILASAN FARM LANE, FREELAND WA 98249
PLAN & PROFILE - EAST HARBOR ROAD

C06

CAD FILE NUMBER P:\CLIENTS\WATER\CASCADIA\WATER PUSTEM\CAL WATERWORKS\PROJECTS\PUMP HOUSE\DWG\DRAWINGS\CAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS - SAVE DATE: 7/22/2022 6:03 PM - SHEET SET: CAL WATERWORKS SYSTEM IMPROVEMENTS_20 - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



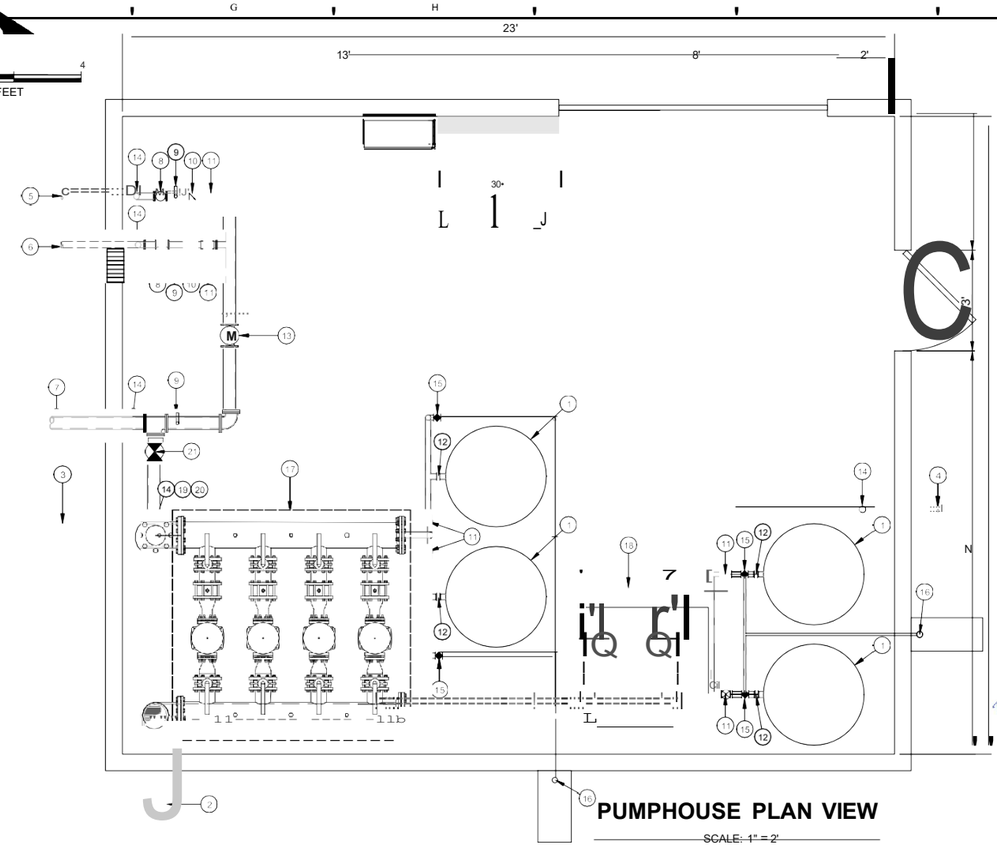
SECTION VIEW - PRESSURE TANKS A-A CO?

NTS

COMBINATION AIR/VACUUM RELEASE B-B CO?

NTS

SCALE IN FEET



PUMPHOUSE PLAN VIEW

SCALE: 1" = 2'

KEY NOTE TABLE

NUMBER	NOTE	DETAIL
G)	317-GALLON PRESSURE TANK	
0	8" DUCTILE IRON SUCTION LINE FROM RESERVOIR	
G)	8" DUCTILE IRON DISTRIBUTION LINE TO PRESSURE ZONE #1 RESTRAIN JOINTS AS NECESSARY	
©	2" PVC SCH 80 DISTRIBUTION LINE TO PRESSURE ZONE #2 SUPPORT PIPES AS NECESSARY	
@	2" PVC SCH 80 LINE FROM WELL 1	
©	2" PVC SCH 80 LINE FROM WELL 2	
0	4" RESERVOIR FILL LINE	
©	1" SOURCE METER	
0	SAMPLE TAP	
@	2" CHECK VALVE	
@	1" BALL VALVE	
@	1"COUPLER	
@	2" SOURCE METER	
@	PIPING THROUGH FLOOR. GROUT AROUND PIPE AS NEEDED.	10/C09
@	3/4" PRESSURE RELIEF VALVE PRV MUST BE ASME SECTION VIII PLUMB TO EXTERIOR AS SHOWN	

NUMBER	NOTE	DETAIL
	FINISH PVC PIPING WITH 90° TURNED DOWN. PLACE 24 MESH SCREEN OVER END. FINISH PIPING APPROX. 12-IN ABOVE SPLASH BLOCK.	
@	PRESSURE ZONE #1: INSTALL BOOSTER PUMPS AND SECURE TO THE FLOOR. BOOSTER PUMPS TO INCLUDE: (4)- 10 HP GRUNDFOS BOOSTER PUMPS CR 32-2 A-G-A-E-HQQE (OR EQUIVALENT) PROVIDE WITH EACH PUMP: (2)-4" ISOLATION VALVES ON INLET AND DISCHARGE (1)-4" CHECK VALVE ON OUTLET (1)-8" DI PRESSURE MANIFOLD (2)- PRESSURE GAUGES (1)-VAL-MATIC AIRNACUUM RELEASE VALVE MODEL 100S OR EQUIVALENT (3)- PRESSURE CONTROL SWITCHES (ON/OFF) WI ALTERNATING LEAD/LAG PUMPS: 60175 PSI (LEAD) 55170 PSI (LAG 1) 50165 PSI (LAG 2) 45160 PSI (LAG 3) (1)-VAL-MATIC AIR RELEASE VALVE MODEL 15A OR EQUIVALENT	
@	PRESSURE ZONE #2: INSTALL BOOSTER PUMPS AND SECURE TO THE FLOOR. BOOSTER PUMPS TO INCLUDE: (2)- 3HP GRUNDFOS CENTRIFUGAL BOOSTER PUMPS CR 5-9-3PH (OR EQUIVALENT) PROVIDE WITH EACH PUMP: (2)-2" ISOLATION VALVES ON INLET AND DISCHARGE (2)-2" CHECK VALVE ON OUTLET (1)- 2" DI PRESSURE MANIFOLD (2)- PRESSURE GAUGES (1)-VAL-MATIC AIRNACUUM RELEASE VALVE MODEL 100S OR EQUIVALENT (3)- PRESSURE CONTROL SWITCHES (ON/OFF) WI ALTERNATING LEAD/LAG PUMPS: 85195 PSI (LEAD) 80190 PSI (LAG) (1)-VAL-MATIC AIR RELEASE VALVE MODEL 15A OR EQUIVALENT	
	8"TEE 8" FL CAP WITH 2" TAP NPT 2" ADAPTER 2" PIPE 2" 90 BEND	
20	AIR RELEASE VALVE	
21	2" BALL VALVE (NC) FOR RESERVOIR BYPASS	
22	2" BALL VALVE (NO)	

ACRONYMS & THE LEGACY LEED AP LOGO ARE TRADEMARKS

LEED AP

Freeland, WA 98249

DCG civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

Robert L. Bailey
Digitally signed by Robert L. Bailey
Date: 2022.07.27 10:17:27 -07'00'

THESE INSTRUMENTS ARE THE PROPERTY OF DCG CIVIL STRUCTURAL AND MAY NOT BE USED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN. go to RHOK TO

CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
PUMPHOUSE IMPROVEMENTS

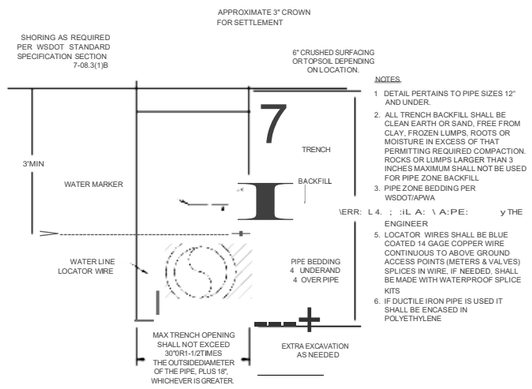
OWNER:
PROJECT:

PROJ. MANAGER	RLB
DESIGNED BY:	SD
DRAWN BY	JS
CHECKED BY	RLB
SCALE:	AS SHOWN
DATE: 7127/2022	REV: 1 OF 1-JUL

SHEET NUMBER
C07

WATER MAIN TRENCHING (UNPAVED) 1 VARIES

NTS

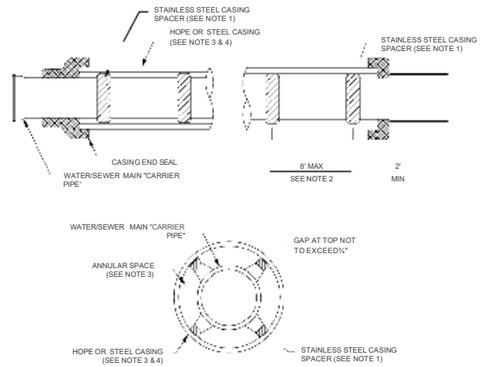


NOTES:

1. DETAIL PERTAINS TO PIPE SIZES 12" AND UNDER.
2. ALL TRENCH BACKFILL SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, FROZEN LUMPS, ROOTS OR MOISTURE IN EXCESS OF THAT PERMITTING REQUIRED COMPACTION. ROCKS OR LUMPS LARGER THAN 3 INCHES MAXIMUM SHALL NOT BE USED FOR PIPE ZONE BACKFILL
3. PIPE ZONE BEDDING PER WSDOT/APWA
4. \ERR: L4. ; :IL A: \A:PE: y THE ENGINEER
5. LOCATOR WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & VALVES) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS
6. IF DUCTILE IRON PIPE IS USED IT SHALL BE ENCASED IN POLYETHYLENE

WATER MAIN CASING PIPE 2 VARIES

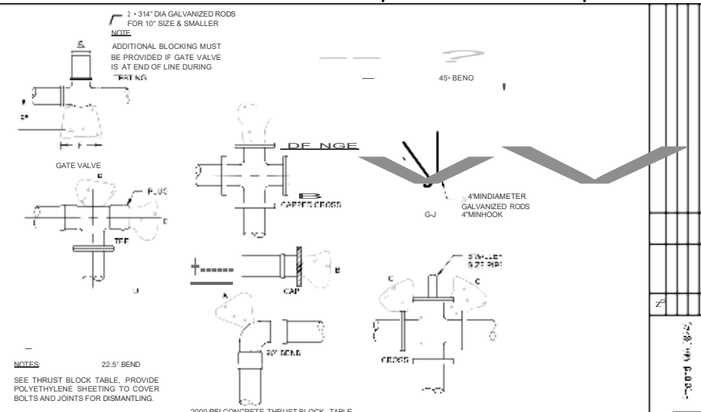
NTS



1. CASING SPACERS SHALL BE CENTER RESTRAINED POSITION TYPE.
2. INSTALL A MINIMUM OF 3 SPACERS PER 20 FEET OF CARRIER PIPE SECTION EQUALLY SPACED
3. THE ANNULAR SPACE BETWEEN THE CARRIER PIPE AND THE CASING SHALL NOT BE FILLED WITH ANY MATERIAL UNLESS OTHERWISE NOTED ON PLANS.
4. IN AREAS WHERE A STEEL CASING IS TO BE USED, THE INSTALLATION SHALL INCLUDE AN ANODE AND/OR A TEST STATION
5. INSTALL WARNING/IDENTIFICATION TAPE AND TRACER WIRE.

WATER MAIN THRUST BLOCKING 3 VARIE

NTS



2000 PSI CONCRETE THRUST BLOCK- TABLE

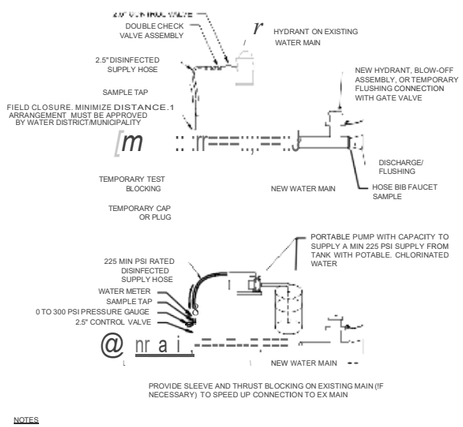
PIPE SIZE	MIN. BEARING AGAINST UNDISTURBED SOIL A-90° (SF)	B-TEE* (SF)	C-45° (SF)	D - 22.5° (SF)	E -11.25° (SF)	F-GV* (SF)	VERTICAL THRUST BLOCKING A-90° (CY)	A-90° (CY)	A-90° (CY)	A-90° (CY)
4"	4	4	4	4	4					
6"	10	7	6	3	2		2			
8"	18	12	10	5	3	3	4	2		
10"	24	22	14	8	5	4	8	3		

NOTES

1. BEARING AREA OF CONCRETE THRUST-BLOCK BASED ON 250 PSI PRESSURE AND SAFE SOIL BEARING LOAD OF 1,000 POUNDS PER SQUARE FOOT.
2. AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZES, PRESSURES AND SOIL CONDITIONS.
3. CONCRETE BLOCKING SHALL BE CAST IN PLACE AND HAVE A MINIMUM OF 36 SQUARE INCHES BEARING AGAINST THE FITTING
4. BLOCK SHALL BEAR AGAINST FITTINGS ONLY AND SHALL BE CLEAR OF JOINTS TO PERMIT TAKING UP OR DISMANTLING OF JOINT
5. CONTRACTORS SHALL INSTALL BLOCKING ADEQUATE TO WITHSTAND FULL TEST PRESSURE AS WELL AS TO CONTINUOUSLY WITHSTAND OPERATION PRESSURE UNDER ALL CONDITIONS OF SERVICE. TEST NOT TO EXCEED 250 PSI AT LOWEST POINT.

WATER **MAIN** FILLING DETAIL 4 VARIES

NTS

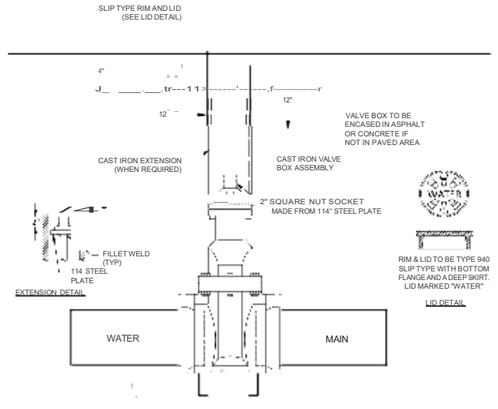


NOTES

1. THE FILLING OF MAINS SHALL BE DONE ONLY UNDER THE SUPERVISION OF THE WATER PURVEYOR.
2. AN APPROVED BACKFLOW PREVENTION ASSEMBLY SHALL BE INSTALLED BETWEEN THE EXISTING AND NEW WATER LINES DURING DISINFECTION AND FLUSHING OF NEW WATERMAIN
3. THE BACKFLOW PREVENTION ASSEMBLY AND SUPPLY HOSE MUST BE DISCONNECTED DURING HYDROSTATIC PRESSURE TESTING OF THE NEW MAIN.
4. THE NEW WATERMAIN SHALL BE CONNECTED TO THE EXISTING SYSTEM ONLY AFTER NEW MAIN IS FLUSHED, DISINFECTED AND SATISFACTORY BACTERIOLOGICAL SAMPLE RESULTS ARE OBTAINED.
5. THE INTERIORS OF ALL PIPES AND FITTINGS TO BE USED IN FINAL CONNECTION MUST BE SWABBED OR SPRAYED WITH A 5% AVAILABLE CHLORINE SOLUTION.
6. PROVIDE TEMPORARY TAPPED TEE, PLUG AND THRUST BLOCK. EXCAVATE 1 FOOT BELOW MAIN (MINIMUM) AND PROVIDE GRAVEL WORKING FLOOR FOR FIELD CLOSURE. FIELD CLOSURE SHALL NOT BE INSTALLED UNTIL APPROVED BY THE WATER PURVEYOR (AFTER A SATISFACTORY BACTERIOLOGICAL REPORT)
7. MINIMUM CHLORINE LEVEL AFTER 24 HOUR RETENTION SHALL BE 25 mg/L. DE-CHLORINATE ALL WATER FLUSHED FROM MAINS
8. MINIMUM PRESSURE SHALL BE 225 PSI. PRESSURE SHALL BE MAINTAINED FOR 2 HOURS WITH LESS THAN 10 PSI DROP IN PRESSURE AND LESS THAN 1 GALLON OF MAKEUP WATER.

WATER MAIN GATE VALVE 5 VARIES

NTS

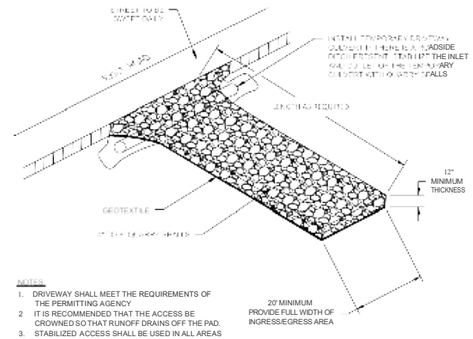


NOTES:

1. VALVE BOXES SHALL BE CENTERED DIRECTLY OVER THE VALVE NUT IN A VERTICAL POSITION.
2. VALVE BOX TOP SHALL BE ADJUSTED TO MEET FINISHED GRADE.
3. EXTENSION PIECES MUST FIT INTO THE TOP SECTION OF THE VALVE BOX AND OVER THE BOTTOM SECTION OF THE VALVE ASSEMBLY.
4. ALIGN PICK HOLES SLOTS OF THE RIM TO BE ALIGNED WITH DIRECTION OF THE WATER MAIN
5. SEE THRUST BLOCK DETAIL FOR ADDITIONAL SPECIFICATIONS

EROSION CONTROL: TEMP CONSTRUCTION ENTRANCE 6 C03

NTS



NOTES

1. DRIVEWAY SHALL MEET THE REQUIREMENTS OF THE PERMITTING AGENCY
2. IT IS RECOMMENDED THAT THE ACCESS BE CROWNED SO THAT RUNOFF DRAINS OFF THE PAD.
3. STABILIZED ACCESS SHALL BE USED IN ALL AREAS OF THE SITE WITH VEHICLE TRAFFIC AND PARKING, INCLUDING PLANTING STRIPS RECYCLED CONCRETE IS NOT ALLOWED

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR OTHER EXISTING CONDITIONS OR CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN. CONTACT DCG PRIOR TO CONSTRUCTION.

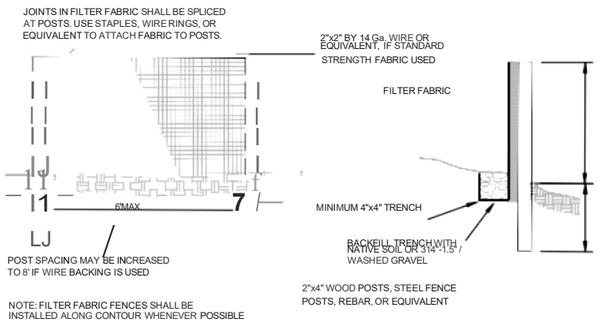
CASCADIA WATER
PO BOX 549
FRFFI ANO, WA 98249

C/AL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
DETAILS 1-6

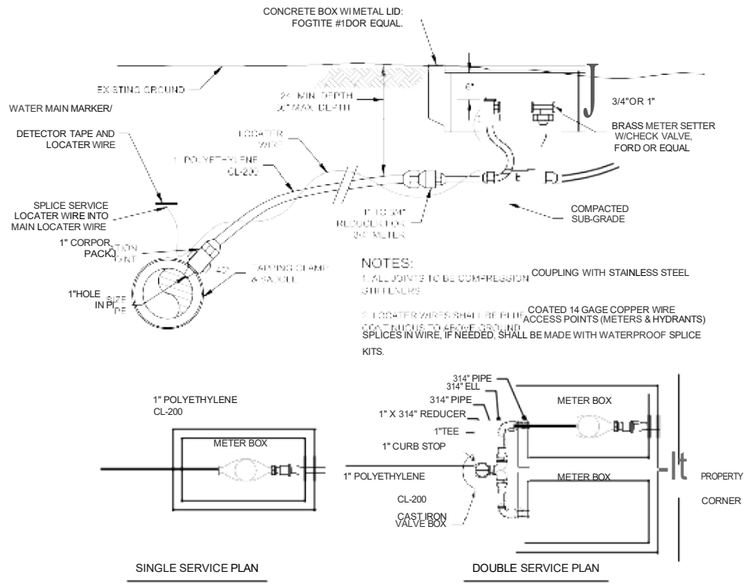
PROJ. MANAGER	RLB
DESIGNED BY	SD
DRAWN BY:	JS
CHECKED BY:	RLB
SCALE:	AS SHOWN
DATE: 7/25/2022	REV SHEET: JL OF -IL

SHEET NUMBER
COB

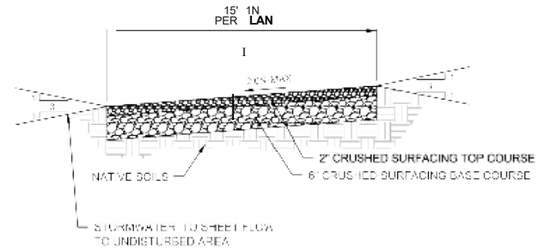
CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIAWATER SYSTEM\COAL WATERWORKS\PROJECTS\PUMPHOUSE\ENGR\MINICIAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS - SAVE DATE: 7/22/2022 6:03 PM - SHEET SET: C/AL WATERWORKS SYSTEM IMPROVEMENTS_20 - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)



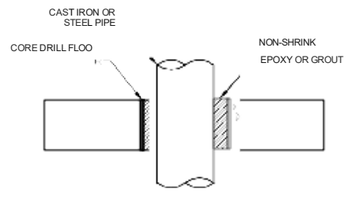
SILT FENCE DETAIL 7
NTS
VARIES



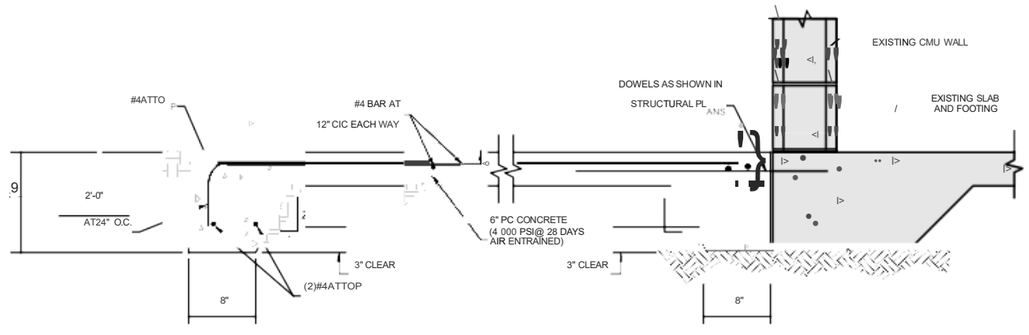
WATER SERVICE DETAIL 8
NTS
VARIES



GRAVEL ROAD SECTION 9
NTS
VARIES



FLOOR PIPE PENETRATION DETAIL 10
NTS
VARIES



CONCRETE SLAB DETAIL 11
NTS
VARIES

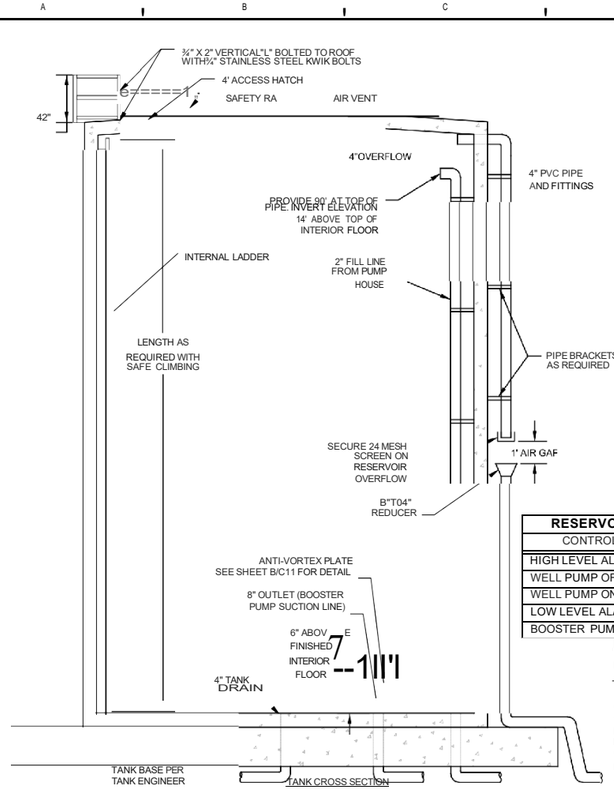
CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG

CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT:
CAL WATERWORKS - SYSTEM IMPROVEMENTS
2030 PHEASANT FARM LANE, FREELAND, WA 98249
DETAILS 7-11

PROJ. MANAGER	RLB
DESIGNED BY	SD
DRAWN BY:	JS
CHECKED BY:	RLB
SCALE:	AS SHOWN
DATE: 7/25/2022	REV

SHEET NUMBER
C0.9



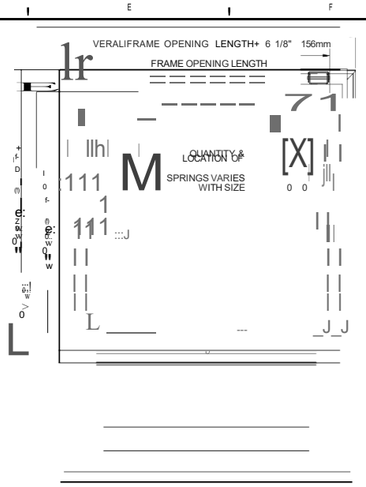
RESERVOIR SET POINTS	
CONTROL POINT	HEIGHT
HIGH LEVEL ALARM	19.5'
WELL PUMP OFF	19.0'
WELL PUMP ON	18.5'
LOW LEVEL ALARM	10.0'
BOOSTER PUMP SHUT-OFF	1.0'

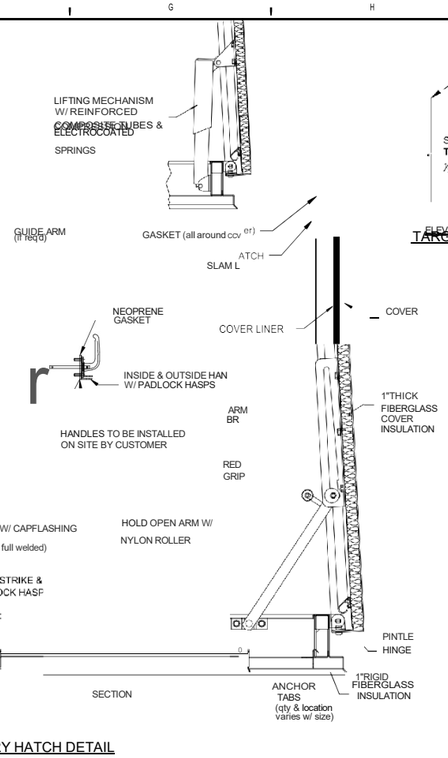
NOTE:

RESERVOIR DESIGN AND STRUCTURAL ENGINEERING IS THE RESPONSIBILITY OF THE RESERVOIR CONTRACTOR. CONTRACTOR TO PROVIDE SITE COMPLIANT DESIGN AND

REQUIRED CONSTRUCTION BUILDING PERMIT FROM ISLAND COUNTY. CONTRACTOR SHALL

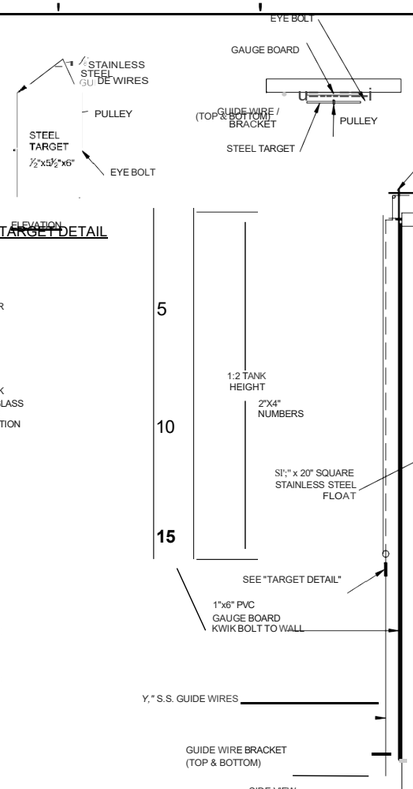
PROVIDE SHOP DRAWINGS FOR ALL DETAILS ON THIS SHEET.





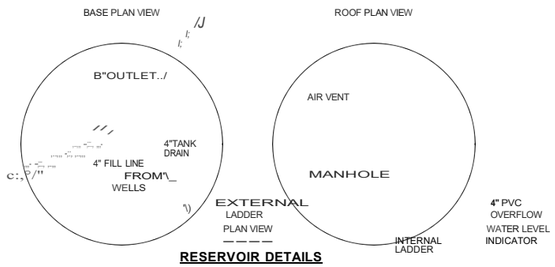
ENTRY HATCH DETAIL

NOTTO SCALE



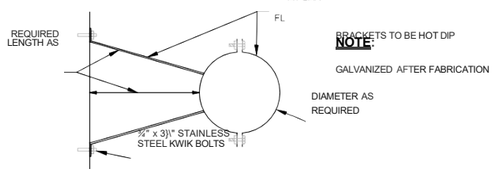
TARGET DETAIL

WATER LEVEL INDICATOR DETAIL

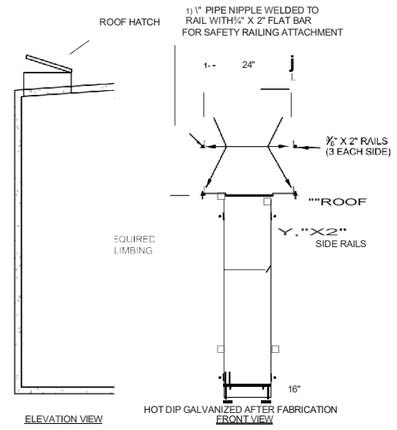


RESERVOIR DETAILS

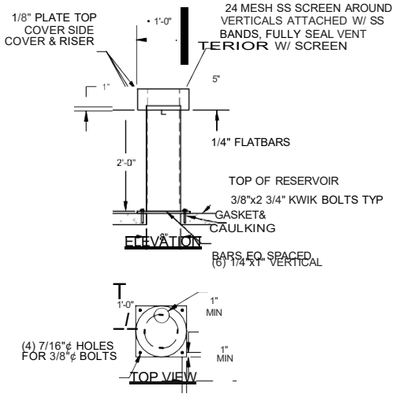
NOTTO SCALE



BRACKETS FOR MOUNTING PIPING TO WALL DETAIL

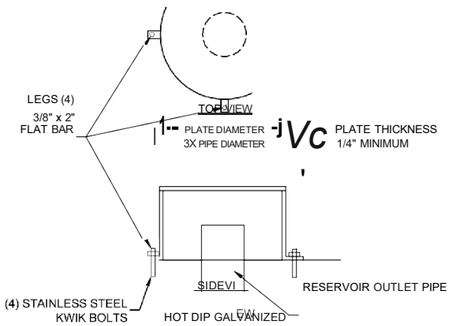


INTERNAL LADDER DETAIL



AIR VENT DETAILS

ANTI-VORTEX PLATE



VORTEX PLATE DETAIL

DCG civil structural
Freeland, WA 98249
CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJ. MANAGER	RLB
DESIGNED BY	SD
DRAWN BY	JS
CHECKED BY:	RLB
SCALE:	AS SHOWN
DATE: 7/25/2022	REV:
SHEET: 1 OF 1	

SHEET NUMBER

C10

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\CAL WATERWORKS\PROJECTS\PUMPHOUSE\DWG\DRAWING\CAL WATERWORKS SYSTEM IMPROVEMENTS_20.DWG
LAST MODIFIED BY: JOSHS - SAVE DATE: 7/22/2022 6:03 PM - SHEET SET: CAL WATERWORKS SYSTEM IMPROVEMENTS_20 - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)

ARSENIC TREATMENT SYSTEM AND RESERVOIR DESIGN PROJECT REPORT

W&B WATERWORKS 1
PWS ID # 46670 3

Freeland, WA 98249

November 2022

System Contact:
Cascadia Water, LLC.
Culley Lehman
PO Box 549
Freeland, WA 98249
Phone: (360) 331-7388

For Submittal to:
Washington State
Department of Health
Northwest Drinking Water
Operations
20425 72nd Ave. S
Building 2, Suite 310
Kent, WA 98032-2388

Davido Consulting Group
Seattle | Mount Vernon | Whidbey Island | Federal Way
P. O. Box 1132
Freeland, WA 98249
Tel 360.331.4131

CERTIFICATE OF ENGINEER
Arsenic Treatment System and Reservoir Design for W&B Waterworks 1

The technical material and data contained within this report has been prepared by or under the direction of the following registered professional engineer(s), licensed in accordance with the laws of the State of Washington to practice in the State of Washington.

Exp: 04/20/2024

QUICK REFERENCE PROJECT INFORMATION

General Project Information

Water System Name	W&B Waterworks 1
Water System ID Number	46670 3
System Owner	Cascadia Water, LLC
Project Description	Storage Reservoir Design Pilot Testing Results and Arsenic Treatment System Design
Well Site	Island County Parcel R22922-370-5000
Sources	S01 – Well #1: DOE Tag: AGA932 S02 – Well #2: DOE Tag: AGA931 S03 – Well #3: DOE Tag: AGA930 S04 – Well #4: DOE Tag: AGA929
Reservoir and Pumphouse/Treatment Site	Island County Parcel R22922-376-5180
System Contact	Culley Lehman, General Manager, Cascadia Water
System Engineer	Jeff Tasoff, P.E. - Davido Consulting Group, Inc.

Project Summary

System Capacity	536 ERU (Q_i limiting factor)
SWI Approved Connections	521 ERU 478 ERUs W&B & 43 ERUs Del Bay
Proposed Storage	Reinforced Circular Concrete Reservoir (30' Diameter x 35' Tall) – 185,000-gallons
Treatment Objective	Iron and Manganese Removal
Proposed Treatment	225 gpm Oxidation/Filtration System
Reaction Vessels	(2) 30" diameter and 60" tall empty vessel contact tank (8) 30" diameter and 60" tall filters (4.91 ft^2 of surface area per filter)
Media	17.2 ft^3 (42" height) of AS-700 Series Filter Media per filter
Loading Rate	5.7 gpm/ft^2 of media surface area (28.1 gpm/filter)
Backwash Rate	137 gpm/filter (28 gpm/ft^2)
Filter Capacity	16 hours of filter runtime, 215,000 gallons (Well 4)
Proposed Sodium Hypochlorite Injection System	(2) 50- gallon polyethylene chemical storage tank Well 1, Well 2, and Well 3: LMI PD076-A40HI chemical injection pump, 4.5 ppm sodium hypochlorite dosing to achieve desired 1.0 ppm residual on outlet of treatment Well 4 LMI PD076-A40HI chemical injection pump, 5.4 ppm sodium hypochlorite dosing to achieve desired 1.0 ppm residual on outlet of treatment
Proposed Ferric Chloride Injection System	(1) 50- gallon polyethylene chemical storage tank Well 1, Well 2, and Well 3: LMI PD075-A30HI chemical injection pump, 1.5 ppm ferric chloride (equates to 0.51 ppm iron dosing) Well 4 LMI PD075-A30HI chemical injection pump, 2.2 ppm ferric chloride (equates to 0.77 ppm iron dosing)
Proposed Potassium Permanganate Injection System	1) 50- gallon polyethylene chemical storage tank LMI PD075-A30HI chemical injection pump, 0.1 ppm dosing
System Design Values	Average Day Demand (ADD) = 220 gpd/ERU Maximum Day Demand (MDD) = 570 gpd/ERU Peak Hour Demand = 447 gpm (at 536 ERUs)
Source Production	Source (Well ID / Well No) – Approved Capacity S01 (AGA932 / Well #1) – 50 gpm (52 gpm) S02 (AGA931 / Well #2) – 75 gpm S03 (AGA930 / Well #3) – 75 gpm S04 (AGA929 / Well #4) – 75 gpm (125 gpm)
Water Rights	Certificate – Instantaneous Withdrawal (Q_i) – Annual Withdrawal (Q_a) G1-22510C – (Q_i) 225-gpm – (Q_a) 45.0 Acre-Ft G1-24539C – (Q_i) 225-gpm – (Q_a) 105.0 Acre-Ft* G1-23683C – (Q_i) 37.5-gpm – (Q_a) 25.0 Acre-Ft ** * Supplemental to G1-22510 for a total of 150 acre-ft/yr. ** Water right to be transferred from Del Bay to W&B Waterworks 1

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1 PROJECT DESCRIPTION

1.1 Project Description

W&B Waterworks 1 (W&B), Public Water System Identification Number 46670 3, is a water system owned and operated by Cascadia Water located in the southern portion of Whidbey Island in Island County Washington. W&B is in the process of consolidating the Del Bay (ID: 18575K) system which will give W&B a total of 494 active connections. W&B currently has various deficiencies that Cascadia Water, the owner, would like to address to increase system capacity, improve reliability of service, and improve the quality of the provided water. The proposed improvements include the following items:

1. Replacement of storage reservoirs to increase storage capacity.
2. Relocation of storage reservoirs to improve system pressures.
3. Installation of an iron and manganese oxidation and filtration system.
4. Pumphouse installation for system maintenance and improved operations.

The analysis was done in compliance with the Washington State Department of Health (DOH) 2019 Water System Design Manual (Design Manual). The system was evaluated to verify that it meets the following requirements:

- Source & water right capacity
- Adequate standby storage volume for the temporary loss of one of the system's wells
- Adequate capacity to maintain 30 psi of pressure at each service connection.
- Adequate storage and distribution capacity to meet fire demands, while maintaining 20 psi at each service connection
- Reliable operation (not subject to pressure loss or back flow)
- Compliance with system's Water Right Permits/Certificates

The capacity and reservoir sizing calculations indicate that a 30-feet diameter by 35-feet tall concrete reservoir with a storage capacity of 185,000 gallons. This sizing will provide the required and recommended storage components for the System in excess of the listed capacity in this report.

1.2 Existing System Configuration

W&B is currently supplied by four wells. The wells are located on the system owned lot on Roy Road (Island County Parcel R22922-370-5000) at an elevation of approximately 255-feet above sea level. The wells function on a lead/lag orientation with Well 1, followed by Well 3, which is followed by Wells 2 and 4 running simultaneously. The well lot also contains two storage reservoirs and a booster pump for a small high-elevation service area adjacent to the reservoirs. Well operation is controlled by level floats in the one of the reservoirs. Wells 1, 2, and 4 pump into one of the reservoirs while Well 3 pumps into the other reservoir. The reservoirs are intertied and hydraulically equivalent. The system has water right certificates with a combined withdrawal rate of 225-gpm and annual withdrawal of 150 acre-feet per year. A fifth well from Del Bay which will soon be connected as an emergency source. Available information for each well is provided in Table 7.

The W&B water system was previously shown to have physical and legal capacity to serve up to 518 ERUs and is currently approved for 500 ERUs. The analysis in this report shows that, based on current water usage, the system has the capacity to supply 536 ERUs.

Past correspondence with the DOH noted that system capacity is subject to seawater intrusion review under Island County Code (ICC) 8.09.099. W&B is currently consolidating with the Del Bay Water System. As the combination of water systems will not result in a net increase in water removed from the aquifer, Sea Water Intrusion (SWI) limitations do not apply, and the additional approved connections associated

with Del Bay will be added to the existing approved connections okayed by Island County for W&B. This will result in an approved number of connections at 521 ERUs (478 existing W&B ERUs and 43 approved from Del Bay). W&B will pursue the incorporation of the water right from Del Bay into the combined system following the consolidation of the systems. Section 3.4, and its associated subsections, provides a capacity analysis of W&B Waterworks 1 without the Del Bay water right which shows that the system has the capacity for a maximum of 536 ERUs (Equivalent Residential Units).

The source water from the system's wells have elevated levels of iron (Fe), manganese (Mn), and arsenic (As). The source water exceeds the secondary maximum contaminant level (SMCL) for Fe and Mn which are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. The source water does not exceed the MCL for arsenic, but the levels are considered elevated and Cascadia Water would like to proactively treat each of these contaminants. Table 1 includes the concentrations of Fe, Mn, and As taken from pilot tests or available source sample data. See Appendix E for the Pilot Test Report.

Table 1: Source Water Concentrations

Contaminant	MCL/SMCL	Well #1	Well #2	Well #3	Well #4
Iron (Fe)	0.3 mg/L	0.05 mg/L	0.07 mg/L	0.07 mg/L	0.15 mg/L
Manganese (Mn)	0.050mg/L	0.252 mg/L	0.143 mg/L	0.23 mg/L	0.381mg/L
Arsenic (As)	0.010 mg/L	0.0068 mg/L	0.007 mg/L	0.007 mg/L	0.0092 mg/L

2 W&B WATERWORKS 1 CAPACITY ANALYSIS

A capacity analysis was done on W&B to assess the physical capacity of the distribution system. This section provides analysis of the legal and physical capacity of the W&B distribution system The detailed capacity calculations are included in Appendix B. The factors involved in determining the W&B system's capacity include source capacity, existing storage volume, water rights, booster pump system and distribution system capacity. The Washington State Department of Health (DOH) requires that water systems comply with the following design standards:

- Provide peak demand flow rate while maintaining 30 pounds per square inch (psi) at each service connection.
- Have adequate source capacity to meet the maximum day demand.
- Have adequate equalizing storage (ES) volume to meet the peak hour demand (PHD) for 150 minutes.
- Have adequate stand-by storage volume for the temporary loss of the system's source(s)
- Maintain reliable operation (not subject to pressure loss or back flow).
- Comply with system's Water Right Permit(s) / Certificate(s).

The capacity analysis was done according to the standards set forth in the 2019 DOH Water System Design Manual which will be referred to as the Design Manual throughout this report. The analysis shows that W&B has the physical and legal capacity to serve 536 ERUs, limited by the treatment system capacity.

2.1 Water System Demands

Water usage and source production data from 2018 through 2020 was analyzed to determine current design values for the system. The W&B source production and usage is summarized in Table 2. Daily source meter readings were recording starting in 2020.Therefore the figure below indicated by * is the maximum daily source production.

Table 2: Water Production and Usage

Year	Annual Production (gallons)	Annual Usage (gallons)	ADD (gpd/ERU)	Max Monthly Production (gallons)	MMADD (gpd/ERU)	MDD (gpd/ERU)
2018	32,599,102	29,958,784	195	5,502,812	421	568
2019	31,092,287	28,355,939	213	4,750,548	358	484
2020	30,922,513	N/A	209	208,500*	n/a	457

2.1.1 Average Day Demand (ADD)

Average day demand (ADD) is defined as the average usage by a full-time ERU each day in the system. It is typically calculated by total volume of water produced in one year divided by the number of days in the year and the number of ERUs in the distribution system. Using water production data rather than consumption data gives an indication of the actual water required by the system to serve its consumers including distribution system leakage. Water production from 2016-2020 was analyzed to determine current design values for the system. The overall ADD of 213 gpd/ERU was found using data from the year 2019; this value was rounded up to be 220 gpd/ERU. See Table 2 for past water usage values and water system calculations.

2.1.2 Maximum Day Demand (MDD)

Maximum day demand (MDD) is ideally determined by meter readings and is the largest single-day usage of water based upon production. The maximum day demand (MDD) could only be determined for 2020 from actual water use data. For 208-2019 no daily source meter readings were available. Therefore, the meter readings for the system were analyzed to determine a maximum monthly average day demand (MMADD). The MMADD is then multiplied by a peaking factor of 1.35 to determine MDD per the Design Section 3.4.1. The design MDD for the system was found to be 568 gpd/ERU, which was rounded up to 570 gpd/ERU in the engineering calculations.

2.1.3 Peak Hour Demand

Equation 3-1 from the Design Manual was used to obtain the estimated PHD based upon the number of existing connections. The equation uses the MDD and the number of potential connections to determine the PHD flowrate.

Design Manual Equation 3-1:

$$PHD = \frac{MDD \cdot (C \cdot N + F)}{1440} + 18$$

Where C and F are coefficients based on system size. These coefficients are listed in Table 3, and the PHD values are provided in Table 4.

Table 3: Peak Hour Demand Calculation Coefficients

Range of ERUs	C	F
15-50	3.0	0
51-100	2.5	25
101-250	2.0	75
251-500	1.8	125
501+	1.6	225

Table 4: Peak Hour Demand

Scenario	MDD (gpd/ERU)	N (ERUs)	C	F	PHD (gpm)
Total current connections	570	456	1.8	125	392
System Capacity	570	536	1.6	125	447
Reservoir Design Max # Connections	570	550	1.6	225	447

W&B's future PHD based on the system capacity of 536 connections is 447 gpm.

2.1.4 Design Values

The design values used in determining the capacity of the system are provided in Table 5. A detailed compilation of production and usage data is provided in Appendix B.

Table 5: System Design Values

Parameter	Value
ADD	220 gpd/ERU
MDD	570 gpd/ERU
PHD	447 gpm

2.2 Water Rights

W&B Waterworks which currently has two (2) water rights permits. These water right permits are summarized in Table 6. The combined instantaneous withdrawal rate and annual withdrawal rate allowed by the water rights is 262.5 gpm and 175 acre-ft/yr, respectively. The water right certificates are included in Appendix A.

Table 6: Water Rights

Water Right No.	Name	Priority Date	Source	Instantaneous Withdrawal (gpm)	Annual Withdrawal (acre-ft/yr)
G1-22510P	W&B Waterworks	06/04/75	Well #1	225	45
G1-24539C	W&B Waterworks	08/24/84	Well #2	*225	105
			Total	225	150

*Non-Additive

The water rights for the wells allow for total instantaneous withdrawal of 225 gpm (Q_i) and an annual withdrawal of 150 acre-ft/yr (Q_a). Water Right Self-Assessment is included in Appendix C.

2.2.1 Water Right Capacity Based on Instantaneous Flow

The water rights for the System allows for an instantaneous pumping rate as of 250 gpm. Equation 4.4a from the Design Manual was used to determine the number of ERUs based upon Maximum Daily Demand (MDD) and water right. The number of ERUs that can be supported by the System's water right based on MDD is 518 ERUs.

Equation 4-4a:

$$\mathrm{N} = \frac{(Q_i)}{(ERU_{MDD}/1440)}$$

N = ERUs Supported
Q_i = Instantaneous Allowed Pumping Rate (gallons/minute)
ERU_{MDD} = MDD value per ERU

$$ERU = \frac{225\ gpm}{570\ gpd/1440} = 568\ ERUS$$

2.2.2 Water Right Capacity Based on Annual Volume

The water rights for the System allows for a specified annual withdrawal of 150 acre-feet/year. Equation 4-4b is provided in the Design Manual to determine the number of ERUs based upon Average Daily Demand (ADD) and water right. The number of ERUs that can be supported by the System's water right based on ADD is 608 ERUs.

Equation 4-4b:

$$\mathrm{N} = \frac{(Q_a)}{(ERU_{ADD})(365)}$$

N = ERUs Supported
Q_a = Annual Volume (gallons/year)
ERU_{ADD} = ADD value per ERU

$$ERU = \frac{48{,}874{,}320\ gallons\ per\ year}{220\ gpd\ per\ ERU * 365} = 609\ ERUS$$

2.3 Source Capacity

The W&B water system currently has four groundwater wells that serve the system. The wells are located on Island County Parcel R22922-376-5180 adjacent to Roy Road. Detailed source information for each well is provided in Table 7.

Table 7: Source Information

Parameter	Well 1	Well 2	Well 3	Well 4	Del Bay
Source (WFI)	S01	S02	S03	S04	S01
Use	Primary	Primary	Primary	Primary	Emergency
Drill Year	1973	1977	1984	1984	1962
Well Tag ID#	AGA932	AGA931	AGA930	AGA929	AGA812
WFI Listed Capacity	50 gpm	75 gpm	75 gpm	75 gpm	38 gpm
Depth	310 ft	301 ft	285 ft	264 ft	254 ft
Casing Diameter	6-in	6-in	6-in	8-in	6-in

Equation 4-3 from the Design Manual was used to determine the number of connections that can be served by all the non-emergency sources based on source capacity as follows:

Design Manual Equation 4-3:

$$N = \frac{V_T}{MDD}$$

$$N = \frac{275\ gpm * 1{,}200\ min/day}{570\ gpd/ERU} = 579\ ERUs$$

Where N is the total number of ERUs that can be served based on the source capacity, V_T is the total volume of water delivered from all nonemergency sources over a 24-hour period. V_T was assumed to be equal to the maximum source instantaneous flow rate over a 24-hour period. Section 3.10.4 of the Design Manual recommends against designs based on pumping 24-hours per day to meet future MDD (570 gpd/ERU). Rather, assessing source capacity based on an assumption of pumping a source no more than 20 hours (1,200 min) per day provides a factor of safety and an increased ability to meet unexpected demands. Therefore, V_T was found by multiplying the total well capacities (275 gpm) by 1,200 min/day. Therefore, the resulting source capacity was found to be 579 ERUs.

2.4 Booster Pumps

The W&B water system is primarily a gravity-fed system. There are a maximum of 11 connections near the reservoir that require pressurized service. A booster pump system will be installed to support these connections and provide backwash supply for the treatment system. The booster pump capacity is 80 gpm which equates to the capacity to supply 66 ERUs.

2.5 Storage

The proposed improvements below discuss the proposed replacement reservoir which will be sized based on a potential of 550 ERUs.

2.6 Capacity Summary

The number of connections that the W&B water system can support was estimated using the methods outlined in the Design Manual, Chapter 4. The components analyzed include the instantaneous water right, the annual water right, and the source capacity. The distribution system and booster system were also analyzed, but they are not considered to be factors that would limit the maximum capacity of the water system since they can be upgraded.

The analysis demonstrated that the System has the physical and legal capacity to serve up to 518 ERUs, limited by the water right. The capacity analysis summary is provided in Table 8 below and calculations are provided in Appendix B.

Table 8: System Capacity Summary

Component	Value	Component Capacity (N)	Equation for N
Instantaneous Water Right, Q_i	225 gpm	568 ERUs	Q_i /MDD
Annual Water Right, Q_a	150 ac-ft/yr	609 ERUs	Q_a /ADD
Source	275 gpm	579 ERUs	Q_s /MDD
Treatment	225 gpm	536 ERUs	Q_T/MDD

2.7 Seawater Intrusion Analysis

The Seawater Intrusion (SWI) Analysis provided in Appendix D indicates that there is medium risk for sea water intrusion into the system's wells and monitoring is required for all 4 wells. The maximum chloride levels measured in wells 1 through 4 are 25 mg/L, 23 mg/L, 27 mg/L, 25 mg/L respectively. Overall, all wells have had consistent chloride concentrations since their construction. Monitoring is required, but SWI does not appear to be a current concern.

Since the wells are indicated at being at medium risk Island County Hydrogeologist had previously resisted the number of approved connections below the physical capacity. The system was limited to 478 ERUs. With the combination of Del Bay which had existing approval for 43 ERUs the new SWI limited capacity is 521 ERUS.

3 PROPOSED SYSTEM IMPROVEMENTS

To proactively address arsenic concerns and to provide improved treatment of excesses of the SMCL, the water system is planning to install an oxidation/filtration system to reduce iron, manganese, and arsenic to less than half the SMCL and MCL. The proposed oxidation/filtration system will utilize ferric chloride and sodium hypochlorite chemical injection to precipitate arsenic out of the source water and a manganese dioxide-based filter media to filter out that precipitate. The treatment system will be installed in a proposed pump house located adjacent to a proposed reservoir site indicated in Figure 1.

Additionally, the system has two aging reservoirs that do not currently provide the DOH recommended level of standby storage. The system will construct a new reinforced concrete storage reservoir sized to provide the system's anticipated storage needs. The proposed reservoir will be placed at a higher elevation which should provide improved system pressures at the bottom of the equalizing storage.

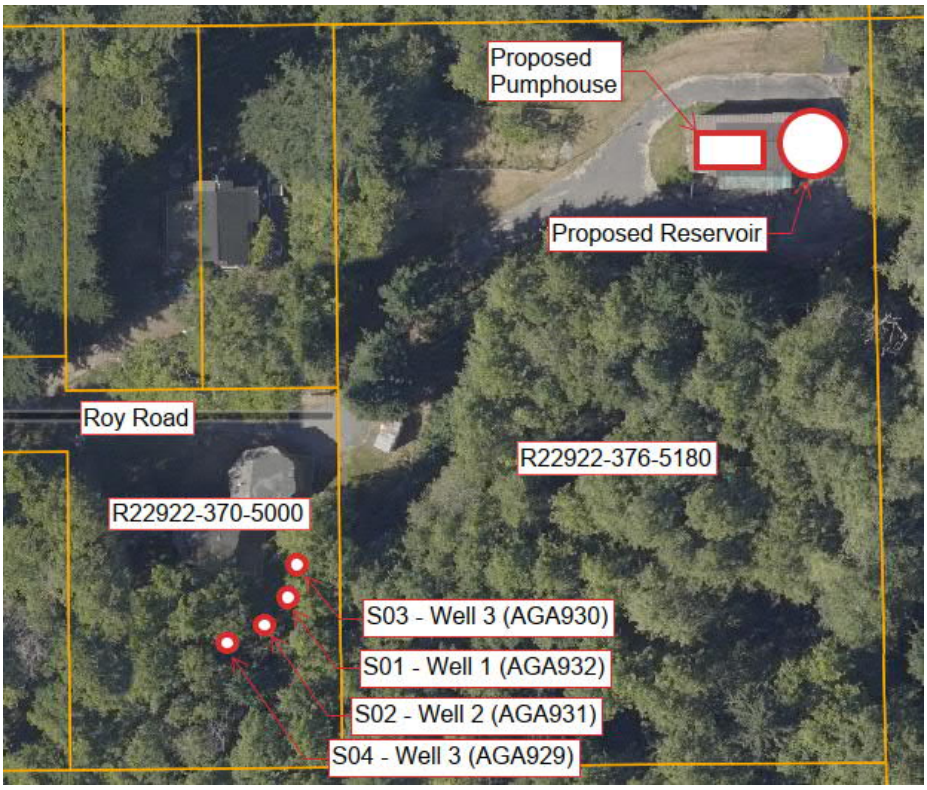


Figure 1: Project Location

4 RESERVOIR DESIGN

The System's existing 50,000-gallon reservoirs are octagonal and are constructed of reinforced concrete. They each have an effective diameter of 28.5 feet and a height of 12 feet. The total storage provided by the reservoirs does not meet the minimum recommended standby storage volume of 200 gpd/ERU as identified in the DOH Water System Design Manual, 2019 edition. Furthermore, the reservoirs are aging and are nearing the end of their useful lifespan.

The proposed improvements will install a new, properly sized reservoir to meet the anticipated future system needs. The existing reservoirs will be kept in service until the storage reservoir proposed in this report is fully functional, at which time they will be removed from service. Installation of this new reservoir, and its associated yard piping, will be performed at the same time as the arsenic treatment system installation.

4.1 Reservoir Sizing

Reservoir sizing was completed according to DOH guidance in the Water System Design Manual, 2019 edition to provide the system with adequate storage capacity to meet system demand and provide a sufficient reserve for fire flow. The five following storage components were considered in the design process:

1. Operational Storage (OS)
2. Equalizing Storage (ES)
3. Dead Storage (DS)
4. Standby Storage (SB)
5. Fire Suppression Storage (FSS)

To size the proposed reservoir for future demands the sizing has been done for 550 ERUs and a corresponding PHD of 498 pgm. The proposed reservoir is a circular reinforced concrete with an internal diameter of 30 ft and a height of 35 ft. This equates to approximately 185,000 gallons of reservoir storage (V_R) and 5,285 gallons of storage per foot of reservoir height (V_f).

$$V_R = \pi \cdot (\frac{30\ ft}{2})^2 \cdot (35\ ft) \cdot (7.48\ gal/ft^3) = 185{,}000\ gallons$$

$$V_f = \frac{185{,}000\ gal}{35\ ft} = 5{,}290\ gal/ft$$

4.1.1 Operational Storage

Operational storage (OS) is the height difference between the water levels in the reservoir where the well pumps are turned on and off. Adequate operational storage will prevent excess cycling of the well pumps by minimizing the number of times they need to start. Additional operational storage will be provided to allow the filter to operate for a longer duration, to increase the percentage of time the filters are run at steady state condition. Four feet of elevation will be provided between the well pump on and off signal. Therefore, the operational storage is calculated as follows:

$$OS = 4.0\ ft \times 5{,}290\ \ gal/ft = 21{,}150\ gallons$$

This would allow for a minimum 94 minutes (=21,150/225 gpm) of filter run time. This should provide better filter performance.

4.1.2 Equalizing Storage

Equalizing storage (ES) is the volume of water that is needed to meet the peak demand period for the water system. Equalizing storage was calculated using Equation 7-1 from the DOH Water System Design Manual, 2019 edition as follows:

$$ES = (PHD - Q_s)(150\ minutes)$$

Where:
PHD = Peak Hour Demand
Q_s = Well Pump Capacity

$$ES = (455\ gpm - 225\ gpm)(150\ minutes) = 34{,}600\ gallons\ (6.5\ ft\ of\ storage)$$

4.1.3 Dead Storage

Dead storage (DS) is the unusable volume at the top (TDS) and bottom (BDS) of the reservoir. Six (6) inches of freeboard will be provided at the top of the reservoir over the well pump off water level. The reservoir outlet will be raised six inches above the bottom of the reservoir to prevent silt and other material that may collect in the reservoir from entering the distribution system. The booster pump low level shut off will be set to three inches above the reservoir outlet. Therefore, dead storage can be calculated as follows:

$$TDS = 0.75\ ft \times 5{,}290\ \ gal/ft = 3{,}970\ gallons$$

$$BDS = 0.75\ ft \times 5{,}290\ \ gal/ft = 3{,}970\ gallons$$

$$DS = TDS + BDS = 6{,}610\ gallons\ (1.5'of\ storage)$$

4.1.4 Standby Storage

Standby storage (SB) is the volume of water available to supply the system in case of abnormal operating conditions that prevent the source or treatment system from properly functioning. A standby storage volume of 200 gallons per ERU is recommended. This equates to 110,000 gallons for 550 ERUs as shown below:

$$SB_{Recommended} = 200\ gal/ERU \times 550\ ERUs = 110{,}000\ gallons$$

The standby storage provided by the proposed reservoir can be calculated as the remaining volume after operational storage, equalizing storage, and dead storage are accounted for. The provided standby storage is calculated as follows:

$$SB = V_R - (OS + ES + DS) = 185{,}000gal - (21{,}150\ gal + 34{,}560\ gal - 6{,}610\ gal)$$

$$SB = 122{,}700\ (23.2\ ft\ of\ storage)$$

The proposed reservoir will provide sufficient standby storage to serve the current and projected future demands of the system.

4.1.5 Fire Suppression Storage

Fire suppression storage (FSS) requirements are set by Island County. The residential fire flow requirement is 500 gpm for 30 minutes, which equates to 15,000 gallons. Fire suppression storage may be nested with standby storage. Since the standby storage provided by the proposed reservoir is greater than 15,000 gallons, adequate fire suppression storage is provided. The provided storage volumes are summarized in Table 10.

Table 9: Storage Components

	Existing Reservoirs		Proposed Reservoir	
Storage Component	Volume (gal)	Equivalent Height (ft)	Volume (gal)	Equivalent Height (ft)
Top Dead Storage	4,776	0.5	3,970	0.75
Operational Storage	4,776	0.5	21,150	4.0
Equalizing Storage	32,973	3.5	34,560	6.5
Standby Storage	67,331	7.0	122,740	23.0
*Fire Suppression Storage	(15,000)	(3.1)	(15,000)	(2.8)
Bottom Dead Storage	4,776	0.575	3,970	0.75
Total	114,634	12.0	185,000	35.0

*Fire suppression storage is nested with standby storage.

4.1.6 Reservoir Floats and Piping Levels

The proposed reservoir will be constructed with a finished floor of approximately 275 feet above sea level. The proposed reservoir will be located adjacent to the proposed pumphouse and treatment facilities. The proposed configuration will minimize the amount of dead storage and increase pressures in the distribution system. The height of the proposed reservoir overflow, inlet, outlet, and drain lines are provided in Table 11.

Table 10: Proposed Reservoir Piping Levels

Piping Component	Height Above Reservoir Bottom (ft)
Overflow (Pipe Invert)	34.65 (34'-8")
Inlet (Pipe Invert)	34.5 (34'-6")
Outlet	0.5 (0'-6")
Drain	0.0

A new control package will be provided in the proposed reservoir. This will include a pressure transducer controller interface in the proposed pumphouse. Well pumps will cycle on based on system needs. If the first pump is not adequate, a second and possible third well pump will activate. The primary and back up well pumps will alternate on each start up cycle. Reservoir set points for lead and lag well pump on/off levels, low and high level alarms, and booster pump shut off levels are summarized in Table 12.

Table 11: Reservoir Set Points

Reservoir Control Set Points	Height Above Reservoir Bottom (ft)
High Level Alarm	34.5 (34'-6")
Well Pumps Off	34.25 (34'-3")
Lead Well Pump On	31.75 (31'-9")
Lag Well Pump #1 On	31.00 (31'-0")
Lag Well Pump #2 On	30.25 (30'-3")
Low Level Alarm	20.0 (20'-0")
Booster Pump Shut Off	0.75 (0'-9")

4.1.7 Water Age

According to Section 7.6.1 of the DOH Water System Design Manual, 2019 edition, "long detention times in reservoirs can lead to loss of disinfectant residual, microbial growth, sediment accumulation, formation of disinfection byproducts, taste and odor problems, and other water quality issues." It is recommended in the manual that a complete turnover of water in a storage reservoir occur at least every three to five days to minimize these problems.

Water age before complete reservoir turnover was calculated for the proposed in operation together with the existing reservoir and the proposed reservoir operating by itself. The lowest recorded average daily demand of 195 gpd/ERU in 2018, a storage volume equal to the total reservoir volume minus top dead storage and lead well pump operational storage, and the current number of active connections were used for these calculations. Water usage data is available in Appendix B.

Water age with both reservoirs in operation:

$$Water\ Age = \frac{Total\ Storage\ Volume - TDS}{ADD} = \frac{(185{,}000\ - 3{,}970 - 13{,}225)\ gal}{195\ gpd/ERU \times 496\ ERUs} \cong 1.7\ days$$

The resulting water age for the reservoirs in operation is less than five days, meaning that the proposed reservoir is not expected to have any problems as a result of water age.

5 TREATMENT DESIGN

The source water from the all the wells have elevated levels of iron (Fe), manganese (Mn), and arsenic (As). The source water exceeds the secondary maximum contaminant level (SMCL) for Fe and Mn which are established as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. The source water does not exceed the MCL for As but the levels are considered elevated and Cascadia would like to proactively treat each of these contaminants.

5.1 Treatment Alternatives

Multiple treatment alternatives were reviewed to determine the best means of reducing the elevated levels of contaminants in the system. These alternatives are summarized in Table 14 and are discussed in greater detail below.

Table 12: Treatment Processes Alternatives

Treatment Type	Considerations
Iron Based Sorbents	High initial cost. High source water turbidity can decrease treatment efficiency and reduce media life.
Ionic Exchange Filter	Reduces water hardness. Complex operational requirements and high operating costs.
Oxidation/Filtration	Requires chlorination. Easy to maintain.

5.1.1 Iron Base Sorbents

Iron based sorbents function by chemisorption of arsenic onto an iron oxide media. Because the sorption is irreversible, the media is used until it is saturated and then disposed in a sanitary landfill. The filter tank is then recharged with fresh media. A lead/lag filter configuration is utilized to enable the media to run to the saturation point. Phosphates compete aggressively for adsorption sites, so complete water chemistry results are needed before determining the adequacy of this treatment option.

Pros:

- Ease of operation.

Cons:

- Lead/Lag configuration leads to higher initial cost.
- Turbidity interferes with efficiency, pre-filtration recommended.
- High turbidity decreases media life.

5.1.2 Ion Exchange

Ion exchange is a treatment process which directly removes soluble arsenic, iron, and manganese in solution without chemical change by replacing, or exchanging, the soluble arsenic, iron, and manganese ions with sodium or potassium ions. Ion exchange has the additional benefit of reducing water hardness.

A primary concern with ion exchange is chromatographic peaking, which can cause arsenic and nitrate levels in the treated water stream to exceed that of the raw water stream if the operation cycle is not properly maintained. This process requires highly skilled operators and frequent monitoring. Ion exchange treatment is appropriate for soluble ions only and most systems have some contaminants in their source water that are not soluble. Operational costs are high with this treatment option due to the

large quantities of salt needed for operation. In addition, the wastewater discharge of the brine solution is problematic if the property is not connected to a municipal sewage disposal system. There is not a municipal sewage disposal system available at the project site. Based on these factors, ion exchange is not recommended as a suitable treatment alternative for this system.

Pros:

- Reduces water hardness.

Cons:

- Complex system operation and frequent monitoring needs.
- High operational costs.
- Disposal of brine solution wastewater.

5.1.3 Oxidation/Filtration with Catalytic Media

Oxidation/Filtration is a proven technology for removal of arsenic and other contaminates in groundwater sources. Iron and manganese in the source water are oxidized and converted to insoluble salts. Arsenic in the source water is also oxidized and absorbs onto the iron hydroxide insoluble salts. The insoluble salts (FeO_2 with bound $HAsO_4$ and MnO_2) are then filtered with a catalytic media.

An iron to arsenic ratio in the source water of 100 to 1 is desired for optimal arsenic removal. Pilot testing results indicate a Well #1 iron concentration of 0.05 mg/L and an arsenic concentration of 0.0068 mg/L, or an approximate ratio of 7 to 1. Pilot testing results indicate a Well #4 iron concentration of 0.15 mg/L and an arsenic concentration of 0.0092 mg/L, or an approximate ratio of 16 to 1. As a result of the low iron to arsenic ratios in both wells, the addition of iron via ferric chloride injection prior to filtration is required for optimal arsenic removal. The added iron, with bound arsenic, would then be removed from the water by the filter media.

Upon review of these alternatives, oxidizing with sodium hypochlorite and filtering using a manganese dioxide-based filter media was selected as the desired treatment alternative. The manganese dioxide oxidation/filtration process was selected based on the chemistry of the source water and increased arsenic removal efficiencies with this media.

Manganese dioxide filtration systems use a natural mineral, pyrolusite, as the catalytic filter media. This filter media ranges from 50-80% manganese dioxide by weight. Consequently, the filter media has a substantially higher capacity to retain excess oxidant and adsorb arsenic, iron, and manganese. These properties translate to higher filter flow rates, greater capacity to sustain overfeeding or underfeeding of chemical oxidants, and a significantly longer filter bed life than other similar filtration systems such as manganese greensand when properly operated. Longer filter bed life allows fewer filter bed replacements over the system's life. Sodium hypochlorite is the recommended oxidant since the system operates better with chlorination.

Pros:

- Effective for arsenic, iron, and manganese reduction.
- Demonstrated success on Whidbey Island.
- Potential to operate at higher flow rates than alternatives.

Cons:

- Requires periodic backwashing to clean filters.

5.1.4 Treatment Selection for Pilot Testing

Upon review of the alternatives listed in Section 5.1 and summarized in Table 14, oxidation/filtration was selected as the preferred treatment alternative. ATEC Systems Associates was selected as the contractor to perform the pilot testing that confirms treatment effectiveness, to develop optimal design parameters, and to provide prefabricated filters. This company has completed pilot tests across the nation and has developed effective oxidation/filtration treatment systems for arsenic removal based on those pilot test results for 30 years. ATEC provides a simple, robust, and cost-effective treatment system with automated backwashing that meets the primary design goals of the treatment system. ATEC utilizes pyrolusite based filtration media, which is not subject to degradation during routine use. These systems are also equipped with a simple control panel for backwash operations that is suitable for this application. ATEC treatment systems typically operate with sodium hypochlorite as the lone oxidant; however, if a drop in the silica concentration is detected across the filter media, potassium permanganate will be required to protect the long-term functionality of the media.

5.2 Treatment Pilot Testing

A pilot study was undertaken to determine optimal operational parameters for the design of the arsenic water treatment system. An ATEC filtration system was determined to be a viable oxidation/filtration treatment alternative for the system based on the existing water chemistry, past success with this type of treatment, and the simplicity of operation. Based on this determination, a pilot test of the ATEC filtration system was completed on July 20th and 21st, 2021. The following sections summarize the details of the pilot testing, including an analysis of the test results. A copy of the Pilot Test Report is included in Appendix E

5.2.1 Objective

The objective was to determine the effectiveness of an ATEC treatment system in removing arsenic from the water of Wells #1 and #4. The pilot test also identified the required ATEC filtration equipment and the optimal operational settings to reliably remove arsenic to less than the MCL of 0.010 mg/L (10 parts per billion, ppb).

5.2.2 Pilot Test Description

Pilot testing was performed on both Wells 1 and 4 to determine the efficacy of removing iron, manganese, and arsenic. The source water quality between Table 13 includes the concentrations of those items in the source water taken during pilot testing; see Appendix E for the Pilot Test Report.

Table 13: Source Water Concentrations

Contaminant	MCL/SMCL	Well #1	Well #4
Iron (Fe)	0.3 mg/L	0.05 mg/L	0.15 mg/L
Manganese (Mn)	0.050mg/L	0.252 mg/L	0.381mg/L
Arsenic (As)	0.010 mg/L	0.0068 mg/L	0.0092 mg/L

As shown in Table 13, the concentration of contaminants in Well #4 surpasses that of Well #1. The concentration of manganese at 0.381 mg/L exceeds the secondary maximum contaminant level (SMCL), of 0.050 mg/L by 762%, set by the United States Environmental Protection Agency (EPA). In addition, the arsenic concentration of Well #4 at 0.0092 mg/L within 90% of the current maximum contaminant level (MCL) set by the EPA. Water quality tests results are included in the Pilot Testing Report (Appendix E). Arsenic is classified as a primary drinking water contaminant and is regulated for its potential adverse effects on human health. According to the Washington State Department of Health (DOH) Publication

#331-262, June 3, 2004, "Arsenic has a primary drinking water standard (of 0.010 mg/L) because it can cause skin lesions, circulatory problems, and nervous system disorders. Prolonged exposure also can cause various forms of cancer." The DOH Water System Design Manual, 2019 edition, states the established EPA arsenic MCL is "based on chronic health concerns, including carcinogenic and cardiovascular risks."

ATEC conducted a pilot test for blended water from Wells #1 and #4 on July 20 and 21, 2021. The pilot test was conducted by diverting a portion of the wells' production to the ATEC pilot filters. The filtered water was dumped to waste and not used for consumption by the system. The removal performance of the pilot filter was monitored as the operating parameters were adjusted to determine optimal sodium hypochlorite and ferric chloride dosing. The pilot filter system is designed to simulate actual operation of an ATEC filter system on a small scale in terms of contact time, media depth, flow per cubic foot of media, flow per square foot of media (loading rate), and so forth. See Appendix E for additional information on the equipment that was utilized for the pilot plant and a summary of the pilot testing conducted on each day.

5.2.3 Pilot Test Set-Up

In this test, sodium hypochlorite and ferric chloride were introduced to the influent immediately ahead of four 6-inch diameter filter columns with 60-inch filter sidewalls. The filters are manifolded together at the inlet and outlet and are filled with 42-inches of AS-700 Series Filter Media.

Filter loading rates, sodium hypochlorite feed rates, and ferric chloride feed rates were varied to determine the most economical filtration equipment necessary to meet treatment objectives. During the pilot testing, the pilot trailer's field lab was used to determine iron, manganese, and arsenic concentrations in the raw and finished water. The pilot test results are displayed in tables and graphically in Appendix E.

Pressure was measured on the influent and effluent manifold to determine head loss across the filters. The sodium hypochlorite and ferric chloride injection points were located as close to the filters as possible to simulate actual operation. Source water enters through a hose inlet in the wall, passes through a flow meter, past a sodium hypochlorite and ferric chloride injection point, through an in-line static mixer, into the inlet manifold, and down and through the filter media. See Appendix E for the flow path and for detailed information on the pilot test set-up.

The pilot-test on July 21st was run for approximately 6 hours and 30 minutes in total. The pilot-test on July 20th was run for approximately 5 hours and 30 minutes in total. On-site analysis was conducted for temperature, pH, total and free chlorine, iron, manganese, hydrogen sulfide, ammonia, silica, and arsenic. These parameters were monitored both before and after the filtration process using Hach sensors and spectrophotometer testing.

5.2.4 Pilot Filter Test Results and Analysis

During the pilot testing for Well #1, water was fed directly from the well at an average flow rate of 4.96 gpm from Well #1. Source water was metered using a totalizing flow meter. Sodium hypochlorite dosing was adjusted to an average of 2.18 mg/L to obtain a 1.16 mg/L average free chlorine residual and a 1.47 mg/L average total chlorine residual on the filter outlet. Ferric chloride was dosed at an average of 0.92 mg/L as iron. The water passed through the filter media with an average loading rate of 6.31 gpm/ft^2.

During pilot testing for Well #4, water was fed directly from the well at an average flow rate of 4.90 gpm from Well #4 and was also metered using a totalizing flow meter. Sodium hypochlorite dosing was

adjusted to an average of 4.92 mg/L to obtain a 0.83 mg/L average free chlorine residual and a 1.83 mg/L average total chlorine residual on the filter outlet. Ferric chloride was dosed at an average of 1.11 mg/L as iron. The water passed through the filter media with an average loading rate of 6.24 gpm/ft^2. Pilot filter test results are provided in Appendix E and summarized in Table 15 for blended water from Well #1 and in Table 16 for Well #4.

The pilot test water quality testing for water from Well #1 indicates that the average influent (raw water) arsenic concentration is 6.8 ppb, or 68% of the MCL of 10 ppb. For the pilot testing, adequate removal is generally considered a reduction to less than 50% of the MCL, with non-detection being ideal. Following the oxidation-filtration treatment, the arsenic concentration was reduced to 3.4 ppb, or 34% of the MCL, which equates to 50% removal.

The pilot test water quality testing for Well #4 indicated that the influent arsenic concentration is 9.2 ppb, or 92% of the MCL of 10 ppb. Following the oxidation-filtration treatment, the arsenic concentration was reduced to 2.4 ppb, or 24% of the MCL, which equates to 74% removal.

The small difference between the free and total chlorine residuals in both pilot tests indicates that chloramine breakpoint, the point at which chloramines are no longer present in the water, was achieved in both cases. Chloramines are formed when chlorine, introduced via sodium hypochlorite injection, reacts with ammonia in the water. Further sodium hypochlorite injection introduces additional chlorine which breaks down the chloramines and converts them to nitrogen gas. Once the chloramines have been broken down, the free and total chlorine residual concentrations should be nearly equal. Pilot testing water quality results, included in Appendix E, indicate that no ammonia was present in the source water. Therefore, achieving chloramine breakpoint was probable.

The pilot test results for Well #1 and Well #4 indicate that effective removal of arsenic was obtained at an average loading rate of 6.31 gpm/ft^2 and 6.24 gpm/ft^2, respectively, of media surface area for blended water. Filtration was not extended to determine when the arsenic concentration started to rise in the filter effluent. This increase is referred to as filter breakthrough and relates to the total binding capacity of the filter media. During treatment validation testing, filter run time will be extended to filter breakthrough to determine optimal filter runtimes that will minimize the amount of water wasted to backwashing.

Table 14: Pilot Test Field Results from Well #1

		Chlorine (mg/L)		Iron (mg/L) SMCL: 0.30 mg/L		Manganese (mg/L) SMCL: 0.050 mg/L		Ammonia (mg/L) MCL: None		Arsenic (ppb) MCL: 10 ppb	
Date	Time	Free	Total	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated
7/20/2021	Start	2.35	2.84	0.16	-	0.27	-				
	10:30	1.93	2.23	0.08	-	0.22	-			6.8	4.8
	11:00	1.69	1.89	0.08	0.01	0.25	-	0.28	-		
	11:30	1.31	1.71	0.06	0.01	0.244	-				5.2
	12:00	1.29	1.62	0.08	0.01	0.258	0.001	0.26	-		
	12:30	1.27	1.54	0.06	-	0.249	-				
	13:00	0.8	1.11	0.02	-	0.242	-	0.28	-		1.1
	13:30	0.75	1.02	0.02	-	0.241	-				
	14:00	0.66	0.92	0.01	-	0.255	-				
	14:30	0.6	0.94	0.01	-	0.261	0.015				
	15:00	0.6	0.89	0.01	-	0.263	0.008			6.7	2.4
	15:30	0.61	0.9	0.02	-	0.265	0.01				
Average		1.16	1.47	0.05	0.00	0.252	0.003	0.273	-	6.8	3.4
Percent of SMCL/MCL		-	-	16.9%	0.8%	503%	6%	-	-	68%	34%

"-" : Non-Detect, counted as zero for averaging.
Empty cell indicates no test was performed.

Table 15: Pilot Test Field Results from Well #4

		Chlorine (mg/L)		Iron (mg/L) SMCL: 0.30 mg/L		Manganese (mg/L) SMCL: 0.050 mg/L		Ammonia (mg/L) MCL: None		Arsenic (ppb) MCL: 10 ppb	
Date	Time	Free	Total	Raw	Treated	Raw	Treated	Raw	Treated	Raw	Treated
7/21/2021	Start	1.17	1.97	0.16	0.02	0.371	0.016				
	8:30	0.22	1.66	0.16	-	0.38	0.004	0.37	0.21		
	9:00	0.37	1.06	0.19	-	0.381	0.013			9.1	2.3
	9:30	0.32	1.58	0.17	-	0.383	0.013	0.34	0.13		
	10:00	0.34	1.89	0.16	-	0.38	0.003				
	10:30	1.13	1.97	-	-	0.387	0.003				2.4
	11:00	1.13	1.43	0.14	-	0.387	0.018				
	11:30	1.17	2.23	0.12	-	0.381	0.008				
	12:00	1.67	2.16	0.18	0.01	0.394	0.011	0.27	-		2.6
	12:30	0.78	2.02	0.13	0.01	0.373	0.004				
	13:00	0.82	2.02	0.17	0.01	0.377	0.01				
	13:30	0.8	1.92	0.16	0.04	0.379	0.012			9.2	2.1
Average		0.83	1.83	0.15	0.01	0.381	0.010	0.327	0.113	9.2	2.4
Percent of SMCL/MCL		-	-	48.3%	2.5%	762%	19%	-	-	92%	24%

"-" : Non-Detect, counted as zero for averaging.
Empty cell indicates no test was performed.

5.2.5 Pilot Plant Results Summary

Based on the pilot test results, the ATEC AS-700 Series filter media-based oxidation/filtration treatment system has been identified as the appropriate technology for the effective removal of arsenic from the source water.

For Well #1, a ferric chloride dosing rate of 0.92 mg/L as Fe and a sodium hypochlorite dosing rate of 2.18 mg/L was shown to provide a 1.16 mg/L free chlorine residual, achieve chloramine breakpoint, and achieve arsenic reduction to 34% of the MCL.

For Well #4, a ferric chloride dosing rate of 1.11 mg/L as Fe and a sodium hypochlorite dosing rate of 4.92 gm/L was shown to provide a 0.83 mg/L free chlorine residual, achieve chloramine breakpoint, and achieve arsenic reduction to 24% of the MCL.

Hypochlorination treatment calculations are provided in Appendix F and based on pilot testing water chemistry and ferric chloride dosing rates, suggest that a dosing rate of 2.18 mg/L and 4.92 mg/L for Wells #1 and #4, respectively, of sodium hypochlorite will be adequate to achieve chloramine breakpoint and provide a minimum of 0.5 mg/L free chorine residual for both wells.

Well #1 experienced a drop in silica concentration of 0.90 mg/L across the pilot filters. It is recommended in the pilot study that a potassium permanganate feed system be included in the design to prevent silica from coating the filter media and reducing filter efficiency.

The system will be configured to allow treated water to provide water for backwash operations. A pressure sustaining solenoid valve will be installed in the pumphouse between the filter outlet and the reservoir inlet to provide adequate backpressure, prevent water from bypassing the filters during backwash operations by flowing directly to the reservoirs, and in doing so, provide an adequate flowrate to properly backwash the filters. This valve will normally be fully open and will only be activated by the ATEC control panel to increase backpressure during backwash operations. Treatment Engineering Calculations.

With the proposed system improvements, the wells will function on a lead/lag alternating orientation with Well 4 as the initial lead, followed by Well 1, Well 2, and Well 3 running simultaneously. To proactively address arsenic concerns and to provide improved treatment of excesses of the SMCL, the water system is planning to install an oxidation/filtration system to reduce iron, manganese, and arsenic to less than half the SMCL and MCL. The proposed oxidation/filtration system will utilize ferric chloride and sodium hypochlorite chemical injection to precipitate arsenic out of the source water and a manganese dioxide-based filter media to filter out that precipitate. The treatment system will be installed in a proposed pump house located adjacent to a proposed reservoir site indicated in Figure 1.

5.3 Water Quality, Quantity, & Water Rights

5.3.1 Water Quality Test Results

Following the installation of the treatment upgrades (and other water system upgrades), the four sources are proposed to be blended in the proposed new storage reservoir.

A mass balance calculation was performed to determine the expected concentration of arsenic, manganese, and iron based on the relative flow rates of the wells. Water quality data used in these calculations was based on the average concentrations from the Pilot Test. In typical operations the flow from Well #4 will alternate with the production from a combination of Wells 1, 2, and 3. The expected approximate concentrations of arsenic, manganese, and iron in the post-treatment blended water are

provided in in Table 17. These concentrations can be used a datapoint for comparison of post-treatment, blended water quality. Should water quality testing values show concentrations reasonably higher than these expected values, further testing and investigation can be completed to determine if the unexpected water quality is due higher concentrations in the source water, or filter breakthrough/failure, etc.

Table 16: Post-Filtration Water Quality

Well	Flow Rate (gpm)	Finished Water Quality		
		As (mg/L)	Fe (mg/L)	Mn (mg/L)
1	55	0.0034	0.010	0.003
2*	75	0.0034	0.010	0.003
3*	75	0.0034	0.010	0.003
4	150	0.0024	0.010	0.010
MCL	-	0.010	0.30	0.050
Combined	-	0.0029	0.010	0.007

* Water quality calculated from Well 1 pilot test results.

5.4 Treatment Engineering Calculations

5.4.1 Treatment System

An oxidation/filtration treatment system has been identified as the appropriate technology for the removal of arsenic, iron, and manganese from the source water. Oxidation/filtration was selected as the treatment method because it has a history of success in removing arsenic from groundwater sources, is a proven and robust technology, and it is simple to operate and maintain. This treatment method involves dosing the source water with sodium hypochlorite and ferric chloride. The arsenic will bind with the iron that is present in the source water, as well as iron that is added in the form of ferric chloride, to form a precipitate that will then be filtered out of the water. The chlorine present in sodium hypochlorite will oxidize the manganese and the remaining iron to form another precipitate which will also be filtered out. The following is a summary of the materials and equipment that will be used in the treatment system:

Table 17: Treatment Component Summary

Component	Description
Pressure Vessels	(8) 30" (D) x 60" (H) filters (4.9 ft^2 filter bed area each) (2) 30" (D) x 60" (H) empty filter for contact tank
Filter Loading Rate	28 gpm/filter or 5.7 gpm/ft^2 of media surface area
Filter Bed	42" of ATEC Advantage filter media (17.2 ft^3/filter)
Backwash	5 minutes/filter at 137 gpm/filter (28 gpm/ft^2)
Hypochlorite Dosing	Well #1: 4.5 mg/L Well #4: 5.4 mg/L
Ferric Chloride Dosing	Well #1: 1.5 mg/L as iron Well #4: 2.2 mg/L as iron
Potassium Permanganate Dosing	0.1 ppm
Chlorine Residual	Target 1.0 ppm (0.5 ppm minimum)

5.4.2 Treatment Tank Sizing

Treatment production will be matched to the instantaneous water right rate of 225 gpm to maximize the capacity of the water system. Filter sizing is a balance between limiting the number of treatment vessels and providing an adequate flow rate to meet the backwash requirements of the filters. Treated water from the reservoir will be used to backwash the filters. A pressure sustaining solenoid valve on the ATEC filter outlet set to 30 psi will be used to maintain adequate pressure for backwashing. The proposed filter media has a recommended backwash flow rate of 28 gpm/ft^2 which equates to 137 gpm for the 30-inch diameter filters. Each filter is backwashed successively while the remaining filters can remain in treatment operation. A flow regulating valve on the ATEC filter backwash line will be set to regulate backwash flow to 137 gpm. Any flow beyond 137 gpm during backwash operations will be returned to the reservoirs.

ATEC's Pilot Testing Report recommended a filter loading rate of approximately 5.7 gpm/ft^2. A 30" diameter filter provides approximately 4.9 ft^2 of media surface area. Using this loading rate, the system filter requirements can be calculated as follows:

$$225\ gpm\ \div 5.7\ gpm/ft^2 = \ 39. ft^2\ of\ filter\ area\ required$$

$$39\ ft^2 \div 4.9\ ft^2/filter = 8\ filters\ are\ required$$

To summarize, (8) 30" diameter filters will provide a sufficient surface area to treat the maximum withdrawal rate from the wells.

5.4.3 Pre-Filter Contact Time

Pre-filter contact volume is provided by a two 30" diameter by 60" tall contact tanks and the 18" of filter headspace above the filter media in each of the six diameter filter vessels. The volume of the contact tanks is calculated as follows:

$$Contact\ Tank\ Volume\ = 2 \cdot Height\ of\ Filter\ \cdot\ \pi \cdot (D\ /2)^2$$

$$Contact\ Tank\ Volume\ = 2 \cdot\ 60\ in\ \cdot\ \pi \cdot \left(\frac{30\ in}{2}\right)^2 = 84{,}823\ in^3 \cong 49\ ft^3 \cong 367\ gal$$

The volume of filter headspace in each filter vessel is calculated as follows:

$$Headspace\ Volume = Height\ of\ Headspace \cdot \pi \cdot (D/2)^2$$

$$Headspace\ Volume\ = 18\ in \cdot \pi \cdot \left(\frac{30\ in}{2}\right)^2 \cong 12{,}724\ in^3 \cong 7.36\ ft^3 \cong 55\ gal$$

Water will flow at 225 gpm through the contact tanks and at 28.1 gpm through each filter; therefore, the pre-filter contact time is calculated as follows:

$$Pre - filter\ Contact\ Time = 367\ gal/225\ gpm + 55\ gal/28\ gpm = 3.6\ min$$

5.4.4 Chemical Feed Equipment

Arsenic removal is accomplished by oxidizing arsenic in the water via the injection of a sodium hypochlorite solution, the binding of the oxidized arsenic to iron oxide, and the subsequent precipitation and filtration of the iron oxide with the bound arsenic. An iron to arsenic ratio of 100 to 1 in the incoming water is ideal for arsenic removal. When the ratio is lower, iron may need to be introduced via chemical injection of a ferric chloride solution. Iron and arsenic concentrations in Table 15 and Table 16 indicate an iron to arsenic ratio of 7:1 for Well #1 and 16:1 for Well #4. These ratios suggest ferric chloride dosing is required for adequate arsenic removal. Furthermore, as discussed in Section 5.2.3 and Section 5.2.4, pilot testing obtained adequate arsenic removal by dosing source water with ferric chloride. Therefore, ferric chloride dosing will be included in the proposed treatment system.

All the chemical injection pumps will be provided with a circuit to a magnetic pulse meter which will regulate the pump's dosing rate based on the flow rate of water to the treatment system. This is particularly important for Wells #1, #2, and #3 since the flow rate can vary depending on the pumps in service. The magnetic pulse meter will ensure there is no underdosing or overdosing of sodium hypochlorite or ferric chloride as operational values change.

The ferric chloride injection will consist of a chemical injection pump shared by Wells #1, #2, and #3 with a separate chemical injection pump for Well #4. All the wells can share a polyethylene chemical storage tank as the dilution of the chemical will be kept consistent. The ferric chloride solution for all wells will consist of one part 39% ferric chloride diluted with 9 parts water. The chemical injection pump for Wells #1, #2, and #3 will be set to provide a flow rate of 0.46 gph and an initial dosing rate of 0.58 mg/L of iron (Ferric chloride dose of 1.5 mg/L). Well #4 will be set to provide a flow rate of 0.43 gph and an initial dosing rate of 0.92 mg/L of iron (Ferric chloride dose of 2.2 mg/L).

New chemical feed equipment will also be used to inject a sodium hypochlorite solution to oxidize raw incoming water for arsenic removal. The chemical injection system will be composed of a shared chemical injection pump and polyethylene chemical storage tank for Wells #1, #2, and #3 with a separate chemical injection pump and polyethylene chemical storage tank for Wells #4. Wells #1, #2, and #3 will use a sodium hypochlorite solution of one part 12.5% sodium hypochlorite diluted with 2 parts water. The chemical injection pump will be set to provide a flow rate of 1.14 gph and an initial dosing of 3.9 mg/L of sodium hypochlorite. Well #4 will use a sodium hypochlorite solution of two parts 12.5% sodium hypochlorite diluted with 3 parts water. The chemical injection pump will be set to provide a flow rate of 0.73 gph and an initial dosing of 4.9 mg/L of sodium hypochlorite.

The initial parameters for all four chemical injection pumps are summarized in Table 19.

Table 18: Initial Parameters for Chemical Injection Pumps

	Wells #1 #2 and #3		Well #4	
Solution Type	Sodium Hypochlorite	Ferric Chloride	Sodium Hypochlorite	Ferric Chloride
Raw Solution Strength	12.5%	39%	12.5%	39%
Raw Solution to Water Ratio	1 to 2	1 to 9	1 to 2	1 to 9
Pump Rate	1.3 gph	0.46 gph	0.97 gph	0.43 gph
Dosing Rate	4.5 mg/L	1.5 mg/L	5.4 mg/L	2.2 mg/L

A dedicated electrical outlet will be provided for each chemical injection pump that is energized when the corresponding well pump(s) are turned on. Each chemical injection pump's stroke frequency will be manually adjusted by the operator in the field to obtain the desired dosing rates and ensure adequate arsenic removal and chlorine residual. A single, shared polyethylene chemical storage tank will be used for both sodium hypochlorite injection pumps. See Appendix G for chemical injection pump specifications and Appendix F for sodium hypochlorite and ferric chloride dosing calculations.

5.4.5 Filter Vessel Capacity and Backwash Frequency

The filter media capacity is based on a potassium permanganate demand equivalent of 10,000 mg per cubic foot of media. The following table lists the potassium permanganate demand equivalent for each chemical species.

Table 19: $KMnO_4$ Equivalents

		Well #1/2/3		Well #4	
Contaminant	Equivalence	Concentration (mg/L)	Effective Conc. (mg/L)	Concentration (mg/L)	Effective Conc. (mg/L)
Iron*	1:1	0.58	0.58	0.92	0.92
Manganese	2:1	0.25	0.50	0.38	0.76
Total	-	-	1.1	-	1.68

* Iron concentration is the sum of iron in the raw water and iron added via injection of ferric chloride.

The iron and manganese concentrations in Table 20 were used to determine the theoretical number of gallons the filter media can treat prior to backwashing. With a media depth of 42 inches, the eight filter vessels combined will contain a total of 137.4 cubic feet of media. The theoretical filter media capacity and volume of production from Well #1 before backwash is calculated as:

$$137.4\ ft^3 \cdot \frac{10{,}000\ mg}{ft^3} \cong 1{,}374{,}000\ mg \text{ total binding capacity}$$

$$1{,}374{,}000\ mg \cdot \frac{L}{1.1\ mg} \cdot \frac{gal}{3.79\ L} \cong 330{,}000 \text{ gallons of source water}$$

$$\frac{330{,}000\ gal}{200\ gal/min} \cdot \frac{1\ hour}{60\ minutes} \cong 27.5 \text{ hours of production}$$

The theoretical filter media capacity and volume of production from Well #4 before backwash is calculated as:

$$137.4\ ft^3 \cdot \frac{10{,}000\ mg}{ft^3} \cong 1{,}374{,}000\ mg \text{ total binding capacity}$$

$$1{,}374{,}000\ mg \cdot \frac{L}{1.68\ mg} \cdot \frac{gal}{3.79\ L} \cong 216{,}000 \text{ gallons of source water}$$

$$\frac{216{,}000\ gal}{125\ gal/min} \cdot \frac{1\ hour}{60\ minutes} \cong 28.8 \text{ hours of production}$$

The theoretical time before backwash for Wells #1 and #4 were calculated to be about 28 hours. However, the Pilot Test Report done by ATEC recommends an initial back wash frequency of 12 hours. Treated water quality will be monitored during treatment validation testing to determine the filter breakpoint. The backwash frequency will be set to ensure that backwashing occurs prior to filter breakpoint. It is anticipated that filter runtime may be extended to 24 hours past the 12 hours recommended in the Pilot Testing Report. Longer runtimes will decrease the total volume of water used for backwash.

5.4.6 Backwash Volume

Each filter will be sequentially backwashed at 28 gpm/ft^2, or 137 gpm, for five minutes. Treated water from the reservoir will be pressurized via booster pumps to provide adequate flow for backwash of the system. A pressure sustaining solenoid valve will be installed on the treated water outlet and will be activated during backwashing operations to ensure that an adequate flow of water is forced through the filter being backwashed. Backwash quantities for each production cycle are as follows:

$$137 \frac{gpm}{filter} \times 5\ minutes = 685\ gallons/filter$$

$$685\ \frac{gallons}{filter} \times 8\ filters = 5{,}480\ gallons$$

Based on pilot test results, the recommended backwash frequency is every 12 hours of production, equating to 90,000 gallons at the production rate of 125 gpm. The percentage of water lost to backwashing is therefore estimated at:

$$\frac{5{,}480\ gallons}{90{,}000\ gallons} = 6\%\ of\ production\ water\ lost\ to\ backwashing$$

Filter performance should be monitored for effectiveness. Adjustment to the backwash frequency, duration, or flowrate may be desired or necessary to minimize water loss or increase filter performance. Decreasing the cycle time between backwashes would result in increased water loss while increasing the cycle time may result in reduced filter performance. A backwash infiltration area near the treatment building will be needed for the disposal of backwash water.

5.4.7 Backwash Infiltration Area

The filter backwash water will be routed to an infiltration area near the treatment building. The infiltration facility was sized using the Island County Soil Survey included in Appendix H. The project area is underlain with Indianola-Useless Bay complex. The Indianola soil type is classified as hydraulic soil group A, and has a typical profile of 1 inch of slightly decomposed plant material and 58 inches of loamy sand and sand. Table 2.4 of the Department of Ecology Stormwater Manual, Volume III, lists long term infiltration rates for Group A soils as greater than 0.30 inches per hour. However, information from Onsite Sewage Evaluations of neighboring parcels shows infiltration rates of 0.50 inches per hour. Therefore, 0.50 inches per hour was used as the design infiltration rate for the backwash infiltration facility.

The MDD of 570 gpd/ERU was used to size the backwash infiltration facility. An overflow to a drainage ditch adjacent to the site will be provided to prevent the infiltration area from flooding. An infiltration rate of 0.50 inches per hour produces a required infiltration area of 1,500 square feet as shown below.

$$Backwash\ Frequency\ at\ MDD = \frac{144{,}000\ gal}{570\ gpd/ERU \times 528\ ERUs} \cdot \frac{24\ hr}{day} \cong 11.5\ hr$$

$$\frac{5{,}480\ gallons}{11.5\ hours} \cdot \frac{1\ ft^3}{7.48\ gal} \cdot \frac{12\ in}{1\ ft} \cdot \frac{1\ hour}{.5\ in} \cong 1{,}500\ ft^2$$

A 25-foot by 60-foot infiltration area with a depth of 6 inches will be provided. This equates to 1,500 square feet and a volume of 5,610 gallons.

6 CONSTRUCTION DRAWINGS

The proposed reservoir will be located at the site of the water system's existing reservoir and pumphouse. The proposed arsenic treatment system will be located inside of the pumphouse. Construction drawings have been prepared and are included in Appendix I.

7 OPERATION AND MAINTENANCE CONSIDERATIONS

The system is currently operated by Cascadia Water LLC, who will be responsible for system upkeep and maintenance. A system operation & maintenance manual will be provided by the treatment equipment supplier.

ATEC treatment systems typically require little operator involvement besides maintaining the proper chemical dosing. The chlorine residual will be measured after treatment to ensure that proper oxidant dosing is occurring. Arsenic and iron concentrations will also be taken after treatment to ensure they are adequately removed. The sodium hypochlorite and ferric chloride chemical storage tanks will need to be replenished on a routine basis. The filter media should last 20 years or more based on current field reports.

The water system will need to maintain and periodically clean the reservoir. The required frequency of reservoir cleaning and line flushing operations should decrease with the addition the proposed treatment system because manganese and iron will be removed in addition to arsenic.

Appendix A: System Information

Water Facilities Inventory Form

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

WATER FACILITIES INVENTORY (WFI) FORM

ONE FORM PER SYSTEM

Quarter: 2
Updated: 09/10/2019
Printed: 1/11/2022
WFI Printed For: On-Demand
Submission Reason: Pop/Connect Update

RETURN TO: Central Services - WFI, PO Box 47822, Olympia, WA, 98504-7822

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
46670 3	W&B WATERWORKS 1	ISLAND	A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS

CULLEY J. LEHMAN [MANAGER]
PO BOX 549
FREELAND, WA 98249

7. OWNER NAME & MAILING ADDRESS

CASCADIA WATER, LLC
CULLEY J. LEHMAN
PO BOX 549
FREELAND, WA 98249

MANAGER

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 18181 SR 525
CITY FREELAND STATE WA ZIP 98249

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN
ADDRESS 220 NW SECOND AVENUE
CITY PORTLAND STATE OR ZIP 97209

9. 24 HOUR PRIMARY CONTACT INFORMATION

Primary Contact Daytime Phone: (360) 331-7388
Primary Contact Mobile/Cell Phone: (360) 661-7781
Primary Contact Evening Phone: (xxx)-xxx-xxxx
Fax:
E-mail: xxxxxxxxxxxxxxxxxxx

10. OWNER CONTACT INFORMATION

Owner Daytime Phone: (360) 331-7388
Owner Mobile/Cell Phone: (360) 661-7781
Owner Evening Phone:
Fax:
E-mail: xxxxxxxxxxxxxxxxxxx

11. SATELLITE MANAGEMENT AGENCY - SMA (check only one)

- [x] Not applicable (Skip to #12)
- [ ] Owned and Managed
- [ ] Managed Only
- [ ] Owned Only

SMA NAME: _____ SMA Number:

12. WATER SYSTEM CHARACTERISTICS (mark all that apply)

- [ ] Agricultural
- [ ] Commercial / Business
- [ ] Day Care
- [ ] Food Service/Food Permit
- [ ] 1,000 or more person event for 2 or more days per year
- [ ] Hospital/Clinic
- [ ] Industrial
- [ ] Licensed Residential Facility
- [ ] Lodging
- [ ] Recreational / RV Park
- [x] Residential
- [ ] School
- [ ] Temporary Farm Worker
- [ ] Other (church, fire station, etc.): _____

13. WATER SYSTEM OWNERSHIP (mark only one)

- [ ] Association
- [ ] City / Town
- [ ] County
- [ ] Federal
- [x] Investor
- [ ] Private
- [ ] Special District
- [ ] State

14. STORAGE CAPACITY (gallons)

100,000

15	16	17	18 SOURCE CATEGORY										19 USE			20	21 TREATMENT						22	23	24 SOURCE LOCATION			
Source Number	SOURCE NAME LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456 IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE	INTERTIE SYSTEM ID NUMBER	WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN SPRINGFIELD	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	PERMANENT	SEASONAL	EMERGENCY	SOURCE METERED	NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	DEPTH TO FIRST OPEN TERVAL IN FEET	CAPACITY (GALLONS PER MINUTE)	1/4, 1/4 SECTION	SECTION NUMBER	TOWNSHIP	RANGE
S01	AGA932 WELL 1				X								X			Y	X						300	50	SE NE	22	29N	02E
S02	AGA931 WELL 2				X									X		Y	X						291	75	SE NE	22	29N	02E
S03	AGA930 WELL 3				X								X			Y	X						270	75	SE NE	22	29N	02E
S04	AGA929 WELL 4				X									X		Y	X						307	75	SE NE	22	29N	02E
S05	Wells 1,2,3,4			X									X			N	X						270	225	SE NE	22	29N	02E

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
46670 3	W&B WATERWORKS 1	ISLAND	A	Comm

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)		456	478
A. Full Time Single Family Residences (Occupied 180 days or more per year)	456		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	0		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	0		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	0		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	0	0	0
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	0	0	0
28. TOTAL SERVICE CONNECTIONS		456	478

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 1048

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?												
B. How many days per month are they present?												

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students, daycare children and/or employees are present each month that are NOT alreay included in the residential population?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	2	2	2	2	2	2	2	2	2	2	2	2

34. NITRATE SCHEDULE	QUARTERLY	ANNUALLY	ONCE EVERY 3 YEARS
(One Sample per source by time period)			

35. Reason for Submitting WFI:

☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other _____

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: _____ **DATE:** _____

PRINT NAME: _____ **TITLE:** _____

Water Rights

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

CERTIFICATE OF WATER RIGHT

☐ *Surface Water* (Issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology.)

☒ *Ground Water* (Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology.)

CERTIFICATE NUMBER	PERMIT NUMBER	APPLICATION NUMBER	PRIORITY DATE
G1-22510C	G1-22510P	G1-22510	June 4, 1975

NAME
WALTER C. LEHMAN

ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)
P. O. Box 55	Freeland	Washington	98249

This is to certify that the herein named applicant has made proof to the satisfaction of the Department of Ecology of a right to the use of the public waters of the State of Washington as herein defined, and under and specifically subject to the provisions contained in the Permit issued by the Department of Ecology, and that said right to the use of said waters has been perfected in accordance with the laws of the State of Washington, and is hereby confirmed by the Department of Ecology and entered of record as shown.

PUBLIC WATER TO BE APPROPRIATED

SOURCE
Well

TRIBUTARY OF (IF SURFACE WATERS)

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE-FEET PER YEAR
	225.0	45.0

QUANTITY, TYPE OF USE, PERIOD OF USE
Community domestic supply - continuously

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION/WITHDRAWAL
1060 feet north and 300 feet west from the east quarter of Sec. 22

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANGE, (E. OR W.) W.M.	W.R.I.A.	COUNTY
SE¼NE¼	22	29	2 E.	06	Island

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY WATER TO BE USED ON

Areas served by W. B. Water Works in Sections 15, 22, 27 and 28, T. 29, R. 2 E.W.M.

PROVISIONS

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390, and 90.44.020.

This certificate of water right is specifically subject to relinquishment for nonuse of water as provided in RCW 90.14.180.

Given under my hand and the seal of this office at Olympia, Washington, this 15th *day of* March, *19*77.

~~JOHN A. BIGGS, *Director*~~
Department of Ecology

by Robert K. McCormick
ROBERT K. McCORMICK, Regional Manager

ENGINEERING DATA
OK JJ

FOR COUNTY USE ONLY

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

CERTIFICATE OF WATER RIGHT

☐ Surface Water (Issued in accordance with the provisions of Chapter 117, Laws of Washington for 1917, and amendments thereto, and the rules and regulations of the Department of Ecology.)

☒ Ground Water (Issued in accordance with the provisions of Chapter 263, Laws of Washington for 1945, and amendments thereto, and the rules and regulations of the Department of Ecology.)

PRIORITY DATE	APPLICATION NUMBER	PERMIT NUMBER	CERTIFICATE NUMBER
August 24, 1984	G1-24539	G1-24539P	G1-24539C

NAME
Walter C. Lehman

ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)
P. O. Box 55	Freeland	Washington	98249

This is to certify that the herein named applicant has made proof to the satisfaction of the Department of Ecology of a right to the use of the public waters of the State of Washington as herein defined, and under and specifically subject to the provisions contained in the Permit issued by the Department of Ecology, and that said right to the use of said waters has been perfected in accordance with the laws of the State of Washington, and is hereby confirmed by the Department of Ecology and entered of record as shown, but is limited to an amount actually beneficially used.

PUBLIC WATER TO BE APPROPRIATED

SOURCE
4 Wells

TRIBUTARY OF (IF SURFACE WATERS)

MAXIMUM CUBIC FEET PER SECOND	MAXIMUM GALLONS PER MINUTE	MAXIMUM ACRE-FEET PER YEAR
	225	105.0*

QUANTITY, TYPE OF USE, PERIOD OF USE
Community domestic supply - continuously

* (Supplemental to Ground Water Certificate G1-22510 for a total of 150 acre-feet per year)

LOCATION OF DIVERSION/WITHDRAWAL

APPROXIMATE LOCATION OF DIVERSION—WITHDRAWAL
1060 feet north and 300 feet west from the E¼ corner of Sec. 22

LOCATED WITHIN (SMALLEST LEGAL SUBDIVISION)	SECTION	TOWNSHIP N.	RANGE, (E. OR W.) W.M.	W.R.I.A.	COUNTY
NE¼SE¼NE¼	22	29	2E	6	Island

RECORDED PLATTED PROPERTY

LOT	BLOCK	OF (GIVE NAME OF PLAT OR ADDITION)

LEGAL DESCRIPTION OF PROPERTY ON WHICH WATER IS TO BE USED

Area served by W.B. Water Works #1 located within Sections 15, 16, 22, 27 and 28, T. 29N., R. 2E.W.M. on Whidbey Island, Island County.

PROVISIONS

Permittee or its successor(s) shall submit in writing to the Department of Ecology, Northwest Regional Office, Redmond, Washington, during the months of April and August each year, the chloride concentration of the water pumped and static water level (pump off) of the well authorized by this permit. Depending on the results of this data collection, the withdrawal of ground water under this permit may be limited, or other appropriate action may be required, by Department of Ecology order, to prevent seawater intrusion into the subject aquifer.

An approved measuring device shall be installed and maintained in accordance with RCW 90.03.360, WAC 508-64-020 through WAC 508-64-040 (Installation, operation and maintenance requirements attached hereto).

The amount of water granted is a maximum limit that shall not be exceeded and the water users shall be entitled only to that amount of water within the specified limit that is beneficially used and required.

The right to the use of the water aforesaid hereby confirmed is restricted to the lands or place of use herein described, except as provided in RCW 90.03.380, 90.03.390, and 90.44.020.

This certificate of water right is specifically subject to relinquishment for nonuse of water as provided in RCW 90.14.180.

Given under my hand and the seal of this office at Redmond, *Washington, this* 15 *day of* August, *19* 86.

Department of Ecology

ENGINEERING DATA

OK.....

by Joan K. Thomas

Joan K. Thomas, Regional Manager

FOR COUNTY USE ONLY

Well Logs

Note: Carbon paper not necessary, as forms are impregnated with chemical which automatically reproduces the written material on each underlying copy.

29/02-22N

File Original and First Copy with Department of Ecology
Second Copy -- Owner's Copy
Third Copy -- Driller's Copy 29/2E/22/H

WATER WELL REPORT
STATE OF WASHINGTON

Application No. G1-22510
Permit No.

(1) OWNER: Name W B WATER WORKS #1 Address P.O. BOX 55 FREELAND WA 98249

(2) LOCATION OF WELL: County ISLAND — SE¼ NE¼ Sec. 22 T. 29 N., R. 2E W.M.
Bearing and distance from section or subdivision corner 1565' SOUTH 210 WEST FROM NE COR. SEC 22

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☒
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 310 ft. Depth of completed well 310 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 22 ft. to 300 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name COOK
Type SS Model No.
Diam. 6 Slot size 10 from 300 ft. to 310 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 60 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name STA RITE
Type: SUB H.P. 5

(8) WATER LEVELS: Land-surface elevation above mean sea level 210 ft.
Static level 252' 6" ft. below top of well Date 5-16-75
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? DRILLER
Yield: 15 gal./min. with 2 ft. drawdown after 4 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 55 Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:
Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
TOP SOIL	0	14
GRAY HARD DRY	14	10
BROWN SAND	10	62
" CLAY	62	135
" SAND	135	260
" SAND (WET)	260	310

Work started 2-25, 19 75 Completed 3-1-75, 19 75

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B & W DRILLING CO.
(Person, firm, or corporation) (Type or print)
Address P.O. Box 55 FREELAND WA 98249
[Signed] (Well Driller)
License No. 265 Date 3-15, 19 75

29/02 -22H

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name W B WATER WORKS #1 Address P.O. BOX 55 FREELAND WA 98249

(2) LOCATION OF WELL: County ISLAND — SE ¼ NE ¼ Sec. 22 T. 29 N., R. 2 W.M.

Bearing and distance from section or subdivision corner 1569' SOUTH 240' WEST FROM NE CORNER SEC 22

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 4
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 8" inches.
Drilled 264 ft. Depth of completed well 264 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from 0 ft. to 262 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON
Type S.S. Model No.
Diam. 8 Slot size .10 from 262 ft. to 264 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata.
Method of sealing strata off

(7) PUMP: Manufacturer's Name STA-RITE
Type: SUB H.P. 5

(8) WATER LEVELS: Land-surface elevation above mean sea level 260 ft.
Static level 252 ft. below top of well Date 9-8-84
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? B&W Pump
Yield: 25 gal./min. with 8 ft. drawdown after 12 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
TOP	0	1
GRAY HARD PAN	1	8
BROWN SAND	8	65
" CLAY	65	157
" SAND MED	157	255
" " MED WW	255	264

RECEIVED
AUG 14 1984
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

Work started 6-15 19 84 Completed 8-7 19 84

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B&W DRILLING CO
(Person, firm, or corporation) (Type or print)

Address P.O. BOX 55 FREELAND 98249

[Signed] Joe Ross
(Well Driller)

License No. 264 Date 8/9/84, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

●6670 w+B Wtr Wrkr ● - 504

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

(X) Construction

( ) Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

PROPOSED USE: (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK: Owner's number of well (if more than one) 504

( ) New well ( ) Reconditioned *Method:* ( ) Dug ( ) Bored ( ) Driven (X) Deepened (X) Cable ( ) Rotary ( ) Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 320 ft.

Depth of completed well 320 ft.

CONSTRUCTION DETAILS

Casing installed: (X) Welded 8" Diam. from +1 ft. to 275' ft.

( ) Liner installed _____" Diam. from _____ ft. to _____ ft.

( ) Threaded _____" Diam. from _____ ft. to _____ ft.

Perforations: (X) Yes ( ) No

Type of perforator used ?

SIZE of perfs ? in. by ? in. and no. of perfs ? from 260 ft. to 270 ft.

Screens: (X) Yes ( ) No (X) K-Pac Location _____

Manufacturer's Name Johnson

Type STAINLESS STEEL Model No. _____

Diam. 8" Slot size 10 from 307' ft. to 320' ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ( ) Yes (X) No ( ) Size of gravel/sand _____

Materials placed from _____ ft. to _____ ft.

Surface Seal: (X) Yes ( ) No To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ( ) Yes (X) No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name GRUNDFOS

Type: Submersible H.P. 10

WATER LEVELS: Land-surface elevation above mean sea level 260 ft.

Static level 252' ft. below top of well Date 4-12-1993

Artesian pressure _____ lbs. per square inch Date _____

Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? (X) Yes ( ) No If yes, by whom? _____

Yield: 100 gal./min. with 24 ft. drawdown after 4 hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 5-1-1993

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water _____ Was a chemical analysis made? ( ) Yes (X) No

CURRENT

Notice of Intent No. _____

Unique Ecology Well ID Tag No. AGA 929

Water Right Permit No. G1-22510C & G1-24539C

Property Owner Name LEHMAN Enterprises Inc

Well Street Address 1584 Roy Rd

City FREELAND County Island

Location SE 1/4-1/4 NE 1/4 Sec 22 Twn 29 R 2 (EWM or WWM) circle one

Lat/Long (s, t, r Still REQUIRED) Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. R22922-370-5000

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top soil	0	1
GRAY HARD PAN	1	8
BROWN SAND	8	65
BROWN CLAY	65	157
BROWN SAND Med.	157	255
BROWN SAND Med W.W.	255	264
BROWN SAND Med W.W.	264	320

Start Date 4-10-1993 Completed Date 4-12-1993

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

(X) Driller ( ) Engineer ( ) Trainee Name (Print) JAMES M.E. LEHMAN

Driller/Engineer/Trainee Signature James M E Lehman

Driller or trainee License No. #0263

Drilling Company B & W Pump Co.

Address P.O. Box 55

City, State, Zip FREELAND WA. 98249

Contractor's Registration No BWPumc*941RG Date 12-20-09

IF TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

Water Quality Tests

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

View Sample Detail - WSID 466703 - W&B WATERWORKS 1

Collect Date	8/12/2021
Lab Number	046
Lab Name	Edge Analytical - Burlington
Sample Number	58607
Source	01
Analyte Group	IOC-INORGANIC CONTAMINANTS
Test Panel	IOC_SHORT-INORGANIC SHORT FORM
Sample Location	sample port at well s02
Sample Type	Unknown

Result Range, A/P, Units: Mouse over for full description

Analyte DOH Num	Analyte Name	Result Range	Result Quantity	Maximum Contaminant Level	State Reporting Limit	Units
0004	ARSENIC	EQ	0.0065	0.0104	0.0010	mg/L
0016	CONDUCTIVITY	EQ	461.0000	700.0000	70.0000	Umhos/cm
0020	NITRATE-N	EQ	0.7900	10.0000	0.5000	mg/L
0021	CHLORIDE	EQ	21.6000	250.0000	20.0000	mg/L

Records 1 - 4 of 4

Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Send inquiries about DOH and its programs to the Health Consumer Assistance Office
Comments or questions regarding this Web site? Send email to Environmental Health Application Testing and Support or call 888-457-2467.

Washington State Department of Health

Division of Environmental Health
Office of Drinking Water

Help

View Sample Detail - WSID 466703 - W&B WATERWORKS 1

Collect Date	8/12/2021
Lab Number	046
Lab Name	Edge Analytical - Burlington
Sample Number	58624
Source	04
Analyte Group	IOC-INORGANIC CONTAMINANTS
Test Panel	IOC_SHORT-INORGANIC SHORT FORM
Sample Location	sample port at well s04
Sample Type	Unknown

Result Range, A/P, Units: Mouse over for full description

Analyte DOH Num	Analyte Name	Result Range	Result Quantity	Maximum Contaminant Level	State Reporting Limit	Units
0004	ARSENIC	EQ	0.0089	0.0104	0.0010	mg/L
0016	CONDUCTIVITY	EQ	458.0000	700.0000	70.0000	Umhos/cm
0020	NITRATE-N	EQ	0.5100	10.0000	0.5000	mg/L
0021	CHLORIDE	EQ	26.3000	250.0000	20.0000	mg/L

Records 1 - 4 of 4

Department of Health, Office of Drinking Water

Street Address:
243 Israel Road S.E. 2nd floor
Tumwater, WA 98501

Mail:
PO BOX 47822
Olympia, WA 98504-7822

Send inquiries about DOH and its programs to the Health Consumer Assistance Office
Comments or questions regarding this Web site? Send email to Environmental Health Application Testing and Support or call 888-457-2467.

Appendix B: Capacity Analysis Calculations

WATER SYSTEM INFORMATION

Date Printed: 11/8/2022

System:	W&B Waterworks 1
PWS ID:	46670-3
Location:	Whidbey Island, Washington
Owner:	Cascadia Water
Operator:	Cascadia Water

Operating Permit	
Issue Date	9/1/2019
Color	Green

Water Facilities Inventory (WFI) Form	
Date Printed	8/23/2019
Active Residential Connections	456
Active Residential Population	1048
Active Non-Residential Connections	0
Average Non-Residential Population	0
Approved Connections	471

WATER USAGE DATA

2016

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	60	301,368	2,254,233	82	
February					
March	61	314,611	2,353,290	85	
April					
May	61	884,152	6,613,457	238	
June					
July	62	1,294,333	9,681,611	342	
August					
September	61	758,345	5,672,421	204	
October					
November	61	291,558	2,180,854	78	
December					
SYSTEM TOTAL	366	3,844,367	28,755,865	172	

2017

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	340,389	2,546,110	95	11.5%
February					
March	61	301,419	2,254,614	81	-4.4%
April					
May	61	714,250	5,342,590	192	-23.8%
June					
July	62	1,717,980	12,850,490	455	24.7%
August					
September	61	859,961	6,432,508	231	11.8%
October					
November	61	286,267	2,141,277	77	-1.8%
December					
SYSTEM TOTAL	365	4,220,266	31,567,590	190	8.9%

2018

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	367,333	2,747,651	102	7.3%
February					
March	61	281,048	2,102,239	76	-7.2%
April					
May	61	943,006	7,053,685	254	24.3%
June					
July	62	1,471,340	11,005,623	389	-16.8%
August					
September	61	664,019	4,966,862	179	-29.5%
October					
November	61	278,439	2,082,724	75	-2.8%
December					
SYSTEM TOTAL	365	4,005,185	29,958,784	180	-5.4%

2019

Month	Days	Usage (Cubic Feet)	Usage (Gallons)	GPD/ERU	% Change from Previous Year
January	59	319,633	2,390,855	89	-14.9%
February					
March	61	351,071	2,626,011	94	19.9%
April					
May	61	1,013,073	7,577,786	272	6.9%
June					
July	62	1,270,200	9,501,096	336	-15.8%
August					
September	n/a	n/a	n/a	n/a	n/a
October					
November	n/a	n/a	n/a	n/a	n/a
December					
SYSTEM TOTAL	243	2,953,977	22,095,748	199	-3.7%

Month	2016	2017	2018	2019
January				
February	2,254,233	2,546,110	2,747,651	2,390,855
March				
April	2,353,290	2,254,614	2,102,239	2,626,011
May				
June	6,613,457	5,342,590	7,053,685	7,577,786
July				
August	9,681,611	12,850,490	11,005,623	9,501,096
September				
October	5,672,421	6,432,508	4,966,862	n/a
November				
December	2,180,854	2,141,277	2,082,724	n/a
Total	28,755,865	31,567,590	29,958,784	22,095,748
ADD	172	190	180	199
Summer usage	16,295,068	18,193,080	18,059,308	17,078,882
ADD (Summer*)	291	324	322	305
max usage	9,681,611	12,850,490	11,005,623	9,501,096
MADD (Summer*)	342	455	389	336

* May through August

Date	S01 Reading	S01 Gallons	S02 Reading	S02 Gallons	S03 Reading	S03 Gallons	S04 Reading	S04 Gallons	Days	Total Gallons	Gallons per Day
1/28/2020	649,418	0	1,000	0	177,769	0	50,007,215	0	-	0	-
1/31/2020	743,087	93,669	1,000	0	177,769	0	50,007,215	0	3	93,669	31,223
2/3/2020	827,123	84,036	3,506	2,506	180,731	2,962	50,021,401	14,186	3	103,690	34,563
2/7/2020	957,455	130,332	3,506	0	180,731	0	50,021,401	0	4	130,332	32,583
2/11/2020	1,090,397	132,942	3,506	0	189,912	9,181	50,021,401	0	4	142,123	35,531
2/14/2020	1,188,329	97,932	3,506	0	206,535	16,623	50,021,401	0	3	114,555	38,185
2/18/2020	1,263,676	75,347	3,506	0	318,695	112,160	50,021,401	0	4	187,507	46,877
2/21/2020	1,371,748	108,072	3,506	0	326,809	8,114	50,021,401	0	3	116,186	38,729
2/25/2020	1,452,432	80,684	3,506	0	460,467	133,658	50,021,401	0	4	214,342	53,586
2/28/2020	1,478,426	25,994	3,506	0	581,337	120,870	50,021,401	0	3	146,864	48,955
3/3/2020	1,543,311	64,885	3,506	0	712,708	131,371	50,021,401	0	4	196,256	49,064
3/6/2020	1,582,089	38,778	3,506	0	822,387	109,679	50,021,401	0	3	148,457	49,486
3/10/2020	1,641,777	59,688	3,506	0	976,769	154,382	50,021,401	0	4	214,070	53,518
3/13/2020	1,681,209	39,432	3,506	0	1,080,471	103,702	50,021,401	0	3	143,134	47,711
3/20/2020	1,825,803	144,594	3,506	0	1,328,111	247,640	50,021,401	0	7	392,234	56,033
3/23/2020	1,903,065	77,262	3,506	0	1,419,645	91,534	50,021,401	0	3	168,796	56,265
3/27/2020	2,005,531	102,466	3,506	0	1,563,851	144,206	50,040,075	18,674	4	265,346	66,337
3/31/2020	2,106,707	101,176	3,506	0	1,710,129	146,278	50,040,075	0	4	247,454	61,864
4/3/2020	2,191,011	84,304	3,506	0	1,814,813	104,684	50,040,075	0	3	188,988	62,996
4/6/2020	2,262,783	71,772	3,506	0	1,903,371	88,558	50,072,785	32,710	3	193,040	64,347
4/9/2020	2,344,321	81,538	3,506	0	2,016,855	113,484	50,073,176	391	3	195,413	65,138
4/13/2020	2,444,416	100,095	3,506	0	2,161,080	144,225	50,119,555	46,379	4	290,699	72,675
4/17/2020	2,565,515	121,099	3,506	0	2,294,610	133,530	50,207,031	87,476	4	342,105	85,526
4/20/2020	2,660,545	95,030	3,506	0	2,382,227	87,617	50,301,727	94,696	3	277,343	92,448
4/29/2020	2,963,377	302,832	3,506	0	2,691,795	309,568	50,440,790	139,063	9	751,463	83,496
5/4/2020	3,135,769	172,392	3,506	0	2,868,862	177,067	50,519,010	78,220	5	427,679	85,536
5/11/2020	3,352,845	217,076	102,065	98,559	3,070,473	201,611	50,797,043	278,033	7	795,279	113,611
5/15/2020	3,475,736	122,891	102,065	0	3,180,481	110,008	50,965,239	168,196	4	401,095	100,274
5/21/2020	3,605,199	129,463	102,065	0	3,275,824	95,343	51,366,256	401,017	6	625,823	104,304
5/29/2020	3,806,041	200,842	102,065	0	3,451,618	175,794	51,875,269	509,013	8	885,649	110,706
6/1/2020	3,904,187	98,146	102,065	0	3,552,817	101,199	51,945,022	69,753	3	269,098	89,699
6/8/2020	4,102,590	198,403	102,065	0	3,771,354	218,537	52,167,311	222,289	7	639,229	91,318
6/29/2020	4,700,010	597,420	140,777	38,712	4,400,843	629,489	52,717,197	549,886	21	1,815,507	86,453
7/3/2020	4,931,023	231,013	189,015	48,238	4,514,976	114,133	52,852,809	135,612	4	528,996	132,249
7/17/2020	5,373,869	442,846	300,440	111,425	4,878,381	363,405	53,855,817	1,003,008	14	1,920,684	137,192
7/21/2020	5,505,118	131,249	461,165	160,725	4,958,847	80,466	54,102,736	246,919	4	619,359	154,840
7/23/2020	5,570,554	65,436	539,678	78,513	4,997,366	38,519	54,220,021	117,285	2	299,753	149,877
7/31/2020	5,838,146	267,592	867,271	327,593	5,209,413	212,047	54,868,276	648,255	8	1,455,487	181,936
8/3/2020	5,938,305	100,159	985,875	118,604	5,299,731	90,318	55,142,752	274,476	3	583,557	194,519
8/6/2020	6,038,045	99,740	1,108,920	123,045	5,401,605	101,874	55,443,476	300,724	3	625,383	208,461
8/14/2020	6,316,137	278,092	1,448,910	339,990	5,633,845	232,240	56,071,741	628,265	8	1,478,587	184,823

8/17/2020	6,413,209	97,072	1,567,790	118,880	5,746,777	112,932	56,364,119	292,378	3	621,262	207,087
8/20/2020	6,513,412	100,203	1,690,036	122,246	5,843,769	96,992	56,614,083	249,964	3	569,405	189,802
8/31/2020	6,879,699	366,287	2,128,261	438,225	6,179,730	335,961	57,484,466	870,383	11	2,010,856	182,805
9/14/2020	7,333,067	453,368	2,523,207	394,946	6,635,025	455,295	58,644,712	1,160,246	14	2,463,855	175,990
9/18/2020	7,460,543	127,476	2,523,207	0	6,775,789	140,764	58,997,931	353,219	4	621,459	155,365
9/22/2020	7,585,533	124,990	2,523,207	0	6,895,376	119,587	59,297,041	299,110	4	543,687	135,922
9/25/2020	7,674,402	88,869	2,525,721	2,514	6,972,642	77,266	59,497,098	200,057	3	368,706	122,902
9/28/2020	7,762,536	88,134	2,529,543	3,822	7,025,081	52,439	59,635,533	138,435	3	282,830	94,277
10/12/2020	8,164,621	402,085	2,541,665	12,122	7,216,611	191,530	60,188,405	552,872	14	1,158,609	82,758
10/29/2020	8,638,590	473,969	2,921,292	379,627	7,216,611	0	60,188,405	0	17	853,596	50,212
11/2/2020	8,745,383	106,793	3,021,786	100,494	7,216,611	0	60,188,405	0	4	207,287	51,822
11/5/2020	8,828,889	83,506	3,095,991	74,205	7,216,611	0	60,188,405	0	3	157,711	52,570
11/10/2020	8,956,264	127,375	3,239,534	143,543	7,216,611	0	60,188,405	0	5	270,918	54,184
11/17/2020	9,148,567	192,303	3,427,461	187,927	7,223,092	6,481	60,212,015	23,610	7	410,321	58,617
11/20/2020	9,238,815	90,248	3,490,752	63,291	7,223,092	0	60,212,015	0	3	153,539	51,180
11/23/2020	9,315,825	77,010	3,573,911	83,159	7,223,092	0	60,212,015	0	3	160,169	53,390
11/30/2020	9,513,419	197,594	3,776,669	202,758	7,223,092	0	60,212,015	0	7	400,352	57,193
12/7/2020	9,699,034	185,615	3,959,774	183,105	7,224,345	1,253	60,217,035	5,020	7	374,993	53,570
12/7/2020	9,703,921	4,887	3,984,181	24,407	7,235,078	10,733	60,217,035	0	0	40,027	0
12/14/2020	9,895,978	192,057	4,137,907	153,726	7,237,319	2,241	60,257,113	40,078	7	388,102	55,443
12/18/2020	10,018,264	122,286	4,236,509	98,602	7,237,319	0	60,265,823	8,710	4	229,598	57,400
										MDD	208,461

CONNECTIONS BASED ON WATER USE DATA

Date Printed: 11/8/2022

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

Year	Active Connections	Active Metered	Active Unmetered	Ready to Serve	Committed Connections
2016	456	456	0		
2017	456	456	0		
2018	456	456	0		
2019	456	456	0		
2020	456	456	0		
2021	456	456	0		

Proposed Connections: 471

WATER RIGHTS SUMMARY

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

Certificate #	Name	Priority Date	Source Name	Primary or Supplemental	Q_i (gpm) Additive	Q_i (gpm) Non-Additive	Q_a (acre-ft) Additive	Q_a (acre-ft) Non-Additive
G1-22510P	W&B Waterworks	06/04/75	4 Wells	Primary	225		45	
G1-24539C	W&B Waterworks	08/24/84	4 Wells	Primary		225	105	
				Total	225		150	Total
				max flow per day (gal)	162,000		6,534,000	annual water rights (CF/yr)
				max flow per year (gal)	59,130,000		48,874,320	annual water rights (gal/yr)
							133,902	avg available daily water rights (gal)

Q_i = Maximum Instantaneous Flow Rate
V_a = Maximum Annual Withdrawal

Conversion Factors	
square feet per acre	43,560
gallons per CF	7.48
days per year	365
hours per day	24

Pump	
pump cycles per hour	6
pump run per hour (min)	30
pump run per day (min)	720

SOURCE INFORMATION

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

Source						
Status	Active					Emergency
Source ID	Well 1	Well 2	Well 3	Well 4		
IC Hydrogeo ID						
DOE Well Tag	AGA932	AGA931	AGA930	AGA929		
Category	Well	Well	Well	Well		
Use	Permanent	Seasonal	Permanent	Seasonal		
Treatment	None	None	None	None		
Capacity (gpm)	50	75	75	75		
Depth to First Interval (ft)	300	291	270	307		
Casing (in)						
Screen Diameter (in)						
Location						
1/4, 1/4	SE NE	SE NE	SE NE	SE NE		
Section	22	22	22	22		
Township	29N	29N	29N	29N		
Range	02E	02E	02E	02E		

DEMAND BASED ON WATER USE DATA

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

Year	Active Connections	Annual Withdrawal (gal)	Annual Withdrawal (ac-ft)	Annual Usage (gal)	Summer* Usage (gal)	Maximum Month Usage (gal)	DSL / Unauthorized Use (gal)	Annual ADD (gpd)	Summer* ADD (gpd)	Maximum Month ADD (gpd)	Annual ADD (gpd/ERU)	Summer* ADD (gpd/ERU)	MMADD (gpd/ERU)	MDD** (gpd/ERU)
2018	456	32,599,102	100.0	29,958,784	18,059,308	5,502,812	2,640,318	88,727	158,715	191,887	195	348	421	568
2021	456	31,092,287	95.4	28,355,939	17,078,882	4,750,548	n/a	98,541	150,477	166,073	216	330	364	492
2020	456	30,922,513	94.9	n/a	n/a	5,889,050	n/a	95,146	-	189,969	209	n/a	417	457
	Average	31,537,967	96.8	29157361.4	17569095.1	5380803.2	2640318.2	94138.1	154596.3	182643.1	206.4	339.0	400.5	506
	Minimum	30,922,513	94.9	28355939.0	17078882.0	4750548.0	2640318.2	88726.7	150477.3	166072.8	194.6	330.0	364.2	492
	Maximum	32,599,102	100.0	29958783.8	18059308.1	5502811.6	2640318.2	98541.5	158715.4	191887.2	216.1	348.1	420.8	568

* May through August
** MDD = 1.35(MMAD)

	Proposed		
ADD	220	gpd/ERU	
MDD	570	gpd/ERU	Based on MDD

SOURCE-BASED PHYSICAL CAPACITY

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

WATER RIGHT CALCULATIONS

Based on Annual Volume & Average Day Demand (Eqn 4-4b):

$N = Q_a/(365*ADD)$

Where: N = Number of Service Connections, ERUs
Q_a = Annual Volume of Water Available from All Sources, as limited by Water Right (gallons/year)
ADD = Average Daily Demand per ERU (gpd/ERU)

	V_a (gal/year)	ADD (gpd/ERU)	N (ERUs)
Potential Connections	48,874,320	220	609

Based on Instantaneous Flow & Maximum Day Demand (Eqn 4-4a):

$N = V_d/MDD = (Q_i*t_d)/MDD$

Where: N = Number of Service Connections, ERUs
V_d = Total Volume of Water Available for Maximum Day's Demand (gpd)
MDD = Maximum Daily Demand per ERU (gpd/ERU)
Q_i = Instantaneous Maximum Water Right Flow Rate (gpm)
t_d = Time that source operates per day (minutes/day)

	Q_i (gpm)	Minutes Pumped/Hr	t_d (min/day)	MDD (gpd/ERU)	N (ERUs)
Potential Connections	225	60	1440	570	568

SOURCE CALCULATIONS

Individual Source Capacity (Eqn 4-1):

$V_j = Q_j*t_j$

Where: Vj = Total volume for source "j" over a specified period of time (gal/specified time period)
Qj = Delivery rate of source (gal/unit time)
tj = Time that flow (Qj) was delivered from source "j"

Total Source Capacity (Eqn 4-2):

$V_T=sum(Q_j*T_j)$

Where: V_T = Total volume of water available to the system over a specified period of time (gal/specified time period)
Q_j = Delivery rate of source (gal/unit time)
t_j = Time that flow (Q_j) was delivered from source "j"

Source ID	Well 1	Well 2	Well 3	Well 4	
Q_j Delivery Rate (gpm)	50	75	75	75	
Max Pump Time (min/day)	1200	1200	1200	1200	
Max Days Pumped (days/yr)	365	365	365	365	
V_j Source Capacity (gal/yr)	21,900,000	32,850,000	32,850,000	32,850,000	

Q_s = 275 gpm

V_T = 120,450,000 gal/yr

Based on Source Capacity & Average Day Demand (Eqn 4-4b)

$N = V_T/(365*ADD)$

Where: N = Number of Service Connections, ERUs
V_T = Annual Volume of Water Available from All Sources, except Emergency Sources (gallons/year)
ADD = Average Daily Demand per ERU (gpd/ERU)

	V_T (gal/year)	ADD (gpd/ERU)	N (ERUs)
Potential Connections	120,450,000	220	1,500

Based on Source Production & Maximum Day Demand (Eqn 4-3):

$N = V_T/MDD = (Q_s*t_d)/MDD$

Where: N = Number of Service Connections, ERUs
V_T = Total Volume of Water Available for Maximum Day's Demand (gpd)
MDD = Max Daily Demand per ERU (gpd/ERU)
Q_s = Total Well Production Flow rate (gpm)
t_d = Time that source operates per day (minutes/day)

	Q_s (gpm)	Minutes Pumped/Hr	t_d (min/day)	MDD (gpd/ERU)	N (ERUs)
Potential Connections	275	50	1200	570	579

SOURCE-BASED PHYSICAL CAPACITY

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

BOOSTER PUMP CALCULATIONS

Based on Booster Pump Production & Maximum Day Demand:

N= [(PHD - 18)1440/MDD -F]/C

Where: N = Number of Service Connections, ERUs
PHD = Peak Hour Demand (gallons/minute) (Booster Pump Capacity)
MDD =Maximum Daily Demand per ERU (gpd/ERU)
F = PHD Coefficient from Table 3-1
C = PHD Coefficient from Table 3-1

	Q_B (gpm)	C	F	MDD (gpd/ERU)	N (ERUs)
Potential Connections	80	2.5	25	570	66

*The booster pumps only serve 11 connections on Roy Road.

TREATMENT CALCULATIONS

Based on Treatment Max Design Flow & Maximum Day Demand (Eqn 4-4a):

$N = V_d/MDD = (Q_t * t_d)/MDD)$

Where: N = Number of Service Connections, ERUs
V_d = Total Volume of Water Available for Maximum Day's Demand (gallons/day)
MDD = Maximum Daily Demand per ERU (gpd/ERU)
Q_t = Treatment System Maximum Design Flow Rate (gpm)
t_d = Time that source operates per day (minutes/day)

	Q_t (gpm)	Minutes Pumped/Hr	t_d (min/day)	MDD (gpd/ERU)	N (ERUs)
Potential Connections	225	57	1358	570	536

SUMMARY

ERUs	Condition	Limiting Factor
609	Water Right	V_a & ADD
568	Water Right	Q_i & MDD
1,500	Source	V_T & ADD
579	Source	Q_s & MDD
66	Booster Pump (Pressurized Zone)	Q_B & MDD
536	Treatment	Q_t & MDD

System Capacity: 536 ERUs
* 101 connections max. in pressurized zone
Limited by: Qt & MDD Treatment
Proposed connections: 536 ERUs

PEAK HOUR DEMAND (PHD) CALCULATION

Date Printed: 11/8/2022

System: W&B Waterworks 1
PWS ID: 46670-3
Location: Whidbey Island, Washington

From DOH Water System Design Manual (Section 3.4.2)

Equation 3-1: PHD = (MDD/1440)[(C)(N) + F] + 18

Where:
PHD = Peak Hourly Demand, (gpm)
C = Coefficient Associated with Ranges of ERUs
N = Number of Service Connections, ERUs
F = Factor Associated with Ranges of ERUs
MDD = Maximum Day Demand, (gpd/ERU)

Table 3-1:

Range of N (ERUs)		C	F
15	50	3.0	0
51	100	2.5	25
101	250	2.0	75
251	500	1.8	125
501	1,000,000	1.6	225

MDD (gpd/ERU)	N (ERUs)	C	F	PHD (gpm)	
570	456	1.8	125	392	2020 ERUs
570	472	1.8	125	404	2026 ERUs
570	550	1.6	225	455	Reservoir Design Min.
570	471	1.8	125	403	Current DOH Approved
570	536	1.6	225	447	Max ERUs

STORAGE CAPACITY CALCULATIONS

System: W&B Waterworks 1
ID No.: 46670-3
Location: Whidbey Island, Washington

Demands	
N (ERUs)	550
ADD (gpd/ERU)	220
MDD (gpd/ERU)	570
PHD (gpm)	455

Sources	
Source ID	Delivery Rate (gpm)
Well 1	50
Well 2	75
Well 3	75
Well 4	75
Q_s =	275
Q_s =	225 water right limited
Q_L =	75 largest source

Reservoirs						
Reservoir ID	Diameter (ft)	Area (ft^2)	Height (ft)	Base Elevation (ft)	Volume (gal)	VF (gal/ft)
Reservoir	30	706.9	35	280	185,056	5,287
				Total	185,056	5,287

Top Dead Storage (TDS)	
Depth (ft)	Volume (gal)
0.75	3,965

Operational Storage (OS)	
Depth (ft)	Volume (gal)
4.0	21,149

Treatment Run Time 94 minutes (desire 60 miutes or more) 70.50
7930.95

Required Equalizing Storage (ES)			
PHD (gpm)	Q_s (gpm)	Volume (gal)	Depth (ft)
455	225	34,559	6.5

ES = (PHD-Q_s)*150 or Zero

Recommended Standby Storage (SB)			
Recommended SB per Connection (gal/ERU)	N (ERUs)	Rcommended SB Volume (gal)	Depth (ft)
200	550	110,000	20.8

SB_{TMS} = (200)(N) or (100)(N) when reduction is applied (see section 7.1.1.3 of the Manual)

Available Standby Storage (SB)			
Storage Provided (gal/ERU)	N (ERUs)	Volume (gal)	Depth (ft)
200	607	121,416	23.0

SB = Total Storage Volume -TDS-OS -ES-BDS

STORAGE CAPACITY CALCULATIONS

System: W&B Waterworks 1
ID No.: 46670-3
Location: Whidbey Island, Washington

Fire Suppression Storage (FSS)		
Fire Flow (gpm)	t_m (min)	Volume (gal)
500	30	15,000

$FSS = FF * t_m$

Where: FF = Required fire flow rate (gpm)
t_m = Duration of FF rate (minutes)

Bottom Dead Storage (BDS)	
Depth (ft)	Volume (gal)
0.75	3,965

Available Storage Summary		
Component	Volume (gal)	Depth of Storage Component (ft)
TDS	3,965	0.75
OS	21,149	4.0
ES	34,559	6.5
SB/FSS	121,416	23.0
BDS	3,965	0.75
Total	185,056	35.0

Is the available SB/FSS...	
greater than recommended SB?	greater than required FSS?
yes	yes

Appendix C: Water Right Self-Assessment

Water Right Self-Assessment Form for W&B Waterworks

Mouse-over any link for more information. Click on any link for more detailed instructions.

Water Right Permit, Certificate, or Claim # *If water right is interruptible, identify limitation in yellow section below	WFI Source # If a source has multiple water rights, list each water right on separate line	Existing Water Rights Qi= Instantaneous Flow Rate Allowed (GPM or CFS) Qa= Annual Volume Allowed (Acre-Feet/Year) This includes wholesale water sold				Current Source Production – Most Recent Calendar Year Qi = Max Instantaneous Flow Rate Withdrawn (GPM or CFS) Qa = Annual Volume Withdrawn (Acre-Feet/Year) This includes wholesale water sold				10-Year Forecasted Source Production (determined from WSP) This includes wholesale water sold				20-Year Forecasted Source Production (determined from WSP) This includes wholesale water sold			
		Primary Qi Maximum Rate Allowed	Non-Additive Qi Maximum Rate Allowed	Primary Qa Maximum Volume Allowed	Non-Additive Qa Maximum Volume Allowed	Total Qi Maximum Instantaneous Flow Rate Withdrawn	Current Excess or (Deficiency) Qi	Total Qa Maximum Annual Volume Withdrawn	Current Excess or (Deficiency) Qa	Total Qi Maximum Instantaneous Flow Rate in 10 Years	10-Year Forecasted Excess or (Deficiency) Qi	Total Qa Maximum Annual Volume in 10 Years	10-Year Forecasted Excess or (Deficiency) Qa	Total Qi Maximum Instantaneous Flow Rate in 20 Years	20-Year Forecasted Excess or (Deficiency) Qi	Total Qa Maximum Annual Volume in 20 Years	20-Year Forecasted Excess or (Deficiency) Qa
1 G1-22510C	Groundwater	225 gpm	---	45.0 ac-ft	---			45.0 ac-ft	0.0 ac-ft			45.0 ac-ft	0.0 ac-ft			45.0 ac-ft	0.0 ac-ft
2 G1-24539C	Groundwater	---	225 gpm	105.0 ac-ft	---	225 gpm	0 gpm	55.0 ac-ft	50.0 ac-ft	225 gpm	0 gpm	70.0 ac-ft	35.0 ac-ft	225 gpm	0 gpm	99.3 ac-ft	5.7 ac-ft
3																	
4																	
5																	
6																	
	TOTALS =	225 gpm		150 ac-ft		225 gpm	0 gpm	100 ac-ft	50.0 ac-ft	225 gpm	0 gpm	115.0 ac-ft	35.0 ac-ft	225 gpm	0 gpm	114.3 ac-ft	5.7 ac-ft
Column Identifiers for Calculations:		A		B		C	=A-C	D	=B-D	E	= A-E	F	=B-F	G	=A-G	H	=B-H

PENDING WATER RIGHT APPLICATIONS: Identify any water right applications that have been submitted to Ecology.

Application Number	New or Change Application?	Date Submitted	Quantities Requested			
			Primary Qi	Non-Additive Qi	Primary Qa	Non-Additive Qa
n/a						

INTERTIES: Systems receiving wholesale water complete this section. Wholesaling systems must include water sold through intertie in the current and forecasted source production columns above.

Name of Wholesaling System Providing Water	Quantities Allowed In Contract		Expiration Date of Contract	Currently Purchased Current quantity purchased through intertie				10-Year Forecasted Purchase Forecasted quantity purchased through intertie				20-Year Forecasted Purchase Forecasted quantity purchased through intertie			
	Maximum Qi Instantaneous Flow Rate	Maximum Qa Annual Volume		Maximum Qi Instantaneous Flow Rate	Current Excess or (Deficiency) Qi	Maximum Qa Annual Volume	Current Excess or (Deficiency) Qa	Maximum Qi 10-Year Forecast	Future Excess or (Deficiency) Qi	Maximum Qa 10-Year Forecast	Future Excess or (Deficiency) Qa	Maximum Qi 20-Year Forecast	Future Excess or (Deficiency) Qi	Maximum Qa 20-Year Forecast	Future Excess or (Deficiency) Qa
1 n/a															
2															
3															
TOTALS =															
Column Identifiers for Calculations:	A	B		C	=A-C	D	=B-D	E	=A-E	F	=B-F	G	=A-G	H	=B-H

INTERRUPTIBLE WATER RIGHTS: Identify limitations on any water rights listed above that are interruptible.

Water Right #	Conditions of Interruption	Time Period of Interruption
1		
2		
3		

ADDITIONAL COMMENTS:

W&B Waterworks 1

Appendix D: Seawater Intrusion Analysis

Island County Public Water System Sources
Seawater Intrusion Risk Ratings

Island County Public Health

System Name	PwsID	Source Number	Source Name	Well Key	SWI Rating	Monitoring Required
Tyee Grocery Water System	AC475	01	Well	98J	V-High	Yes
University Lions-Camano Youth Camp	52924	01	AGA501 University Lio	A4H	Low	No
Useless Bay Shores	33261	01	AGA789 WELL 1	77X	Med	Yes
Utsalady Bay Shore	AB944	01	Well # 1 ALT170	3RX	Low	No
Utsalady Heights Owners Assn	00982	01	AGA758 Well	BFY	ND	No
Utsalady Point	90850	01	AGA775 WELL	3QR	Low	No
Utsalady Water	90847	01	AGA759 WELL 1	BN7	Low	No
Valdez Water System	61291	01	WELL #1 APH136	BNP	Low	No
Valley High Park	90976	01	(ABR418) WELL #1	4XG	Low	No
Vanderwell Road Water System	23479	01	WELL #1 AKY798	4NU	Low	No
Veterans of Foreign Wars Post 7392	90879	01	VFW AGA532	4XV	Low	No
Veterans of Foreign Wars Post 7392	90879	02	VFW BAA999	4XW	Low	No
View Ridge Estates Water System	AC620	01	Well APR939	DHP	Med	Yes
View Ridge Water Co	31601	01	WELL APR755	3QA	V-High	Yes
View Road Water System	44818	01	WELL ALT136	FDC	ND	No
View Water System	03692	01	WELL #1 ALQ391	FA3	Low	No
Viewcrest Water System	91902	01	AGA970 DRILLED WE	444	Low	No
Vista Camano Water Association	15661	01	Well #1 AKY743	3JJ	Low	No
Vistaire Water System	57414	01	AGA909 Well A	7RQ	Low	No
Vistaire Water System	57414	02	InAct 06/20/2007 BCB7	7GR	Low	No
Vistaire Water System	57414	03	BAA966 Well B	7MA	Low	No
W&B Waterworks 1	46670	01	AGA932 WELL 1	7BU	Med	Yes
W&B Waterworks 1	46670	02	AGA931 WELL 2	7CB	Med	Yes
W&B Waterworks 1	46670	03	AGA930 WELL 3	7BX	Med	Yes
W&B Waterworks 1	46670	04	AGA929 WELL 4	7BV	Med	Yes
Wagon Wheel	92070	01	Well 1 BCB778	4XY	Low	No
Wagon Wheel	92070	02	Well 2 BCB779	FKV	Low	No
Waif Water System	AC171	01	Well APR969	DPX	Low	No
Wallace Family Water System	AD505	01	Well 1	94F	Med	Yes
Waterloo Acres Community Water Sys	93580	01	AGA872 WATERLOO	43J	Low	No
Waterloo Water Company	10514	01	WELL #1 ALQ100	4YW	Low	No
Waterman Enterprises, Inc.	93584	01	WELL APH036	7J9	Low	No
Waynes Ridge Water Assoc	93909	01	AGA732 WELL 1	B7R	Low	No
Waynes Ridge Water Assoc	93909	02	BKI181 WELL 2	HRK	Low	No
Well Being Water System	45104	01	WELL #1 ALQ053	G7H	Low	No
Wells Estate Water System	01174	01	WELL #1 ALT139	9HN	V-High	Yes
West Beach Road Association	17970	01	AGA969 Well 1	3TJ	V-High	Yes
West Camano Water Association	02628	01	WELL #1 ALT143	377	ND	No
West Deer Lake ~1	00615	01	WELL #1 AKY708	73B	Low	No
West Meadows Water System	01512	01	WELL #1 APH117	49U	ND	No
West Ridge Water System	94942	01	APR773 Well 1	4XJ	Low	No
West Ridge Water System	94942	02	APR774 Well 2	BAU	Low	No

Appendix E: Treatment Pilot Test Report

ATEC SYSTEMS ASSOCIATES

August 24, 2021

TO: Jeff Tasoff, PE
Principal-Civil Engineering
Davido Consulting Group, Inc.
T 360.331.4131 x203

FROM: Cullen J. Wilder, P.E.[1]

SUBJECT: Summary of Pilot Testing, W B Water Works, Well 4

On July 20 and July 21, 2021, we pilot tested two of four wells of a well field owned by WB Waterworks, Well 1 and Well 4. The purpose of the pilot test was to determine the efficacy of the ATEC system in removing manganese, iron and arsenic from the water produced by this well field and to identify the optimal ATEC filtration equipment for treatment that will reliably remove these contaminants to less than their Maximum Contamination Levels set by the USEPA.

The pilot filter system is designed to simulate actual operation of an ATEC filter system on a small scale in terms of retention, media depth, flow per cubic foot of media, flow per square foot of media (loading rate) and so forth. During the pilot testing the pilot trailer's field lab was used to determine chlorine, iron, manganese, hydrogen sulfide (H_2S) and ammonia concentrations in the raw and finished water. Arsenic samples were sent to the lab.

Excellent pilot test results were attained in the pilot testing. Based on these results, an ATEC filter system comprised of (8) 30-inch filters with 60-inch sidewalls filled with 42-inches of AS 741 M (pyrolusite) media is recommended. The eight filters would be preceded by two empty filters to provide about 1 minute of retention to aid in the removal of arsenic. The system would be delivered on four skids, with piping, manifolds, valves. underdrain and underdrain support factory installed. Preliminary plans for the recommended system are given in this report.

The capacity of the each of the four wells is 100 gpm. The treatment plant should have a capacity of 225 gpm.

The remainder of the report discusses the pilot testing and the recommended system. This report is meant to summarize and document the results of the pilot testing and the basis for the recommended systems. This pilot test report should be helpful in preparing a Technical report that might be required by the Washington DOH but is not meant to satisfy their requirements.

General Description of the ATEC Iron, Manganese and Arsenic Removal Process

ATEC Systems uses pyrolusite based media for its high-rate arsenic, iron, and manganese removal systems. The iron is oxidized to its insoluble state and filtered while the manganese is adsorbed on the surface of the media where it is secured and oxidized in place. Chlorine is injected upstream of the filters. The chlorine is used to oxidize the iron and to maintain the filter bed in an oxidized state, not to oxidize and precipitate the manganese as is the case with most other treatment systems.

In this pilot test, chlorine application was ahead of a 60-inch section of 6-inch diameter pipe (to aid in arsenic removal) followed by four 6-inch diameter filter columns with 60-inch filter sidewalls. The filters are manifolded together at the inlet and outlet and filled with 42-inches of Pyrolox Advantage Filter Media.[2] The pilot test characteristics are given in the Appendix.

[1] Registered in WA and CA
[2] This media has the same treatment characteristics as the AS 741 M media recommended.

Ferric chloride was added in varying amounts after the retention for arsenic co-precipitation.

Pilot testing results for the wells are tabulated in Tables 1 and 2 and shown graphically in Figures 1, 2, 3 and 4 of this report.

Pilot Test Results

Of the two wells tested, Well 4 had higher concentrations of arsenic, iron and manganese the constituents needing removal than Well 1. For the purposes of sizing the treatment system and discussion in the report, the water quality of Well 4 will be used as representative of the worst of any combination of wells in the well field making up the 225 gpm treatment capacity.

A total of 12 samples were taken on a half-hourly basis until the end of the test. The average loading rate was 6.24 gpm/sf.

Raw water iron concentration was consistent and averaged 0.15 mg/L, 50 percent of the Secondary Maximum Contamination Level (SMCL) of 0.30. Manganese concentrations were also consistent and averaged 0.381 mg/L, 762 % of the SMCL of 0.050 mg/L.

Two tests of arsenic were taken of the raw water, 9.1 µ/mg and 9.2 µ/mg each greater than 90 percent of the Maximum Contamination Level (MCL) of 10 µ/L.

In three tests, ammonia averaged 0.327 mg/L. The USEPA has no maximum standard for ammonia, but its presence can be the cause of taste and odor complaints.

Chlorine dosage varied from 3.23 mg/L to 6.19 mg/L averaging 4.92 mg/L. Treated water chlorine concentration averaged 1.83 mg/L. The average chlorine demand was 3.09 mg/L.

Ferric Chloride dosage averaged 1.11 mg/L as iron.

Iron concentrations in the finish water were mostly below the detection limit

Manganese removal was excellent. Finish water manganese concentrations averaged 0.01 mg/L, 19 percent of the SMCL of 0.050 mg/L.

Arsenic removal also was excellent reducing the arsenic from about 90 percent of the SMCL to an average 2.4 µ/mg, 24 percent of the MCL of 10 µ/L.

In three tests of the finish water, ammonia concentrations were reduced by about 2/3 to an average of 0.113 mg/L. In other ATEC systems, we have found that the removal of ammonia takes time for completion and that its concentration diminishes or disappears with time in storage or the distribution system.

We understand that the well will pump into a nearby reservoir providing about about 7 psi system pressure. Because the treatment system requires 20-30 psi to regulate the backwash, the design engineer should include a means to increase the pressure when backwashing. One that has been done is to provide a pressure sustaining valve on the finish water line that would be activated during backwash.

The needed backwash is 137 gpm. The design engineer will need to control the wells so that flow is provided during backwash.

There was a loss of silica across the media in one test of Well 1. ATEC has found that a loss of silica over the media can cause the decrease of treatment efficacy over time. In a proprietary process we have found that a small dosage (0.1 mg/L as manganese) will prevent this treatment denigration.

The design engineer should strongly consider including a permanganate feed system in his design. If one is not included, or if one is not used, silica should be tested at least once a month. If there is a loss in treatment efficacy, a loss of silica across the media is the likely cause.

Recommended System

At the treatment objective of 225 gpm capacity, the recommended system of (8) 30-inch diameter filters would have a loading rate of 5.74 gpm/sf during production and 6.55 gpm/sf during the 40 minutes of backwash when one filter was out of service.

Summary

Based on ATEC's experience with previous systems with similar water, we recommend that backwash should be set initially at 12 hours. The system should be observed for 6 to 8 weeks to determine whether the interval should be adjusted.

Preliminary drawings for this system are included in this report.

Summary of the Recommended Filter System

Parameter	Value
Production Rate	225 gpm
Loading Rate	5.74 gpm/sf
Backwash Rate	28 gpm/sf
Backwash Flow	133 gpm
Backwash Duration	5-minutes per filter
Backwash Frequency	12 hours of production
Backwash Amount	5,320 gallons
Production Between Backwash Cycles	162,000 gallons
Backwash as a Percentage of Production	3.3 %

Please contact me if you have any questions or need further information.

Yours truly,

Cullen Wilder

Cullen J. Wilder, P.E. (CA, WA)
Vice President
ATEC Systems Associates, Inc.
916-742-5542 (direct)

W B Waterworks

Wells 1 – 4 Well Field

Well 4 Pilot Test

Table 1
Summary of Pilot Study Test Conditions
WB Water Works, Well 4
July 21, 2021

Date	Sample Number	Time	Meter Reading (Gallons)	Average Flow (gpm)	Loading Rate (gpm/ft^2)	Loading Rate (gpm/ft^3)	Media Contact Time (Minutes)	Cl_2 Dose (mg/L)	$FeCl_3$ Dose (mg/L) as Fe	Temp °C
7/21	Start	8:30	-	4.78	6.09	1.74	4.30	4.00	ND	10.9
	1	9:00	142.1	4.74	6.03	1.72	4.34	3.23	1.25	NT
	2	9:30	284.5	4.75	6.04	1.73	4.33	5.07	1.34	NT
	3	10:00	424.4	4.66	5.94	1.70	4.41	4.10	1.08	NT
	4	10:30	576.9	5.08	6.47	1.85	4.04	3.76	1.10	NT
	5	11:00	705.0	4.27	5.44	1.55	4.82	6.72	1.23	NT
	6	11:30	854.3	4.98	6.34	1.81	4.13	5.76	1.07	NT
	7	12:00	994.6	4.68	5.95	1.70	4.40	6.13	1.05	NT
	8	12:30	1,133.5	4.63	5.90	1.68	4.44	6.19	1.03	NT
	9	13:00	1,276.6	4.77	6.07	1.74	4.31	5.21	1.02	NT
	10	14:00	1,567.3	4.85	6.17	1.76	4.24	5.13	1.02	NT
	11	15:00	1,966.8	6.66	8.48	2.42	3.09	3.73	1.02	NT
Total or Average			**1,966.80**	4.90	6.24	1.78	4.24	4.92	1.11	10.9

NA, indicates Not Applicable for this test
Not Dosed, (ND) indicating the period of the test
Not Tested, (NT) indicating no value entered because there was no sample to test
Media contact time = Empty bed contact time

Design 225 gpm, well 100 gpm, ≤ 7 psi (pump to resevoir)
Used 42" Pyrolox ™Advantage media
Sodium Hypochlorite titrated @ 6882.0
Used 60" long X 6" diameter contact tank
BW start of test
pH meter quit working after first reading
Breakpoint Annalysis (readings 15 minutes apart)
Cl_2 Free/Total 0.34/1.84; 0.17/1.46; 0.21/1.03; 0.20/0.89; 0.17/0.74; 0.20/0.64; 0.17/0/63
BW end of test

Table 2
Summary of Pilot Test Results
WB Water Works, Well 4
July 21, 2021

	Source Water								Product Water									
Sample Number	**pH (Units)**	**Fe (mg/L)**	**Mn (mg/L)**	**H_2S (mg//L)**	**Ammonia (mg//L)**	**Silica (mg/L)**	**As (lab) (ppb)**	**PSI**	**pH (Units)**	**Cl_2 (F) (mg/L)**	**Cl_2 (T) (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**	**H_2S (mg//L)**	**Ammonia (mg//L)**	**Silica (mg/L)**	**As (lab) (ppb)**	**PSI**
Start	**8.25**	0.16	0.371			17.70		40	**8.23**	**1.17**	**1.97**	0.02	0.016			18.80		39
1	**NT**	0.16	0.380		0.370			40	**NT**	**0.22**	**1.66**	-	0.004		0.210			39
2	**NT**	0.19	0.381	-			9.1	40	**NT**	**0.37**	**1.06**	-	0.013	-			2.3	39
3	**NT**	0.17	0.383		0.340			40	**NT**	**0.32**	**1.58**	-	0.013		0.130			39
4	**NT**	0.16	0.380	-				40	**NT**	**0.34**	**1.89**	-	0.003	-				39
5	**NT**	-	0.387			17.90		40	**NT**	**1.13**	**1.97**	-	0.003			17.90	2.4	39
6	**NT**	0.14	0.387					40	**NT**	**1.13**	**1.43**	-	0.018					39
7	**NT**	0.12	0.381					40	**NT**	**1.17**	**2.23**	-	0.008					39
8	**NT**	0.18	0.394		0.270			39	**NT**	**1.67**	**2.16**	0.01	0.011		-		2.6	38
9	**NT**	0.13	0.373					39	**NT**	**0.78**	**2.02**	0.01	0.004					38
10	**NT**	0.17	0.377					39	**NT**	**0.82**	**2.02**	0.01	0.010					38
11	**NT**	0.16	0.379				9.2	39	**NT**	**0.80**	**1.92**	0.04	0.012				2.1	38
Total or Average	**8.25**	**0.15**	**0.381**	**-**	**0.327**	**17.80**	**9.2**	**40**	**8.23**	**0.83**	**1.83**	**0.01**	**0.010**	**-**	**0.113**	**18.35**	**2.4**	39
Average as Percent of MCL		***48.3%***	***762.2%***									***2.50%***	***19.17%***					
Average Removal Rate												***94.8%***	***97.49%***					

Non Detect, indicating the absence of a metal or chemical at or above the method detection limit is shown as "-" and calculated in the total or average as zero.

Figure 1
Pilot Test Results
Chlorine Dosage and Free Residual Concentrations
WB Water Works, Well 4
July 21, 2021

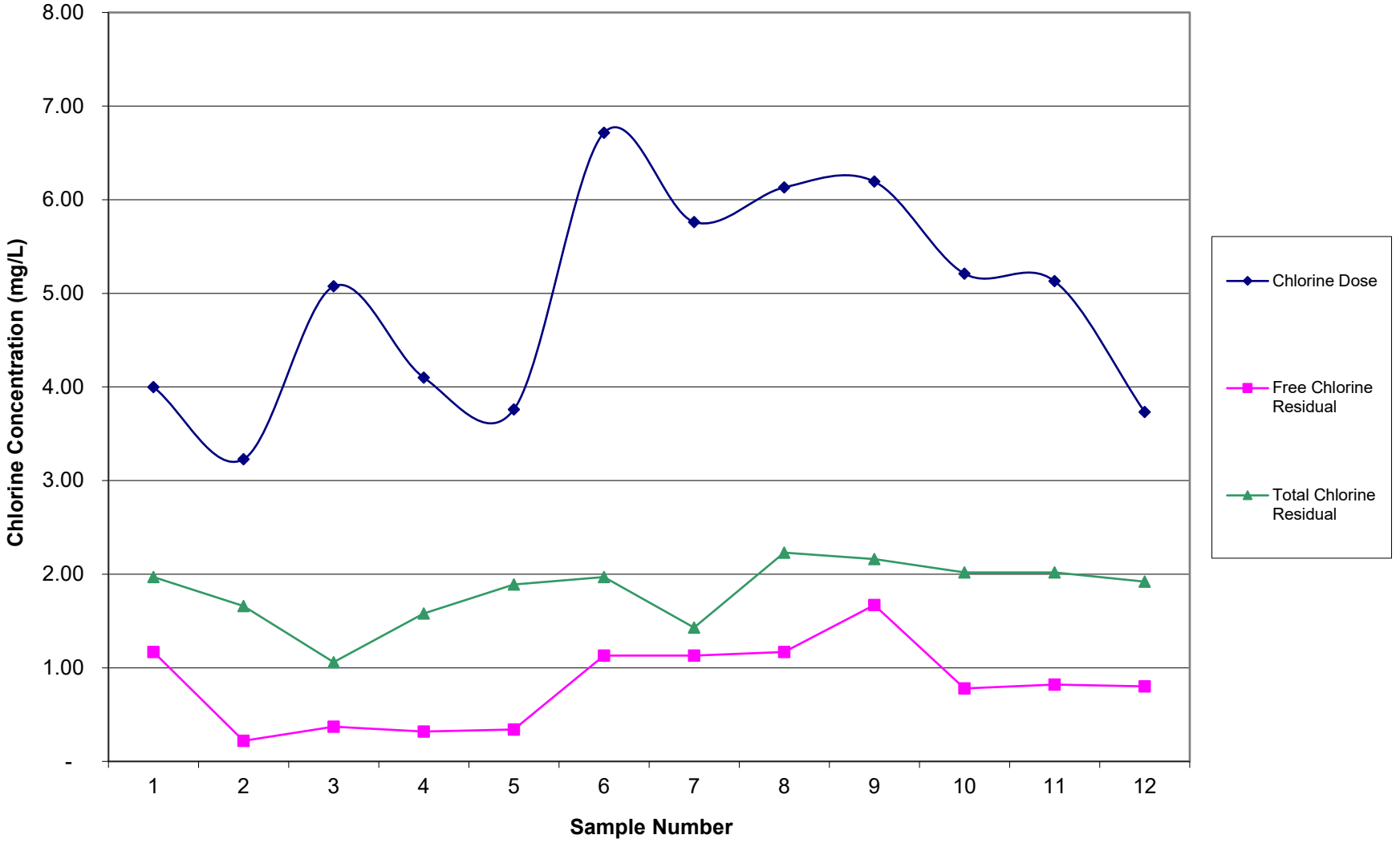


Figure 2
Pilot Test Results
Manganese Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 4
July 21, 2021

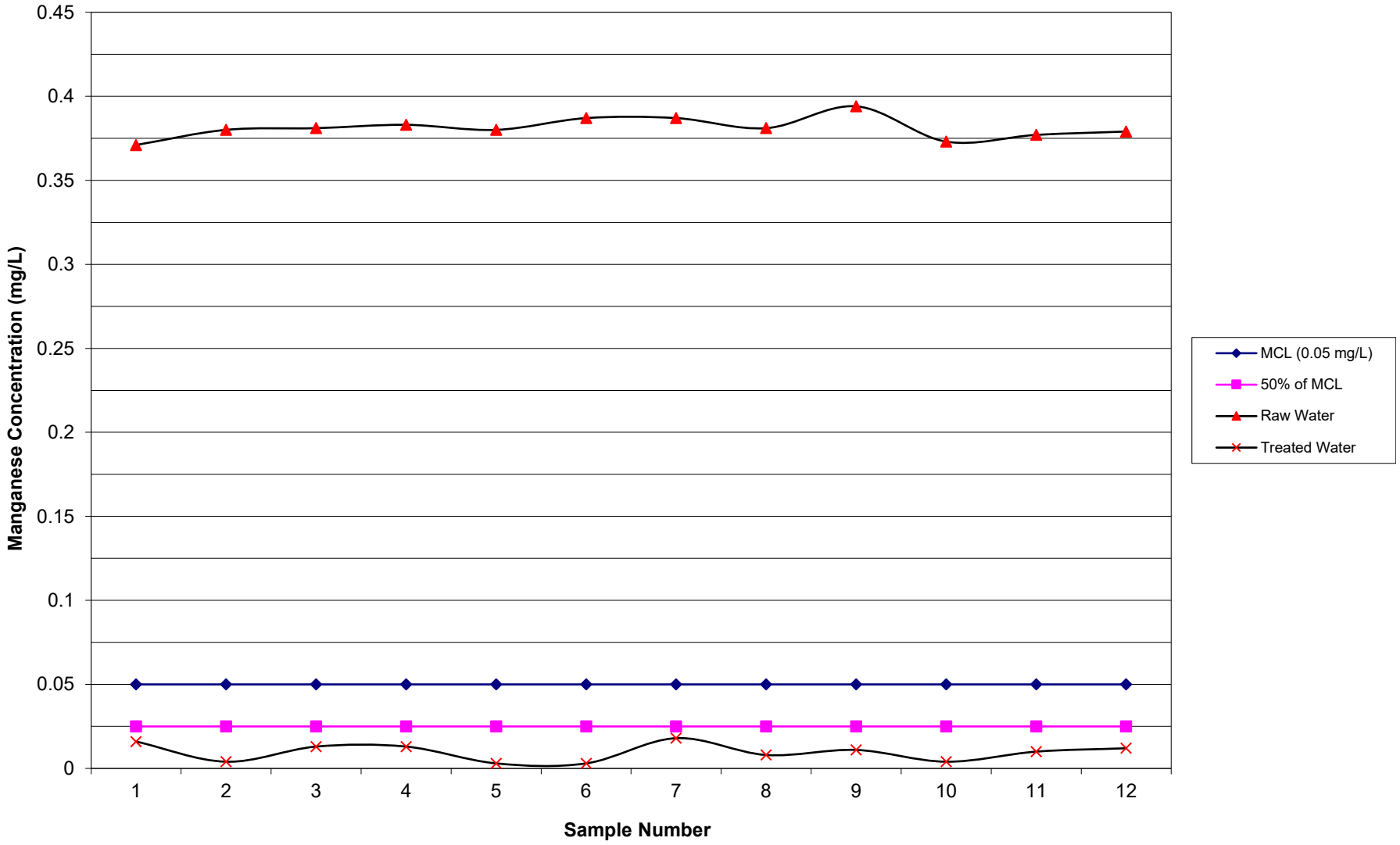


Figure 3
Pilot Test Results
Iron Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 4
July 21, 2021

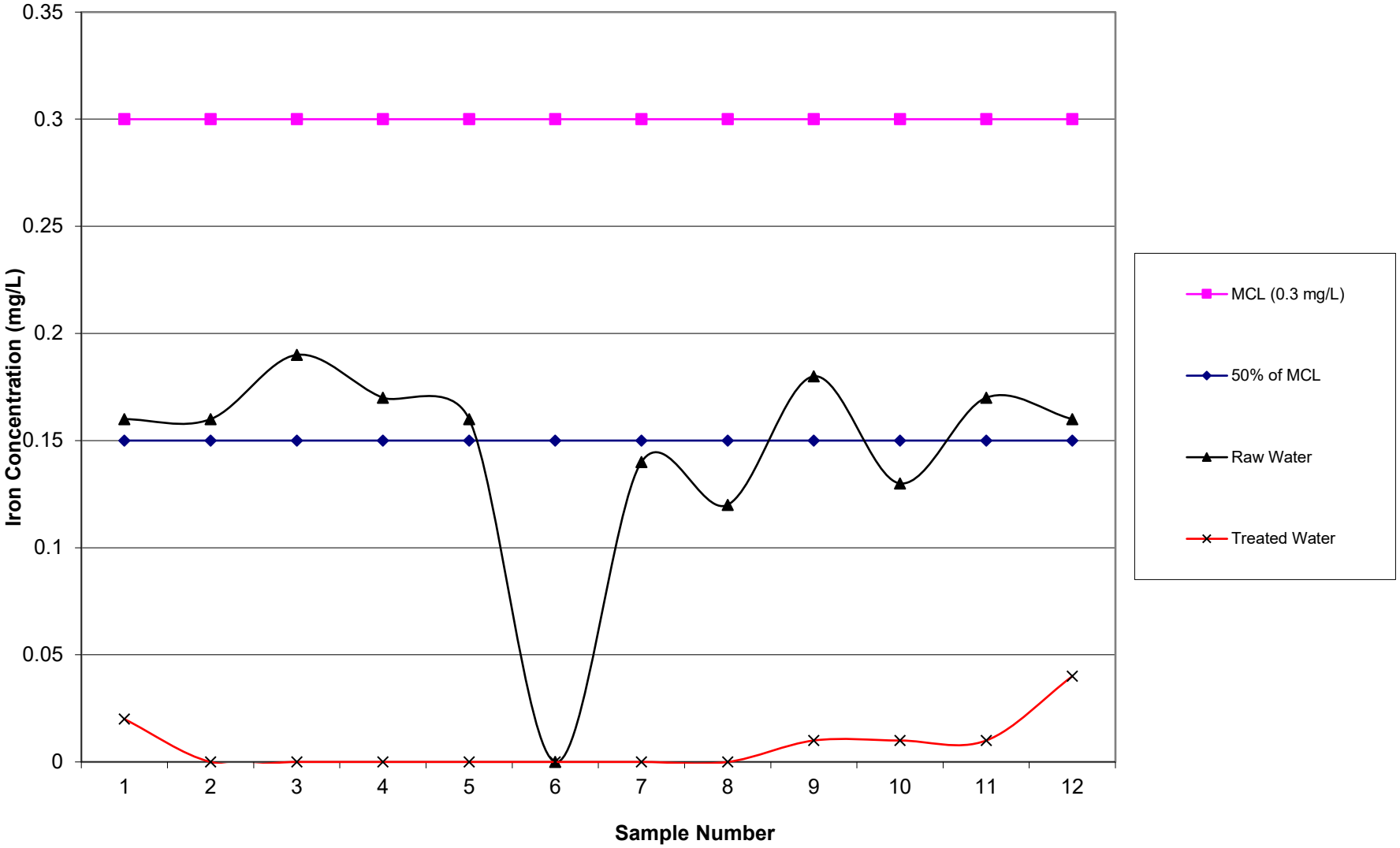
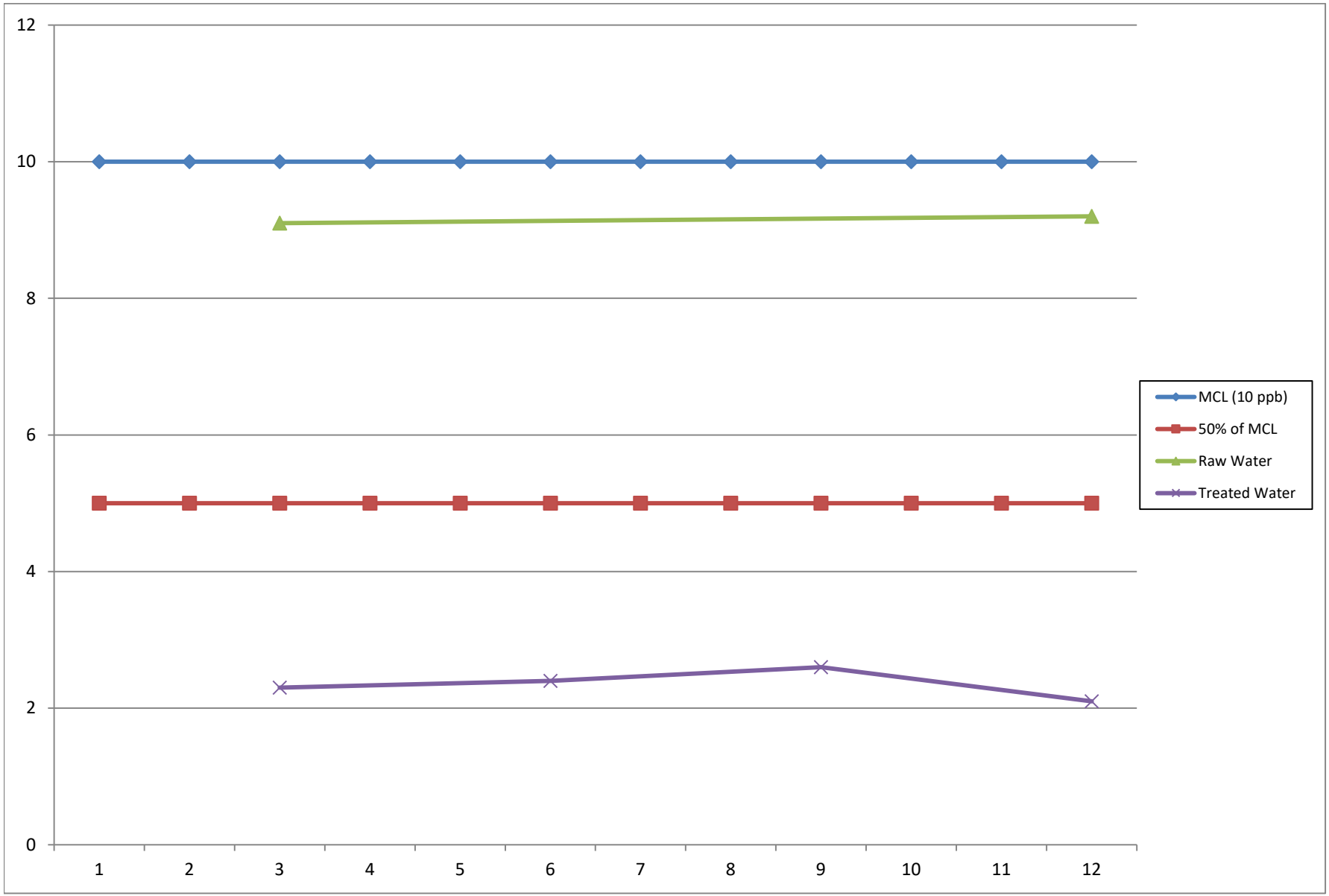


Figure 4
Pilot Test Results
Arsenic Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 4
July 21, 2021



W B Waterworks

Wells 1 – 4 Well Field

Well 1 Pilot Test

Table 1
Summary of Pilot Study Test Conditions
WB Water Works, Well 1
July 20, 2021

Date	Sample Number	Time	Meter Reading (Gallons)	Average Flow (gpm)	Loading Rate (gpm/ft^2)	Loading Rate (gpm/ft^3)	Media Contact Time (Minutes)	Cl_2 Dose (mg/L)	$KMnO_4$ (mg/L) as Mn	$FeCl_3$ Dose (mg/L) as Fe	Temp °C
7/20	Start	10:30	-	4.98	6.34	1.81	4.13	3.84	ND	ND	11.4
	1	11:00	-	4.92	6.26	1.79	4.18	2.72	ND	ND	12.2
	2	11:30	181.1	4.87	6.20	1.77	4.22	1.96	ND	ND	12.3
	3	12:00	319.0	4.60	5.85	1.67	4.47	2.08	ND	ND	12.4
	4	12:30	459.0	4.67	5.94	1.70	4.41	2.05	ND	ND	12.4
	5	13:00	615.9	5.23	6.66	1.90	3.93	1.83	ND	0.91	12.3
	6	13:30	750.9	4.50	5.73	1.64	4.57	2.12	ND	0.85	12.2
	7	14:00	945.4	6.48	8.25	2.36	3.17	1.47	ND	0.97	12.3
	8	14:30	1,055.5	3.67	4.67	1.34	5.60	2.60	ND	0.90	12.2
	9	15:00	1,260.8	5.33	6.79	1.94	3.86	1.79	ND	0.97	12.4
	10	15:30	1,567.7	5.35	6.81	1.95	3.84	1.79	ND	0.90	12.4
	11	16:00	1,715.0	4.91	6.25	1.79	4.19	1.95	ND	0.92	12.5
	Total or Average		**1,715.00**	4.96	6.31	1.80	4.21	2.18	ND	0.92	12.3

NA, indicates Not Applicable for this test
Not Dosed, (ND) indicating the period of the test
Not Tested, (NT) indicating no value entered because there was no sample to test
Media contact time = Empty bed contact time

Design 225 gpm, well 50 gpm, ≤ 7 psi (pump to resevoir)
Used 42" Pyrolox ™Advantage media
Sodium Hypochlorite titrated @ 6882.0
Used 60" long X 6" diameter contact tank
BW start of test
Used Booster Pump
BW 12:05 - 12:13
Began dosing $FeCl_3$ at 12:44
BW end of test

Table 2
Summary of Pilot Test Results
WB Water Works, Well 1
July 20, 2021

	Source Water								Product Water									
Sample Number	**pH (Units)**	**Fe (mg/L)**	**Mn (mg/L)**	**H_2S (mg//L)**	**Ammonia (mg//L)**	**Silica (mg/L)**	**As (lab) (ppb)**	**PSI**	**pH (Units)**	**Cl_2 (F) (mg/L)**	**Cl_2 (T) (mg/L)**	**Fe (mg/L)**	**Mn (mg/L)**	**H_2S (mg//L)**	**Ammonia (mg//L)**	**Silica (mg/L)**	**As (lab) (ppb)**	**PSI**
Start	**7.02**	0.16	0.270					66	**7.50**	**2.35**	**2.84**	-	-					65
1	**7.71**	0.08	0.220			12.80	6.8	66	**7.76**	**1.93**	**2.23**	-	-			11.20	4.8	65
2	**7.85**	0.08	0.250		0.280			66	**7.90**	**1.69**	**1.89**	0.01	-		-			65
3	**7.95**	0.06	0.244	-				66	**7.96**	**1.31**	**1.71**	0.01	-	-			5.2	65
4	**7.96**	0.08	0.258		0.260			66	**7.97**	**1.29**	**1.62**	0.01	0.001		-			65
5	**7.94**	0.06	0.249	-				63	**7.94**	**1.27**	**1.54**	-	-	-				62
6	**8.01**	0.02	0.242		0.280			63	**7.75**	**0.80**	**1.11**	-	-		-		1.1	62
7	**7.54**	0.02	0.241					63	**7.51**	**0.75**	**1.02**	-	-					62
8	**7.61**	0.01	0.255					63	**7.49**	**0.66**	**0.92**	-	-					62
9	**7.57**	0.01	0.261			12.30		63	**7.48**	**0.60**	**0.94**	-	0.015			12.10		62
10	**7.54**	0.01	0.263				6.7	63	**7.49**	**0.60**	**0.89**	-	0.008				2.4	62
11	**7.60**	0.02	0.265					63	**7.45**	**0.61**	**0.90**	-	0.010					62
Total or Average	**7.69**	**0.05**	**0.252**	**-**	**0.273**	**12.55**	**6.8**	**64**	**7.68**	**1.16**	**1.47**	**0.00**	**0.003**	**-**	**-**	**11.65**	**7.0**	63
Average as Percent of MCL		***322.7%***	***503.0%***									***0.83%***	***5.67%***					
Average Removal Rate												***99.7%***	***98.87%***					

Non Detect, indicating the absence of a metal or chemical at or above the method detection limit is shown as "-" and calculated in the total or average as zero.

Raw iron values include raw iron and FeCl3 dose (as Fe)

Figure 1
Pilot Test Results
Chlorine Dosage and Free Residual Concentrations
WB Water Works, Well 1
July 1, 2021

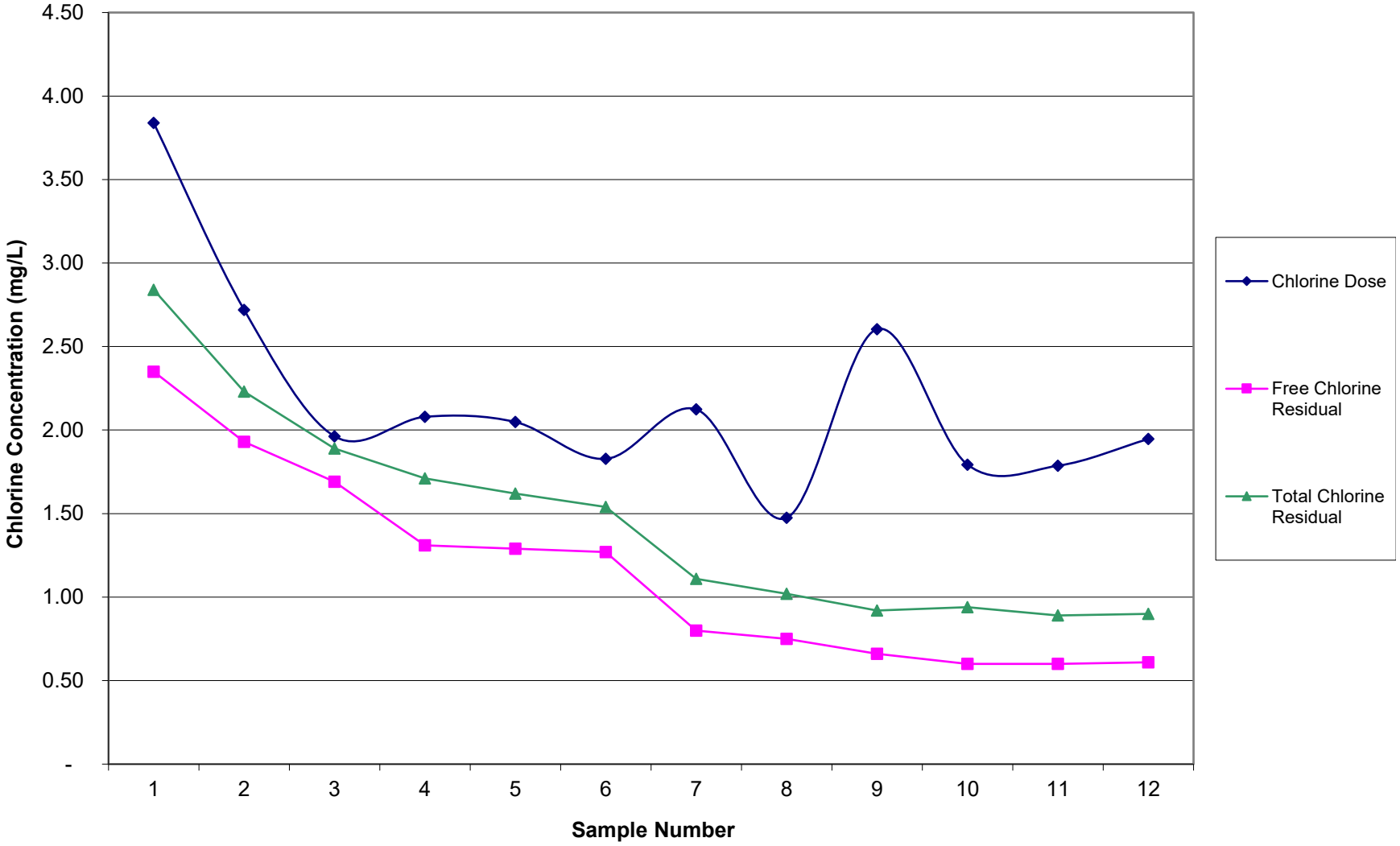


Figure 2
Pilot Test Results
Manganese Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 1
July 1, 2021

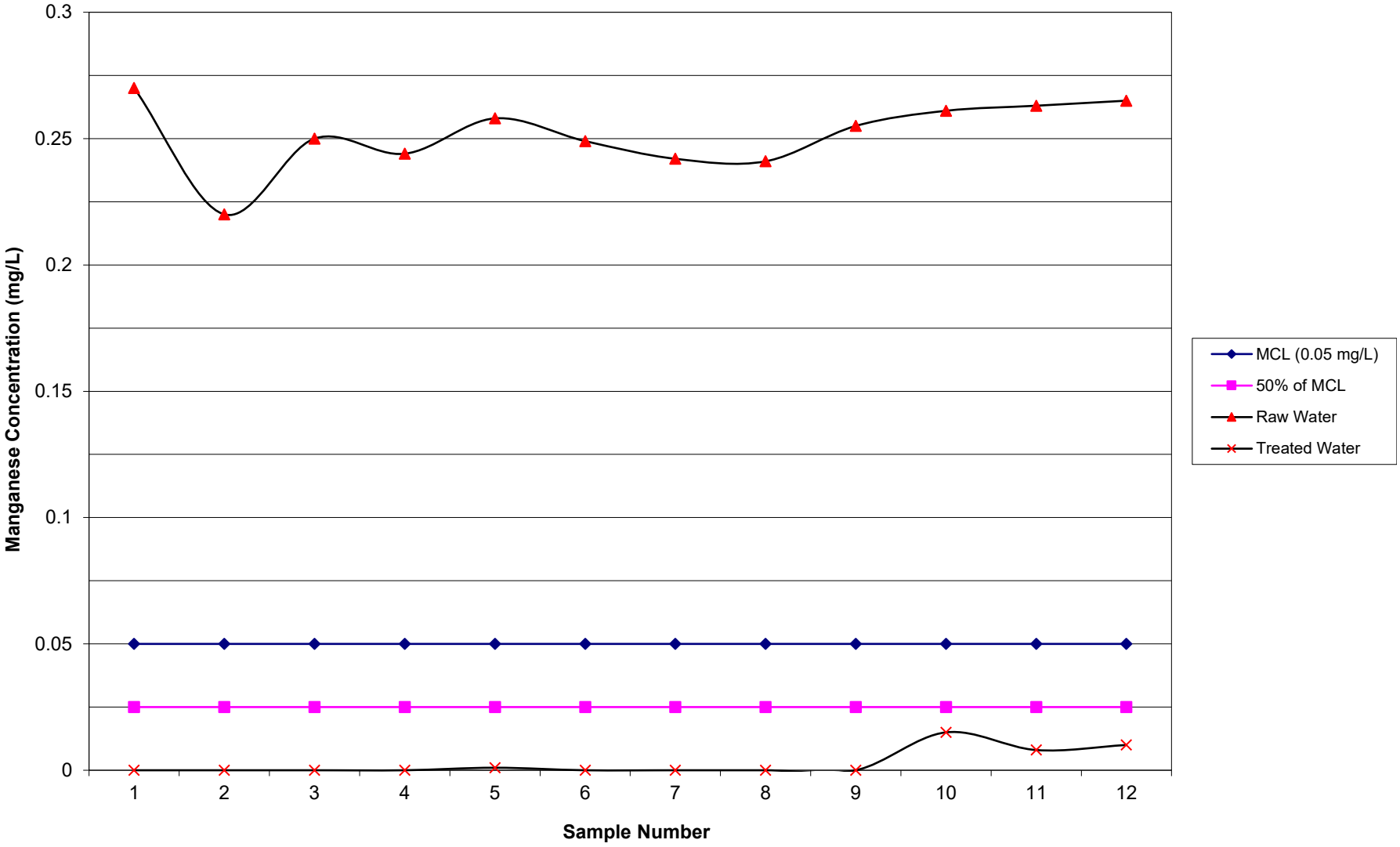


Figure 3
Pilot Test Results
Iron Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 1
July 1, 2021

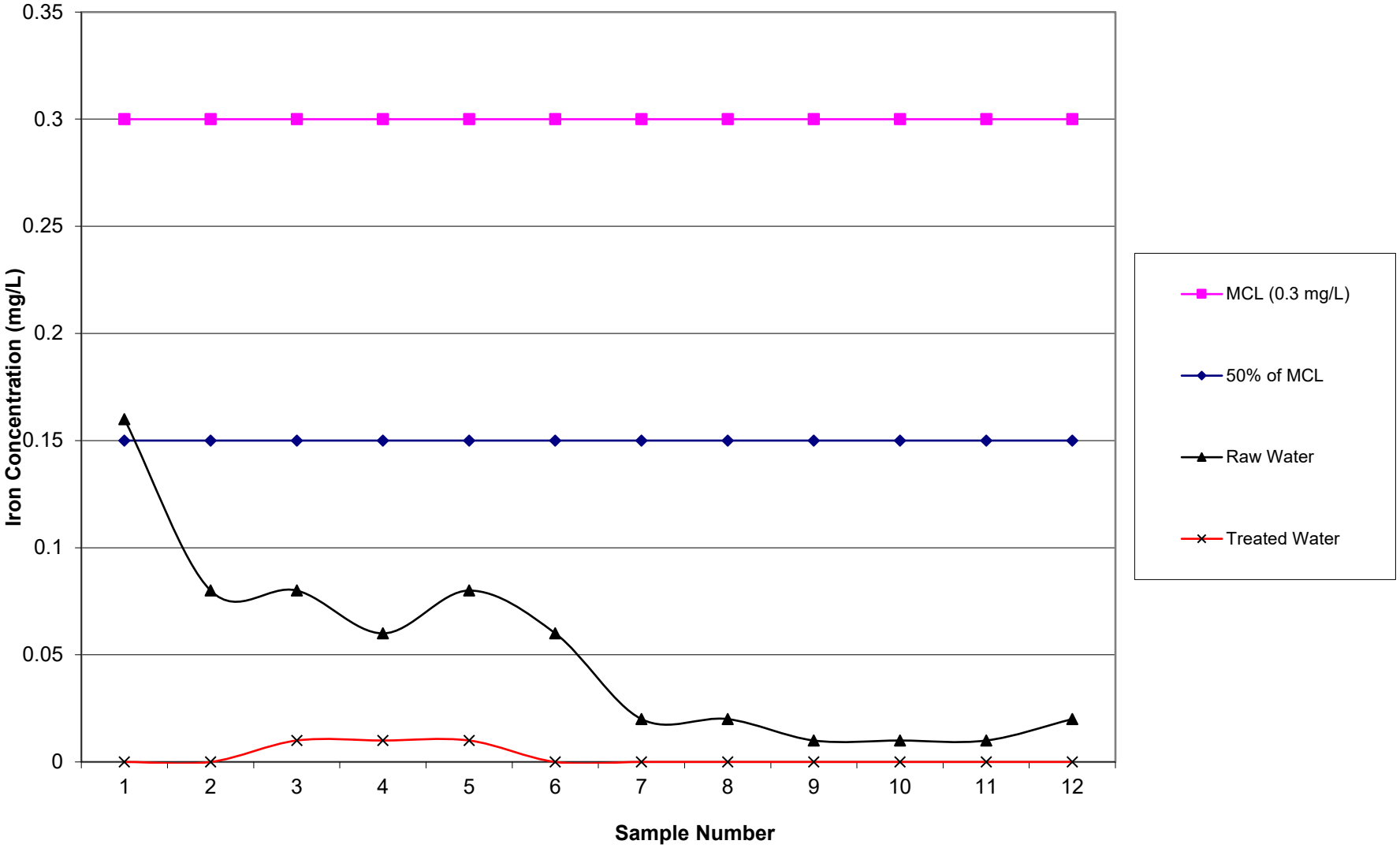
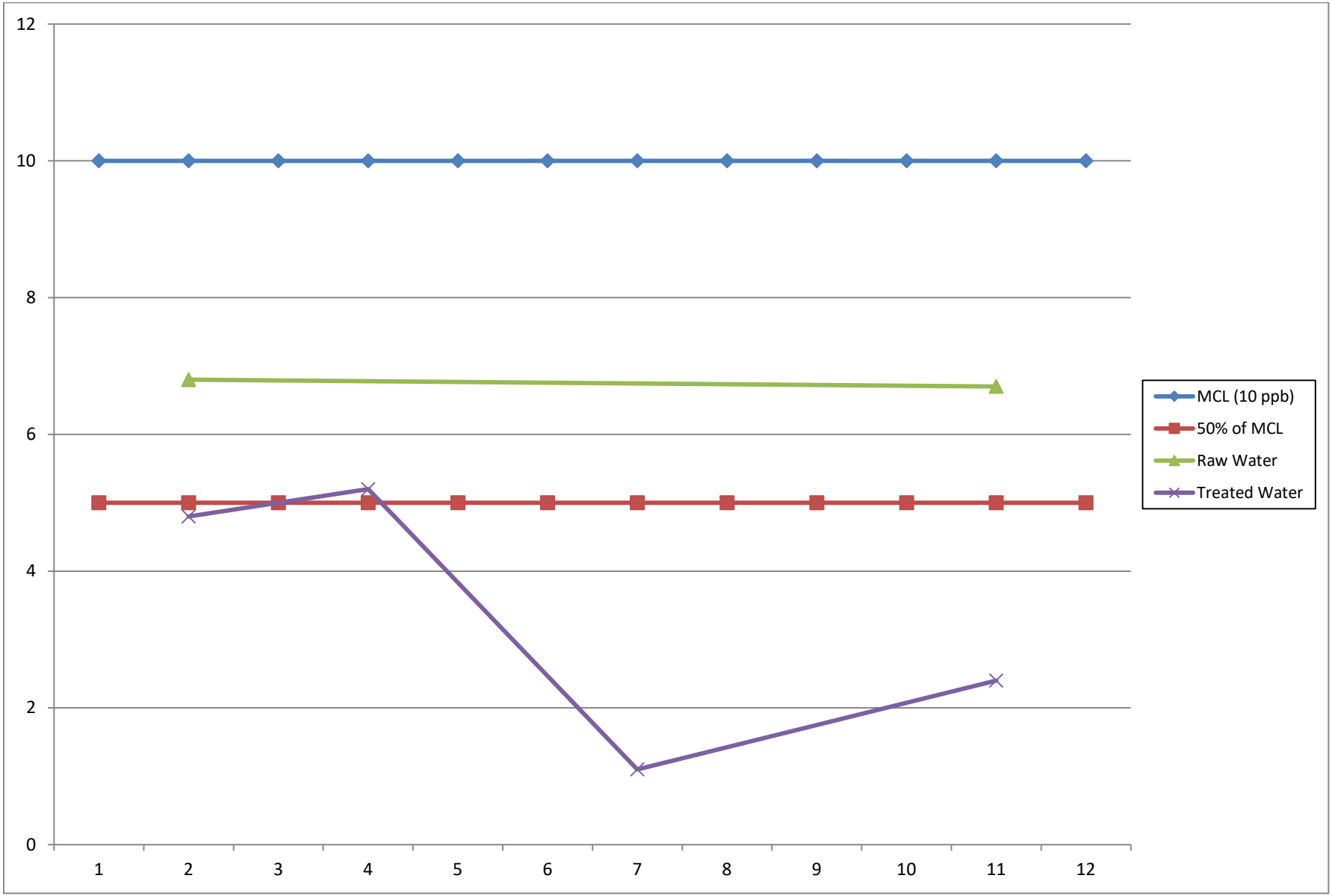
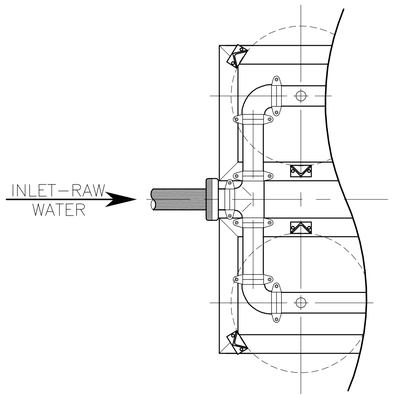
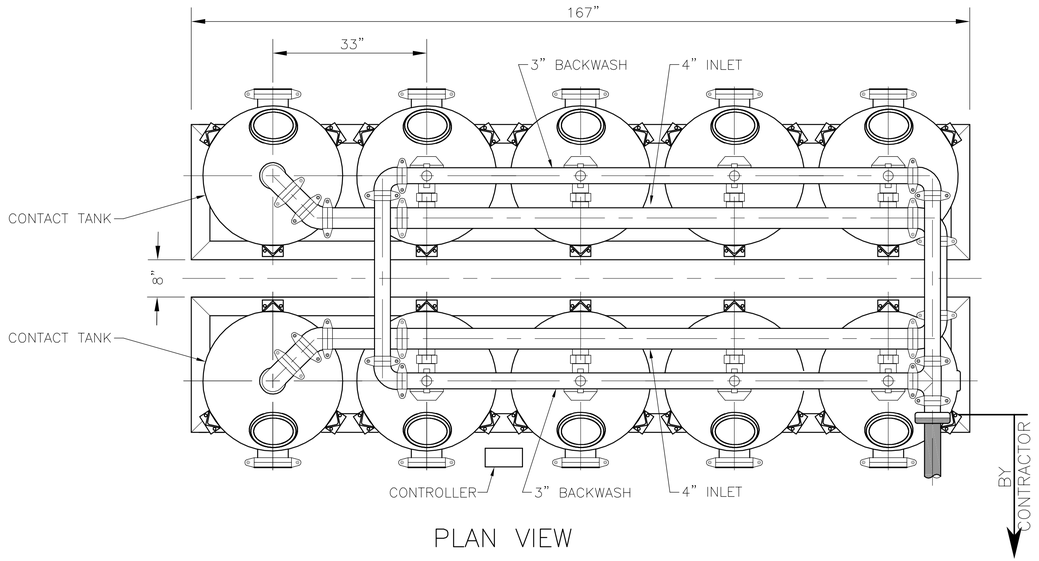


Figure 4
Pilot Test Results
Arsenic Removal Using ATEC Pyrolox ™Advantage Filter Media
WB Water Works, Well 1
July 1, 2021

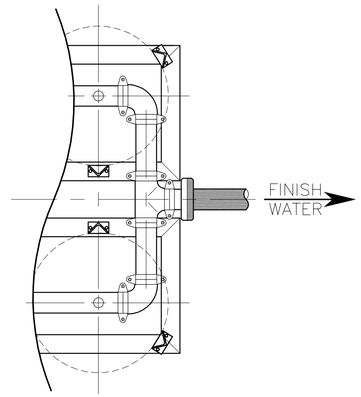




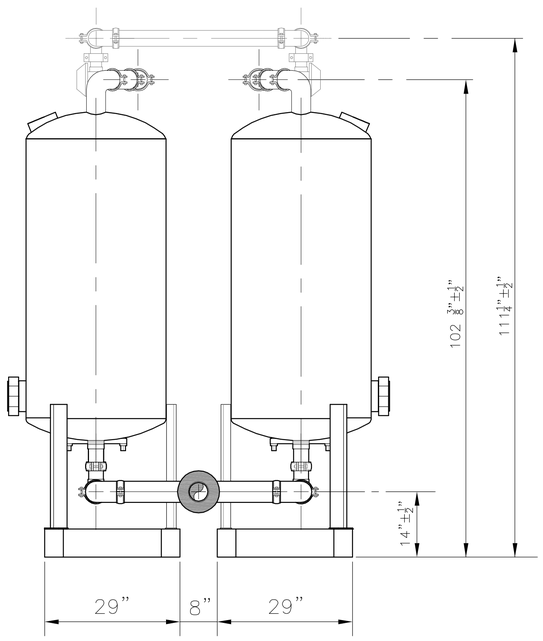
LEFT SIDE, FILTERS REMOVED



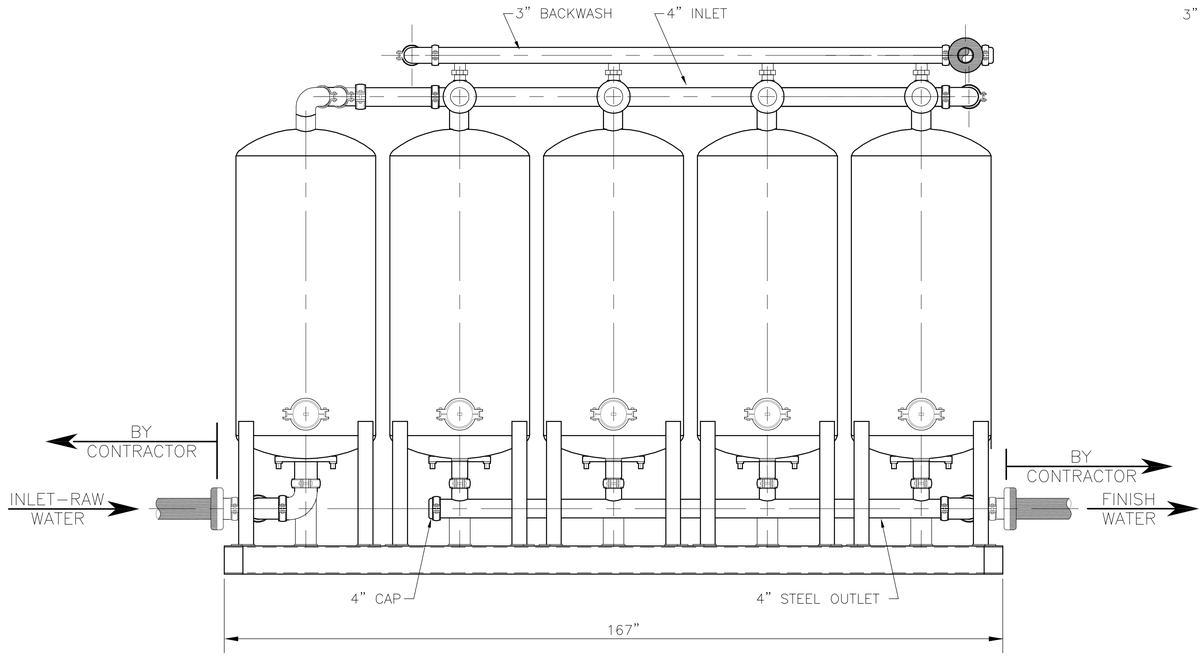
PLAN VIEW



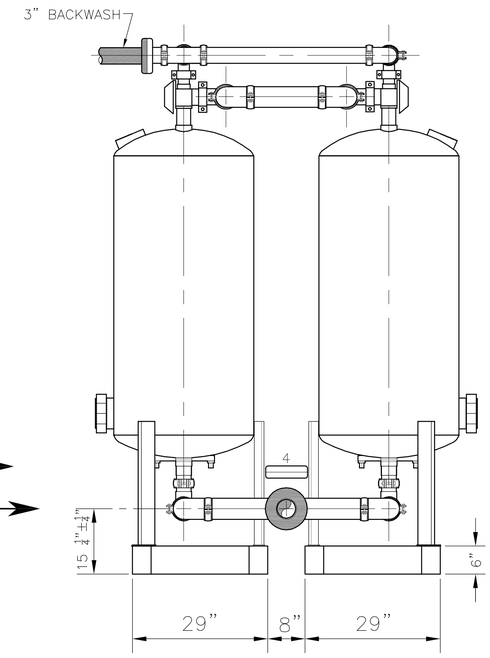
RIGHT SIDE, FILTERS REMOVED



LEFT ELEVATION



FRONT ELEVATION



RIGHT ELEVATION

NOTES:

1. A 60" LONG, 3–INCH BACKWASH FLANGED BACKWASH ASSEMBLY WITH REGULATING VALVE, METER AND SIGHT GLASS CAN BE SHIPPED LOOSE TO REGULATE BACKWASH TO 137 GPM. (EXTRA COST ITEM LINE)

ATEC SYSTEMS ASSOCIATES
P.O. BOX 10329
BAINBRIDGE ISLAND, WASHINGTON 98110-0329
PHONE: (360) 414-9223

DESIGN BY:	.
DRAWN BY:	.
CHECKED BY:	.
APR'D BY:	.

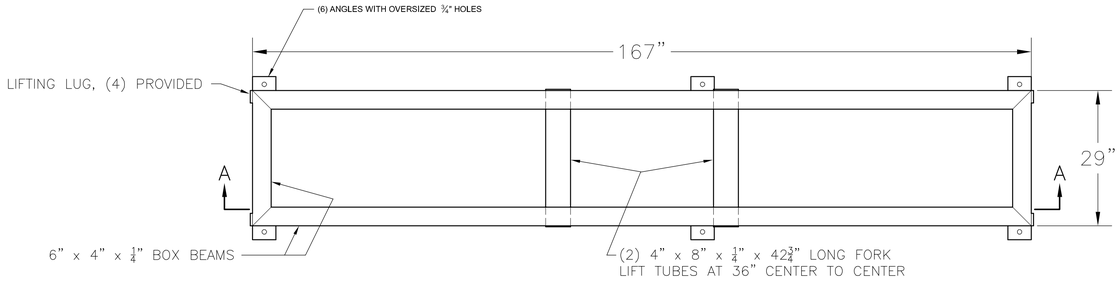
NO.	DATE		BY	APVD

0 2 4
SCALE IN FEET
NOTE: CHECK SCALE
SCALEABLE IN 22x34 - 3/4" = 1'-0"
SCALEABLE IN 11x17 - 3/8" = 1'-0"

W B WATERWORKS
WELLS 1 THROUGH 4 WELL FIELD
225 GPM

FILTER DETAILS

SHEET NO.	1 of 2
DWG. NO.	
DATE:	8-26-2021
FILE:	W B Waterworks



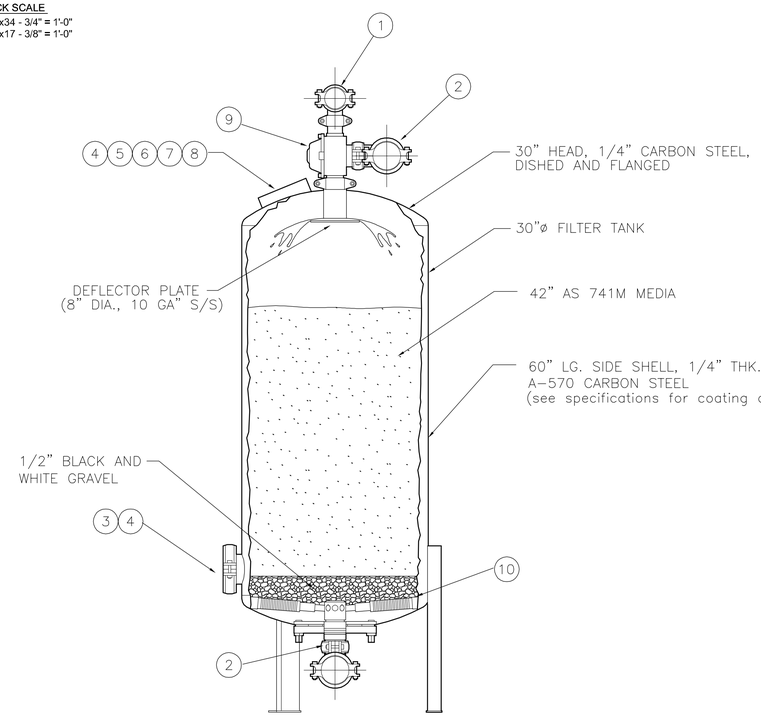
SKID PLAN
(4 FILTER)

0 1 2

SCALE IN FEET

NOTE: CHECK SCALE

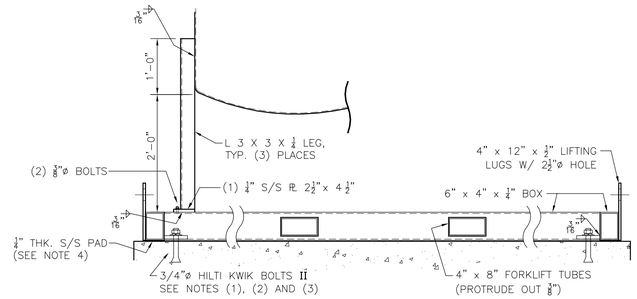
SCALEABLE IN 22x34 - 3/4" = 1'-0"
SCALEABLE IN 11x17 - 3/8" = 1'-0"



TANK SECTION
N.T.S.

BILL OF MATERIAL			
ITEM	QTY	PART NO.	DESCRIPTION
1	1	PFS-CPL03	3" GROOVED COUPLING, CAST IRON W/ BOLTS & GASKET
2	3	PFS-CPL04	4" GROOVED COUPLING, CAST IRON W/ BOLTS & GASKET
3	1	PFS-CAP08	6" GROOVED END CAP
4	1	PFS-CPL08	6" GROOVED COUPLING, CAST IRON W/ BOLTS & NUTS
5	1	PFS=HHP11	6"x8" HAND HOLE PLATE
6	1	PFS-HHG11	6"x8" HAND HOLE GASKET
7	1	PFS-HHGS11	6"x8" HAND HOLE BOLT SET
8	1	PFS-HHCR11	6"x8" HAND HOLE HOLD DOWN CRAB
9	1	UA SS48	3"x3"x3" SERIES 350 BERMAD BACKWASH VALVE
10	1	V-BF4	UNDER-DRAIN ASSEMBLY 316L SS W/ SCH 80 PVC CAP COMPLETE

NOTE: QUANTITIES FOR ONE (1) TANK



SECTION A-A
SCALE 1" = 1'-0"

0 1 2

SCALE IN FEET

NOTE: CHECK SCALE

SCALEABLE IN 22x34 - 1" = 1'-0"
SCALEABLE IN 11x17 - 1/2" = 1'-0"

NOTES:
(1) DESIGNER SHALL DETERMINE NO. AND DEPTH OF ANCHOR BOLTS TO SUIT LOCAL CODE REQUIREMENTS.

(2) ANCHOR BOLT HOLES ARE TO BE DRILLED INTO CONCRETE FOUNDATION THROUGH OVERSIZED DRILL HOLES IN GUSSETS IN SKID ASSEMBLY BY INSTALLATION CONTRACTOR.

(3) 1/4" THICK S/S PADS ARE PROVIDED UNDER SKIDS FOR CLEARANCE BETWEEN SKIDS AND CONCRETE FOUNDATION. SIX PADS ARE PROVIDED FOR 2 & 3 FILTER SKIDS, EIGHT PADS FOR 3-14 FILTER SKIDS

NOTE:
DIMENSIONS GIVEN ARE FOR THE CONTRACTOR'S INFORMATION BUT WILL VARY BECAUSE OF NORMAL FABRICATION TOLERANCES. CONTRACTOR SHALL CONNECT EXTERIOR PIPING TO FIT THE ATEC UNIT AS SHIPPED.

FILTER TANKS AND MANIFOLDS ON THIS SHEET SUPPLIED BY ATEC SYSTEMS:

THE CONTRACTOR WILL BE RESPONSIBLE FOR:
1. UNLOADING THE UNITS AND PLACING THEM IN THE CORRECT INSTALLED LOCATION.
2. ATTACH MANIFOLDS CONNECTING THE TWO BANKS OF FILTERS.
3. LOADING THE TWO TYPE OF MEDIA INTO THE FILTER.
4. CONNECTING POWER SUPPLY TO FILTER BACKWASH PLC (120 VAC, SWITCHED CIRCUIT).

ATEC SYSTEMS ASSOCIATES
P.O. BOX 10329
BAINBRIDGE ISLAND, WASHINGTON 98110-0329
PHONE: (360) 414-9223

DESIGN BY: .
DRAWN BY: .
CHECKED BY: .
APR'D BY: .

NO.	DATE		BY	APVD

0 2 4

SCALE IN FEET

NOTE: CHECK SCALE

SCALEABLE IN 22x34 - 3/4" = 1'-0"
SCALEABLE IN 11x17 - 3/8" = 1'-0"

W B WATERWORKS
WELLS 1 THROUGH 4 WELL FIELD
225 GPM

FILTER DETAILS

SHEET NO. 2 of 2
DWG. NO.
DATE: 8-26-2021
FILE: W B Waterworks

APPENDIX

ATEC
SYSTEMS ASSOCIATES

Table 1

Physical Characteristics of Pilot Filter Set and Media
ATEC Iron and Manganese Removal System

Pilot Filters[1]	
Sidewall Height (inches)	48 to 60
Overall Height (inches)	62 to 74
Diameter (inches)	6
Filter Surface Area (each) ($ft.^2$)	0.1964
Total Filter Surface Area (ft^2)	0.7854
Underdrain	Stainless Steel Wedgewire, 0.01" slots
Media Support	¾" minus crushed granite, 4"
Source Water Connections	¾" Standard Hose
Recommended Minimum/Maximum Working Pressure	20/90 psi
Filter Media[2]	
Depth in Filters (inches)	36 to 48
Volume in Filters (ft^3)	2.36 to 3.15
Approximate Weight in Filters (lbs.)	285
Weight ($lbs./ft^3$)	120.5
Physical Size (mm)	0.32 –to-0.85
Maximum Removal Capacity	
Iron Removal (mg/L)	10
Manganese Removal (mg/L)	10
Hydrogen Sulfide Removal (mg/L)	5
Non-Adsorptive Removal (microns)	>20

Chemical Dosing Equipment[3]

Stenner Peristaltic Solution Metering Pumps (up to 17.0 gpd @ 100 psi)
LMI Solution Metering Pumps (various capacities)

Other Equipment

Chlorine Analyzer, Hach CL 17 or ProMinent D2C
Flow Meters, Sea Metrics, Inc., FT-420
Data Logger, Endress + Hauser, Mini-Logger
Automatic Samplers, ISCO, Inc.

1/ The pilot filter plant consists of four, 6" filter columns connected by common manifolds for influent, effluent and backwash water. Each filter is controlled by a three-way ball valve. The system is set up to closely mimic a full-scale filter system in terms of media depth, application rates in terms of both area (gpm/ft^2 of filter area) and volume (gpm/ft^3 of media), and backwash characteristics to the extent possible. Source water is metered using a totalizing flow meter. Pressure is measured on the influent and effluent manifold to determine headloss. Chemical injection points are located as close to the filter as possible to simulate actual operation. In cases where extended contact time is desired before the source water enters the filters, a pipe section of pre-determined volume is placed between the chemical injection points and the filters to provide accurate contact time measurement. Sidewall height is variable to a maximum of 60" without modification, allowing a maximum media bed depth of 48".

2/ AS-721M and AS-741M Filter Media, 0.85 to 2.36mm and 0.42mm to 0.85mm, respectively, are both granular manganese dioxide media, derived from naturally occurring pyrolusite, and are certified to ANSI/NSF Standard 61.

3/ Solution metering pumps are available for the injection of up to three chemicals, if needed. Normally, the only chemical injected is chlorine. And in the case of arsenic, ferric chloride. There are, however, provisions for special circumstances, such as pH adjustment for corrosion control or the treatment of water at fish hatcheries that do not permit chlorine.

Table 2 Analytical Equipment

The following analytical equipment is normally carried on our pilot trailers.

Spectrophotometer, Model DR/2800, Hach Co., Loveland, CO
Digital Titrator, Hach Co., Loveland, CO
pH Meter, Model 266, Orion Co., Boston, MA
Stir Plate, Hach Co., Loveland, CO
0.45-Micron Filter, Nalgene

Glassware—beakers, flasks, columns, sample cells, 10 and 25 ml

Although not normally carried in each trailer, a turbidity meter is available.

Reagents for the following field tests:

Spectrophotometer

Free Chlorine, DPD, Method 8021 and 10059 (300 tests)
Total Chlorine, DPD, Method 8167 or 10060 (300 tests)

Iron, FerroZine Method, Method 8147 (500 tests)
Iron, Total, FerroVer Method, Method 8008 (300 tests)

Manganese, Low Range, PAN Method, Method 8149 (500 tests)

Nitrogen, Ammonia, Salicylate Method, Method 8155 (100 tests)

Sulfide, Methylene Blue Method, Method 8131 (100 tests)

Silica, Molybdate Method, Method 8282 (100 tests)

Digital Titrator

Alkalinity, Phenolphthalein and Total Method, Method 8203 (100 tests)
Hardness, Phenolphthalein and Total Method, Method 8203 (100 tests)
Total Chlorine, Iodometric Method, Method 8209 (100 tests)

Field tests not listed above may be available. Please note that we send all tests for arsenic and other contaminants that require digestion or distillation to a commercial laboratory.

Figure 1

ATEC Iron and Manganese Removal Pilot Plant

The exterior of ATEC Systems' pilot trailer is shown above. The source and product water connections are shown entering and exiting the trailer. Inside dimensions are 14' x 6' x6½'.

The front one-half of the trailer is shown above. The instrument foreground on the wall is an in-line chlorine analyzer. The smaller boxes on the wall above the light are electronic flow meters used to monitor cumulative as well as instantaneous flow for each treatment train in the pilot plant.

Picture above shows the interior of the pilot plant trailer from the rear. The sample outlets and the analytical equipment are on the desk in the front of the trailer.

The picture on the left shows one set of filters. Source water enters through the hose inlet in the wall, passes through a flow meter, past a chlorine injection point, through an in-line static mixer, into the inlet manifold, down through the filter media. Product water is discharged through the wall. The pail holding the sodium hypochlorite solution can be seen to the right of the filter vessels and the in-line chlorine analyzer is on the wall above the NaOCl container. The sample ports and analytical equipment is forward of the chlorine analyzer. A second container of Ferric Chloride solution and feed pump is provided for pilot testing for arsenic removal.

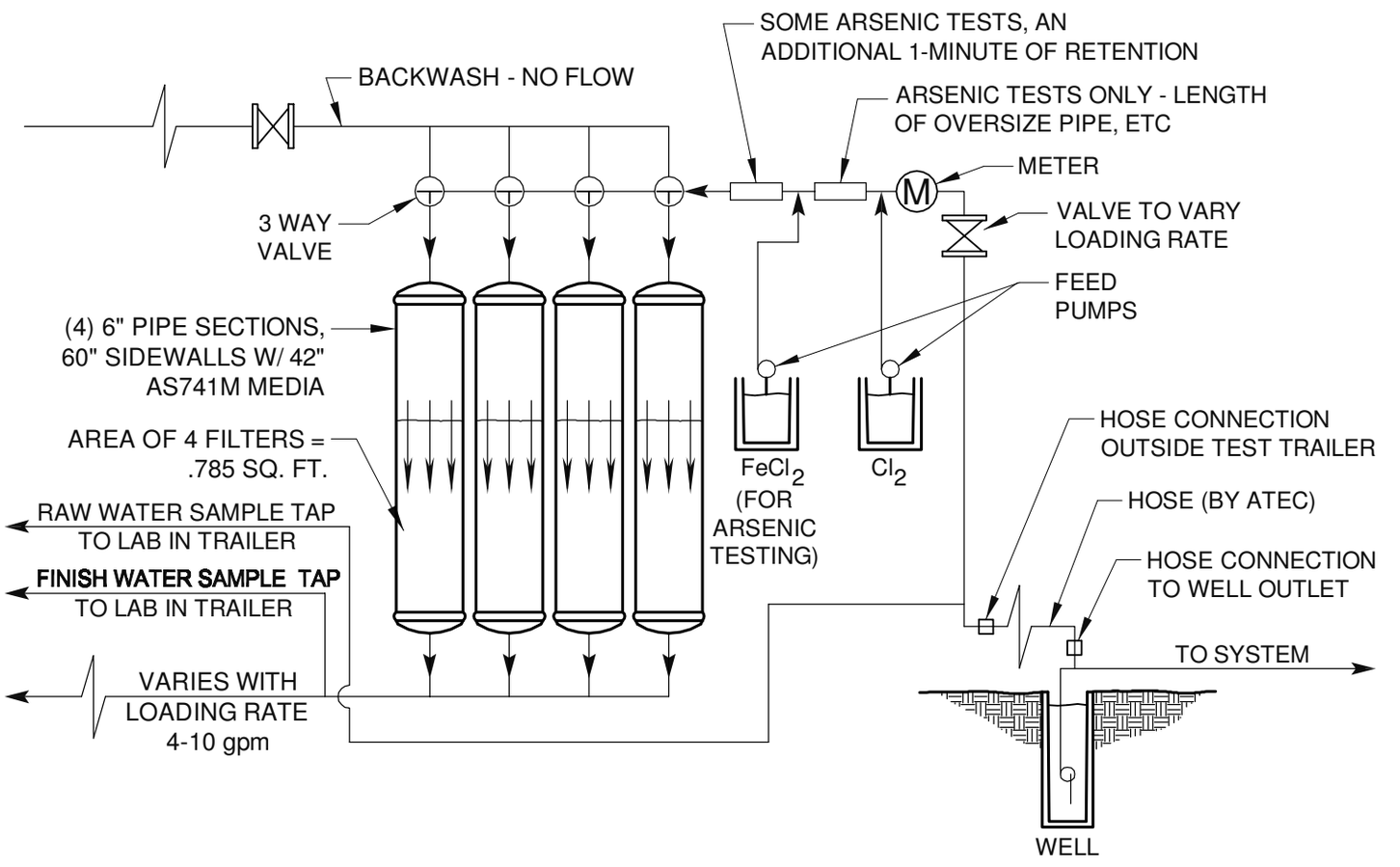
Table 3
SUMMARY OF SITE AND INITIAL DATA REQUIREMENTS

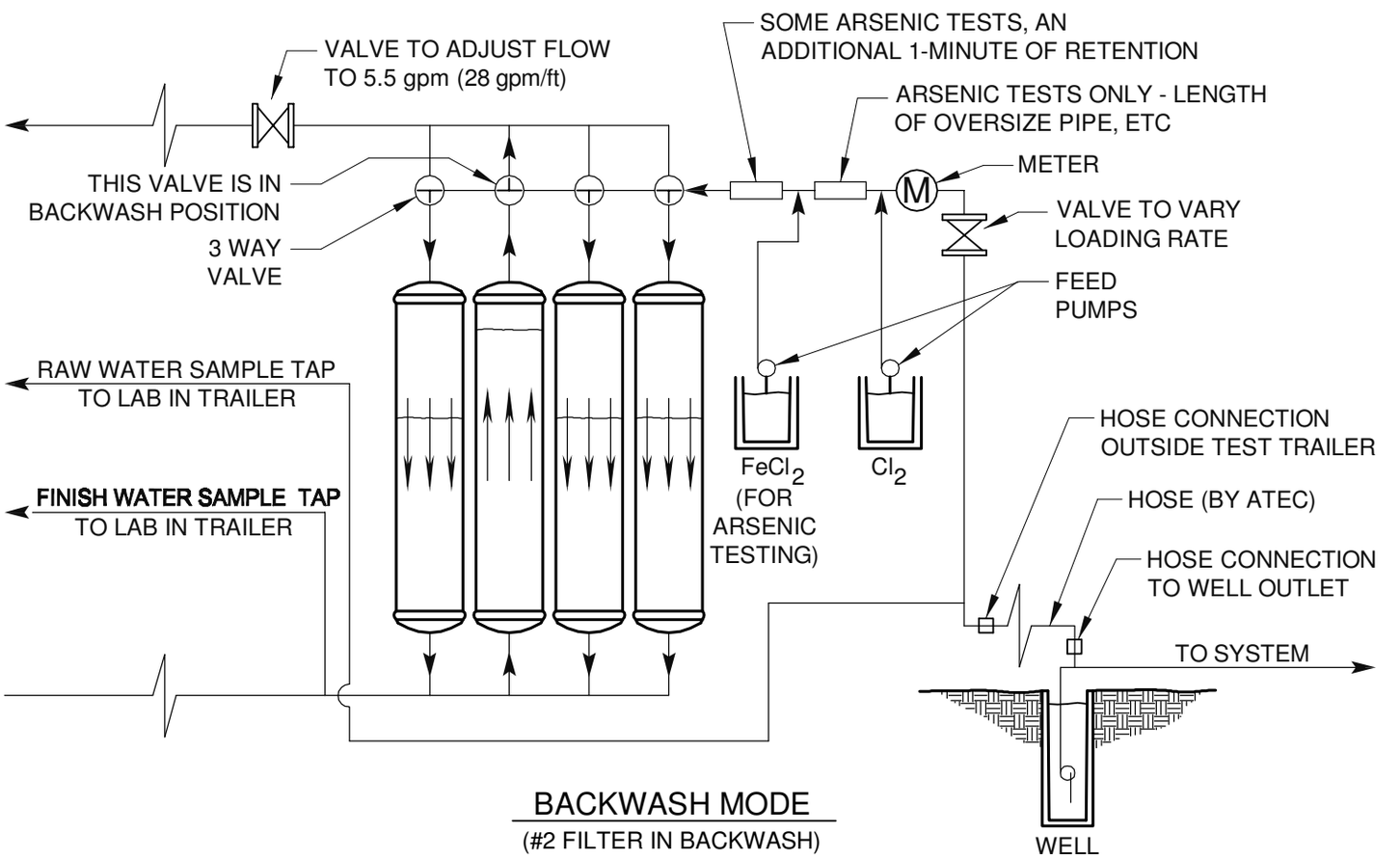
1. Power, 115 VAC for injection equipment and lighting
2. Source water, minimum 10 gpm @ 30 psig (ATEC will supply pump if necessary).
3. Disposal of water and backwash effluent[1]

Data Needed from Utility

1. Comprehensive Water System Plan (relevant sections)
2. Inorganic test results (most recent)

[1] Any necessary permits are the responsibility of the client





BACKWASH MODE
(#2 FILTER IN BACKWASH)

ATEC SYSTEMS ASSOCIATES
P.O. BOX 10239
BAINBRIDGE ISLAND, WASHINGTON 98110-0329
PHONE: (360) 414-9223 FAX: (360) 397-0375

EXHIBIT 1 PILOT TESTING EQUIPMENT SCHEMATIC

SHEET NO.	1 of 1
DWG. NO.	
DATE:	8-1-12
FILE:	Pilot Test Equip Schematic

Appendix F: Engineering Treatment Calculations

Wells #1 - #3

Hypochlorination Oxidative Demand Calculations

Water System Name: W&B Waterworks 1
Water System I.D. Number: 46670 3
Source: Well 1-3
Date: 11/9/2022

Contaminant	*Well 1	Well 2	Well 3	Combined Concentration (mg/L)	Free Chlorine Demand Factor	Chlorine demand (mg/L)
Iron (In Source Water)	0.05	0.07	0.07	0.065	0.64	0.04
Iron (Added $FeCl_2$)	-	-	-	0.62	0.64	0.39
Manganese	0.25	0.143	0.23	0.203	1.29	0.26
Sulfide					2.08	0.00
Nitrite - N					5.00	0.00
Ammonia - N	0.273			0.273	10.00	2.73
Organic Nitrogen					1.00	0.00
Total Organic Carbon (TOC)		0.92	1.02	0.720	0.10	0.07
Hydrogen Sulfide					8.32	0.00
Arsenic	0.0068	0.0061	0.0048	0.0058	N/A	N/A
					Total	3.50

Source Flow Rate (gpm)	52	75	75

Hypochlorination Worksheet Calculations
DOH Water System Design Manual - October 2019

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	Well 1-3
Date:	11/9/2022

Water System Operating Parameters

Pressure at Sodium Hypochlorite Injection Point		50	psi
Average Day Demand	ADD	220	gpd/ERU
Maximum Day Demand	MDD	570	gpd/ERU
Number of Approved Connections	N	536	ERU
Number of Existing Connections		494	ERU
System Wide Daily Average Water Usage		117,920	gpd
Flow Rate at Sodium Hypochlorite Injection Point	Qs	200	gpm
Peak Hour Demand	PHD	447	gpm

Values Used for PHD Calculation	MDD	570	gpd/ERU
Equation 3-1, WSDM 2019 Edition	C	1.6	
	F	225	
	N	536	connections

Estimated Required Sodium Hypochlorite Dose

	Demand	3.5	ppm (mg/L)
	Residual	1	ppm (mg/L)
Required Sodium Hypochlorite Dose	Cs	4.5	ppm (mg/L)

Sodium Hypochlorite Metering Pump Requirements

Proposed Raw Sodium Hypochlorite Solution Concentration	Cc	12.5%	
Volume		16	cups
	or	1	gallons
Dilution Water Volume		2	gallons
Total Volume of Diluted Solution		3	gallons
Sodium Hypochlorite Concentration of Diluted Solution	Cf	41,667	ppm (mg/L)
Required Metering Pump Rate	Qf	1.30	gph

Sodium Hypochlorite Metering Pump Specifications

Pump Make	LMI PD76-A40HI			
Maximum Injection Pressure of Pump			50	psi
Greater than or Equal to Pressure at Injection Point?			Yes	
Maximum Stroke Rate of Pump			160	strokes/min
Minimum Pumping Rate			0	gph
Maximum Pumping Rate			1.75	gph
Desired Pumping Rate			1.30	gph
Percent of Maximum Pumping Rate			74%	
Midrange of Pump Output (20% - 80%)?			Yes	
Pulse Meter Make	Seametrics			
Pulse Meter Model	iMAG 4700 2"			
Pulse Meter Rate			0.7	pulses/gal
Pulse Frequency to Metering Pump			140	pulses/min
Pulse Meter Volume per Stroke			0.69	mL/stroke
Desired Metering Pump to Well Production Flow Rate Ratio			0.58	mL/gal
Pulse Meter Stroke %			85%	strokes/min
Metering Pump Input: Pulses per Event			1	pulses/event
Metering Pump Input: Volume to Pump per Event			0.58	mL/event
Definition of "Event"		1 event =	1	gal

Sodium Hypochlorite Solution Tank

Size of Tank				50	gal
Percentage of System Demand Supplied by Chlorine Tank				50%	
	Current Buildout		Full Buildout		
	ADD	MDD	ADD	MDD	
System Connections	494	494	536	536	ERU
Daily Water Usage	220	570	220	570	gpd/ERU
Daily Pumping Duration	4.5	11.7	4.9	12.7	hours
Estimated Daily Solution Used	5.9	15.2	6.4	16.5	gpd/ERU
Days to Empty	9	3	8	3	days
Shelf Life of Diluted Solution				2	months

Ferric Chloride Worksheet Calculations

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	Well 1-3
Date:	11/9/2022

Estimated Required Ferric Chloride Dose

Pressure at Ferric Chloride Injection Point		50	psi
Molecular Weight of Ferric Chloride		162.2	g/mol
Molecular Weight of Iron		55.8	g/mol
Naturally Occurring Iron Concentration		0.06	ppm (mg/L)
Arsenic Concentration		0.0058	ppm (mg/L)
Desired Iron Concentration for Arsenic Removal		0.58	ppm (mg/L)
Additional Iron Dosage Required		0.51	ppm (mg/L)
Required Ferric Chloride Dose	Cs	1.5	ppm (mg/L)

Ferric Chloride Metering Pump Requirements

Proposed Raw Ferric Chloride Solution Concentration	Cc	39%	
Volume		16	cups
		1	gallons
Dilution Water Volume		9	gallons
Total Volume of Diluted Solution		10	gallons
Ferric Chloride Concentration of Diluted Solution	Cf	39,000	ppm (mg/L)
Flow Rate at Ferric Chloride Injection Point	Qs	200	gpm
Required Metering Pump Rate	Qf	0.46	gph

Ferric Chloride Metering Pump Specifications

Pump Make	LMI PD75-A30HI			
Maximum Injection Pressure of Pump			50	psi
Greater than or Equal to Pressure at Injection Point?			Yes	
Maximum Stroke Rate of Pump			160	strokes/min
Minimum Pumping Rate			0	gph
Maximum Pumping Rate			0.85	gph
Desired Pumping Rate			0.46	gph
Percent of Maximum Pumping Rate			54%	
Midrange of Pump Output (20% - 80%)?			Yes	
Pulse Meter Make	Seametrics			
Pulse Meter Model	iMAG 4700p			
Pulse Meter Rate			0.7	pulses/gal
Pulse Frequency to Metering Pump			140	pulses/min
Pulse Meter Volume per Stroke			0.34	mL/stroke
Desired Metering Pump to Well Production Flow Rate Ratio			0.15	mL/gal
Pulse Meter Stroke Rate			87	strokes/min
Metering Pump Input: Pulses per Event			1	pulses/event
Metering Pump Input: Volume to Pump per Event			0.15	mL/event
Definition of "Event"		1 event =	1	gal

Ferric Chloride Solution Tank

Size of Tank				50	gal
Percentage of System Demand Supplied by Source				50%	
	Current Buildout		Full Buildout		
	ADD	MDD	ADD	MDD	
System Connections	494	494	536	536	ERU
Daily Water Usage	220	570	220	570	gpd/ERU
Daily Pumping Duration	4.5	11.7	4.9	12.7	hours
Estimated Daily Solution Used	2.1	5.4	2.3	5.9	gpd/ERU
Days to Empty	24.0	9.3	22.1	8.5	days
Shelf Life of Diluted Solution				2	months

Potassium Permanganate Worksheet Calculations

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	All Wells
Date:	11/9/2022

Estimated Required Potassium Permanganate Dose

Desired Potassium Permanganate Dose		0.10	ppm (mg/L)
Residual		0	ppm (mg/L)

Water System Operating Parameters

Pressure at Potassium Permanganate Injection Point		50	psi
Maximum Day Demand	MDD	570	gpd/ERU
Flow Rate at Potassium Permanganate Injection Point	Qs	200	gpm

Potassium Permanganate Metering Pump Requirements

Proposed Potassium Permanganate Solution		
Amount of Potassium Permanganate Used	1	ounces
Dilution Water Volume	3	gallons
Potassium Permanganate Concentration of Diluted Solution	2,497	ppm (mg/L)
Required Metering Pump Rate	0.48	gph

Potassium Permanganate Metering Pump Requirements

Pump Make	LMI PD75-A30HI			
Maximum Injection Pressure of Pump			50	psi
Greater than or Equal to Pressure at Injection Point?			Yes	
Maximum Stroke Rate of Pump			160	strokes/min
Minimum Pumping Rate			0	gph
Maximum Pumping Rate			0.85	gph
Desired Pumping Rate			0.48	gph
Percent of Maximum Pumping Rate			57%	
Midrange of Pump Output (20% - 80%)?			Yes	
Pulse Meter Make	Seametrics			
Pulse Meter Model	Imag4700			
Pulse Meter Rate			0.7	pulses/gal
Pulse Frequency to Metering Pump			140	pulses/min
Pulse Meter Volume per Stroke			0.34	mL/stroke
Desired Metering Pump to Well Production Flow Rate Ratio			0.15	mL/gal
Pulse Meter Stroke Rate			90	strokes/min
Metering Pump Input: Pulses per Event			1	pulses/event
Metering Pump Input: Volume to Pump per Event			0.15	mL/event
Definition of "Event"		1 event =	1	gal

Potassium Permanganate Solution Tank

Size of Tank				50	gal
Percentage of System Demand Supplied by Source				100%	
	Current Buildout		Full Buildout		
	ADD	MDD	ADD	MDD	
System Connections	494	494	536	536	ERU
Daily Water Usage	220	570	220	570	gpd/ERU
Daily Pumping Duration	9.1	23.5	9.8	24.0	hours
Estimated Daily Solution Used	4.4	11.3	4.7	11.5	gpd/ERU
Days to Empty	11	4	11	4	days
Shelf Life of Diluted Solution				2	months

Filter Sizing Calculations
DOH Water System Design Manual - October 2019

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	Well 1-3
Date:	11/9/2022

Water System Operating Parameters

Average Day Demand	ADD	220	gpd/ERU
Number of Approved Connections	N	536	ERU
System Wide Daily Average Water Usage		117,920	gpd
Desired Treatment System Capacity		225	gpm

Raw Water Quality

Arsenic Concentration	0.0068	ppm (mg/L)
Iron Concentration	0.68	ppm (mg/L)
Fe:As Ratio	100	:1
Manganese Concentration	0.380	ppm (mg/L)

Filter Vessel Sizing

Flow Rate to Filters	Qs	225	gpm
Filter Diameter		30	in
Filter Media Depth		42	in
Filter Quantity		8	filters
Surface Area per Filter		4.9	sf/filter
Total Filter Surface Area (All Filters)		39.3	sf
Filter Loading Rate (All Filters in Service)		5.7	gpm/sf
Flow Rate per Filter (All Filters in Service)		28.1	gpm/filter
Filter Loading Rate (During Backwash with One Filter Out of Service)		6.5	gpm/sf
Flow Rate per Filter (During Backwash with One Filter Out of Service)		28.1	gpm/filter
Filter Loading Rate (During Backwash with One Filter Out of Service)		6.5	gpm/sf
Flow Rate per Filter (During Backwash with One Filter Out of Service)		12.6	gpm/filter

Pre-Filter Chlorine Contact Time

Contact Tank Height	60	in
Contact Tank Diameter	30	in
Contact Tank Volume	184	gal
Contact Tank Quantity	2	tanks
Total Tank Volume	367	gal
Filter Height	60	in
Filter Diameter	30	in
Filter Media Depth	42	in
Filter Headspace	18	in
Filter Quantity	8	filters
Headspace Volume	55	gal
Total Contact Volume	422	gal
Pre-Filter Contact Time	3.6	minutes

Backwash Frequency

$KMnO_4$ Demand Equivalent	10,000	mg/cf
Iron Concentration	0.68	ppm (mg/L)
Iron Equivalence	1	:1
Effective Iron Concentration	0.68	ppm (mg/L)
Manganese Concentration	0.38	ppm (mg/L)
Manganese Equivalence	2	:1
Effective Manganese Concentration	0.76	ppm (mg/L)
Total Effective Concentration	1.44	ppm (mg/L)
Media Volume per Filter	17.2	cf/filter
Filter Quantity	8	filters
Total Media Volume	137.4	cf
Total Binding Capacity	1,370,000	mg
Theoretical Filter Capacity Before Backwash	251,000	gallons
Pumping Rate	200	gpm
Theoretical Filter Run Time Before Backwash	21	hours
Theoretical Filter Capacity Before Backwash	251,000	gallons

ATEC Recommended Run Time Before Backwash	12	hours
ATEC Recommended Filter Capacity Before Backwash	144,000	gallons
Backwash Frequency	1.2	days

Backwash Quantity

Backwash Rate per Filter Area	28	gpm/sf
Surface Area per Filter	4.91	sf/filter
Backwash Rate per Filter	137	gpm
Backwash Duration per Filter	5	min
Rinse Duration	0	min
Backwash Quantity per Filter	685	gal/filter
Filter Quantity	8	filters
Total Backwash Quantity	5,480	gallons
Backwash Loss	3.8%	

Backwash Infiltration Area

Backwash Quantity		5480	gallons
Maximum Day Demand	MDD	570	gpd/ERU
Number of Approved Connections	N	536	ERU
System Wide Maximum Day Demand		305,520	gpd
Backwash Frequency at MDD		19.7	hours
Soil Infiltration Rate		0.5	in/hr
Required Infiltration Area		892	sf
Area Length		25.0	feet
Area Width		36.0	feet
Depth		6	inches
Provided Surface Area		900	sf
Provided Volume		3,366	gallons

PROPOSED SODIUM HYPOCHLORITE INJECTION SYSTEM SPECIFICATION (WELLS #1-#3)	
STOCK SOLUTION RAW STRENGTH	12.5%
RAW SODIUM HYPOCHLORITE VOLUME	1 GAL
DILUTION WATER VOLUME	2 GAL
TOTAL DILUTED SOLUTION VOLUME	3 GAL
WELL PUMPING RATE	200 GPM
TARGET POST-TREATMENT FREE CHLORINE RESIDUAL	1 mg/L
METERING PUMP MAKE & MODEL	LMI PD76-A40HI
METERING PUMP FLOW RANGE	0 - 1.75 gph
METERING PUMP PERCENT OF MAXIMUM PUMP RATE	74%
METERING PUMP EXTERNAL PULSE MODE SETTING: PULSES PER EVENT	0.7 PULSES/EVENT
METERING PUMP EXTERNAL PULSE MODE SETTING: VOLUME TO PUMP PER EVENT	0.58 mL/EVENT

PROPOSED FERRIC CHLORIDE INJECTION SYSTEM SPECIFICATION (WELLS #1-#3)	
STOCK SOLUTION RAW STRENGTH	39%
RAW FERRIC CHLORIDE VOLUME	1 GAL
DILUTION WATER VOLUME	9 GAL
TOTAL DILUTED SOLUTION VOLUME	10 GAL
WELL PUMPING RATE	200 GPM
TARGET PRE-TREATMENT IRON CONCENTRATION	0.6 mg/L
TARGET POST-TREATMENT IRON CONCENTRATION	0.0 mg/L
METERING PUMP MAKE & MODEL	LMI PD75-A30HI
METERING PUMP FLOW RANGE	0 - 0.85 gph
METERING PUMP PERCENT OF MAXIMUM PUMP RATE	54%
METERING PUMP EXTERNAL PULSE MODE SETTING: PULSES PER EVENT	0.7 PULSES/EVENT
METERING PUMP EXTERNAL PULSE MODE SETTING: VOLUME TO PUMP PER EVENT	0.15 mL/EVENT

PROPOSED POTASSIUM PERMANGANATE INJECTION SYSTEM SPECIFICATION (ALL WELLS)	
RAW POTASSIUM PERMANGANATE	1 OUNCE(S)
DILUTION WATER VOLUME	3 GAL
WELL PUMPING RATE	200 GPM
METERING PUMP MAKE & MODEL	LMI PD75-A30HI
METERING PUMP FLOW RANGE	0 - 0.85 gph
METERING PUMP PERCENT OF MAXIMUM PUMP RATE	57%
METERING PUMP EXTERNAL PULSE MODE SETTING: PULSES PER EVENT	0.7 PULSES/EVENT
METERING PUMP EXTERNAL PULSE MODE SETTING: VOLUME TO PUMP PER EVENT	0.15 mL/EVENT

PULSE METER SETTINGS	
MAKE & MODEL	SEAMETRICS IMAG 4700p
SIZE	2"
PULSE SETTING	0.7 PULSES/GAL

ATEC CONTROLLER SETTINGS	
TREATMENT SYSTEM CAPACITY	225 GPM
FILTER DIAMETER	30 INCHES
EMPTY FILTERS FOR CONTACT TANK QUANTITY	2
FILTERS WITH FILTER MEDIA QUANTITY	8
TOTAL FILTER CAPACITY BEFORE BACKWASH	144,000 GAL
BACKWASH RATE PER FILTER	137 GPM
BACKWASH DURATION PER FILTER	5 MINUTES
TOTAL BACKWASH VOLUME	5,480 GAL
PERCENTAGE OF WATER LOST TO BACKWASH	3.8%

Well #4

Hypochlorination Oxidative Demand Calculations

Water System Name: W&B Waterworks 1
Water System I.D. Number: 46670 3
Source: Well 4
Date: 11/9/2022

Contaminant	Concentration (mg/L)	Free Chlorine Demand Factor	Chlorine demand (mg/L)
Iron (In Source Water)	0.15	0.64	0.10
Iron (Added $FeCl_2$)	0.77	0.64	0.49
Manganese	0.38	1.29	0.49
Sulfide		2.08	0.00
Nitrite - N		5.00	0.00
Ammonia - N	0.330	10.00	3.30
Organic Nitrogen		1.00	0.00
Total Organic Carbon (TOC)		0.10	0.00
Hydrogen Sulfide		8.32	0.00
Arsenic	0.0092	N/A	N/A
Total	N/A	N/A	4.38

*From pilot test. August 2021

Hypochlorination Worksheet Calculations
DOH Water System Design Manual - October 2019

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	Well 4
Date:	11/9/2022

Water System Operating Parameters

Pressure at Sodium Hypochlorite Injection Point		50	psi
Average Day Demand	ADD	220	gpd/ERU
Maximum Day Demand	MDD	570	gpd/ERU
Number of Approved Connections	N	536	ERU
Number of Existing Connections		494	ERU
System Wide Daily Average Water Usage		117,920	gpd
Flow Rate at Sodium Hypochlorite Injection Point	Qs	125	gpm
Peak Hour Demand	PHD	447	gpm

Values Used for PHD Calculation	MDD	570	gpd/ERU
Equation 3-1, WSDM 2019 Edition	C	1.6	
	F	225	
	N	536	connections

Estimated Required Sodium Hypochlorite Dose

	Demand	4.4	ppm (mg/L)
	Residual	1	ppm (mg/L)
Required Sodium Hypochlorite Dose	Cs	5.4	ppm (mg/L)

Sodium Hypochlorite Metering Pump Requirements

Proposed Raw Sodium Hypochlorite Solution Concentration	Cc	12.5%	
Volume		16	cups
	or	1	gallons
Dilution Water Volume		2	gallons
Total Volume of Diluted Solution		3	gallons
Sodium Hypochlorite Concentration of Diluted Solution	Cf	41,667	ppm (mg/L)
Required Metering Pump Rate	Qf	0.97	gph

Sodium Hypochlorite Metering Pump Specifications

Pump Make	LMI PD76-A40HI			
Maximum Injection Pressure of Pump			50	psi
Greater than or Equal to Pressure at Injection Point?			Yes	
Maximum Stroke Rate of Pump			160	strokes/min
Minimum Pumping Rate			0	gph
Maximum Pumping Rate			1.75	gph
Desired Pumping Rate			0.97	gph
Percent of Maximum Pumping Rate			55%	
Midrange of Pump Output (20% - 80%)?			Yes	
Pulse Meter Make	Seametrics			
Pulse Meter Model	iMAG 4700p			
Pulse Meter Rate			1	pulses/gal
Pulse Frequency to Metering Pump			125	pulses/min
Pulse Meter Volume per Stroke			0.69	mL/stroke
Desired Metering Pump to Well Production Flow Rate Ratio			0.49	mL/gal
Pulse Meter Stroke Percent			71%	
Metering Pump Input: Pulses per Event			1	pulses/event
Metering Pump Input: Volume to Pump per Event			0.49	mL/event
Definition of "Event"		1 event =	1	gal

Sodium Hypochlorite Solution Tank

Size of Tank				50	gal
Percentage of System Demand Supplied by Source				50%	
	Current Buildout		Full Buildout		
	ADD	MDD	ADD	MDD	
System Connections	494	494	536	536	ERU
Daily Water Usage	220	570	220	570	gpd/ERU
Daily Pumping Duration	7.2	18.8	7.9	20.4	hours
Estimated Daily Solution Used	7.0	18.2	7.6	19.7	gpd/ERU
Days to Empty	7.1	2.8	6.6	2.5	days
Shelf Life of Diluted Solution				2	months

Chlorine Contact Time

Reservoir Height		35	feet
Reservoir Diameter		30	feet
Reservoir Volume		185,056	gallons
Reservoir Volume per Foot		5,287	gallons
Reservoir Top Dead Storage	TDS	1	feet
		5,287	gallons
Reservoir Bottom Dead Storage	BDS	1	feet
		5,287	gallons
Reservoir Operational Storage	OS	1	feet
		5,287	gallons
Total Source Capacity		262.5	gpm
Reservoir Equalizing Storage	ES	27,604	gallons
Reservoir Standby Storage	SBS	141,589	gallons
Reservoir Contact Volume (SBS and BDS)		146,877	gallons
Reservoir Baffling Efficiency (Top Fill/Bottom Out)		10%	
Reservoir Contact Time During PHD		33	minutes
Pipe Length (Reservoir to First Connection)		1000	feet
Pipe Internal Diameter (Reservoir to First Connection)		8	inches
Pipe Volume (Reservoir to First Connection)		2,611	gallons
Contact Time in Pipe (100% Baffling Efficiency)		6	minutes
Total Contact Time		39	minutes
Ct x T		39	min x ppm
	Minimum:	6	Okay

Ferric Chloride Worksheet Calculations

Water System Name:	W&B Waterworks 1
Water System I.D. Number:	46670 3
Source:	Well 4
Date:	11/9/2022

Estimated Required Ferric Chloride Dose

Pressure at Ferric Chloride Injection Point		50	psi
Molecular Weight of Ferric Chloride		162.2	g/mol
Molecular Weight of Iron		55.8	g/mol
Naturally Occurring Iron Concentration		0.15	ppm (mg/L)
Arsenic Concentration		0.0092	ppm (mg/L)
Desired Iron Concentration for Arsenic Removal		0.92	ppm (mg/L)
Additional Iron Dosage Required		0.77	ppm (mg/L)
Required Ferric Chloride Dose	Cs	2.2	ppm (mg/L)

Ferric Chloride Metering Pump Requirements

Proposed Raw Ferric Chloride Solution Concentration	Cc	39%	
Volume		16	cups
		1	gallons
Dilution Water Volume		9	gallons
Total Volume of Diluted Solution		10	gallons
Ferric Chloride Concentration of Diluted Solution	Cf	39,000	ppm (mg/L)
Flow Rate at Ferric Chloride Injection Point	Qs	125	gpm
Required Metering Pump Rate	Qf	0.43	gph

Ferric Chloride Metering Pump Specifications

Pump Make	LMI PD74-A20HI			
Maximum Injection Pressure of Pump			50	psi
Greater than or Equal to Pressure at Injection Point?			Yes	
Maximum Stroke Rate of Pump			160	strokes/min
Minimum Pumping Rate			0	gph
Maximum Pumping Rate			0.85	gph
Desired Pumping Rate			0.43	gph
Percent of Maximum Pumping Rate			51%	
Midrange of Pump Output (20% - 80%)?			Yes	
Pulse Meter Make	Seametrics			
Pulse Meter Model	iMAG 4700p			
Pulse Meter Rate			1.0	pulses/gal
Pulse Frequency to Metering Pump			125	pulses/min
Pulse Meter Volume per Stroke			0.34	mL/stroke
Desired Metering Pump to Well Production Flow Rate Ratio			0.22	mL/gal
Pulse Meter Stroke Rate			81.0224	strokes/min
Metering Pump Input: Pulses per Event			1	pulses/event
Metering Pump Input: Volume to Pump per Event			0.22	mL/event
Definition of "Event"		1 event =	1	gal

Ferric Chloride Solution Tank

Size of Tank				50	gal
Percentage of System Demand Supplied by Source				50%	
	Current Buildout		Full Buildout		
	ADD	MDD	ADD	MDD	
System Connections	494	494	536	536	ERU
Daily Water Usage	220	570	220	570	gpd/ERU
Daily Pumping Duration	7.2	18.8	7.9	20.4	hours
Estimated Daily Solution Used	3.1	8.1	3.4	8.8	gpd/ERU
Days to Empty	16.0	6.2	14.8	5.7	days
Shelf Life of Diluted Solution				2	months

Filter Sizing Calculations
DOH Water System Design Manual - October 2019

Water System Name: W&B Waterworks 1
Water System I.D. Nu 46670 3
Source: Well 4
Date: 11/9/2022

Water System Operating Parameters

Average Day Demand	ADD	220	gpd/ERU
Number of Approved Connections	N	536	ERU
System Wide Daily Average Water Usage		117,920	gpd
Desired Treatment System Capacity		225	gpm

Raw Water Quality

Arsenic Concentration	0.0092	ppm (mg/L)
Iron Concentration	0.92	ppm (mg/L)
Fe:As Ratio	100	:1
Manganese Concentration	0.380	ppm (mg/L)

Filter Vessel Sizing

Flow Rate to Filters	Qs	225	gpm
Filter Diameter		30	in
Filter Media Depth		42	in
Filter Quantity		8	filters
Surface Area per Filter		4.9	sf/filter
Total Filter Surface Area (All Filters)		39.3	sf
Filter Loading Rate (All Filters in Service)		5.7	gpm/sf
Flow Rate per Filter (All Filters in Service)		28.1	gpm/filter
Filter Loading Rate (During Backwash with One Filter Out of		6.5	gpm/sf

Pre-Filter Chlorine Contact Time

Contact Tank Height	60	in
Contact Tank Diameter	30	in
Contact Tank Volume	184	gal
Contact Tank Quantity	2	tanks
Total Tank Volume	367	gal
Filter Height	60	in
Filter Diameter	30	in
Filter Media Depth	42	in
Filter Headspace	18	in
Filter Quantity	8	filters
Headspace Volume	55	gal
Total Contact Volume	422	gal
Pre-Filter Contact Time	3.6	minutes

Backwash Frequency

$KMnO_4$ Demand Equivalent	10,000	mg/cf
Iron Concentration	0.92	ppm (mg/L)
Iron Equivalence	1	:1
Effective Iron Concentration	0.92	ppm (mg/L)
Manganese Concentration	0.38	ppm (mg/L)
Manganese Equivalence	2	:1
Effective Manganese Concentration	0.76	ppm (mg/L)
Total Effective Concentration	1.68	ppm (mg/L)
Media Volume per Filter	17.2	cf/filter
Filter Quantity	8	filters
Total Media Volume	137.4	cf
Total Binding Capacity	1,370,000	mg
Theoretical Filter Capacity Before Backwash	215,000	gallons
Pumping Rate	125	gpm
Theoretical Filter Run Time Before Backwash	29	hours
ATEC Recommended Run Time Before Backwash	12	hours

ATEC Recommended Filter Capacity Before Backwash	90,000	gallons
Backwash Frequency	0.8	days

Backwash Quantity

Backwash Rate per Filter Area	28	gpm/sf
Surface Area per Filter	4.91	sf/filter
Backwash Rate per Filter	137	gpm
Backwash Duration per Filter	5	min
Rinse Duration	0	min
Backwash Quantity per Filter	685	gal/filter
Filter Quantity	8	filters
Total Backwash Quantity	5,480	gallons
Backwash Loss	6.1%	

Backwash Infiltration Area

Backwash Quantity		5480	gallons
Maximum Day Demand	MDD	570	gpd/ERU
Number of Approved Connections	N	536	ERU
System Wide Maximum Day Demand		305,520	gpd
Backwash Frequency at MDD		7.1	hours
Soil Infiltration Rate		0.5	in/hr
Required Infiltration Area		2487	sf
Area Length		25.0	feet
Area Width		100.0	feet
Depth		6	inches
Provided Surface Area		2500	sf
Provided Volume		9,350	gallons

PROPOSED SODIUM HYPOCHLORITE INJECTION SYSTEM SPECIFICATION (WELL #4)	
STOCK SOLUTION RAW STRENGTH	12.5%
RAW SODIUM HYPOCHLORITE VOLUME	1 GAL
DILUTION WATER VOLUME	2 GAL
TOTAL DILUTED SOLUTION VOLUME	3 GAL
WELL PUMPING RATE	125 GPM
TARGET POST-TREATMENT FREE CHLORINE RESIDUAL	1 mg/L
METERING PUMP MAKE & MODEL	LMI PD76-A40HI
METERING PUMP FLOW RANGE	0 - 1.75 gph
METERING PUMP PERCENT OF MAXIMUM PUMP RATE	55%
METERING PUMP EXTERNAL PULSE MODE SETTING: PULSES PER EVENT	1 PULSES/EVENT
METERING PUMP EXTERNAL PULSE MODE SETTING: VOLUME TO PUMP PER EVENT	0.49 mL/EVENT

PROPOSED FERRIC CHLORIDE INJECTION SYSTEM SPECIFICATION (WELL #4)	
STOCK SOLUTION RAW STRENGTH	39%
RAW FERRIC CHLORIDE VOLUME	1 GAL
DILUTION WATER VOLUME	9 GAL
TOTAL DILUTED SOLUTION VOLUME	10 GAL
WELL PUMPING RATE	125 GPM
TARGET PRE-TREATMENT IRON CONCENTRATION	0.9 mg/L
TARGET POST-TREATMENT IRON CONCENTRATION	0.0 mg/L
METERING PUMP MAKE & MODEL	LMI PD74-A20HI
METERING PUMP FLOW RANGE	0 - 0.85 gph
METERING PUMP PERCENT OF MAXIMUM PUMP RATE	51%
METERING PUMP EXTERNAL PULSE MODE SETTING: PULSES PER EVENT	1 PULSES/EVENT
METERING PUMP EXTERNAL PULSE MODE SETTING: VOLUME TO PUMP PER EVENT	0.22 mL/EVENT

PULSE METER SETTINGS	
MAKE & MODEL	SEAMETRICS IMAG 4700p
SIZE	2"
PULSE SETTING	1 PULSES/GAL

ATEC CONTROLLER SETTINGS	
TREATMENT SYSTEM CAPACITY	225 GPM
FILTER DIAMETER	30 INCHES
EMPTY FILTERS FOR CONTACT TANK QUANTITY	2 EA
FILTERS WITH FILTER MEDIA QUANTITY	8 EA
TOTAL FILTER CAPACITY BEFORE BACKWASH	90,000 GAL
BACKWASH RATE PER FILTER	137 GPM
BACKWASH DURATION PER FILTER	5 MINUTES
TOTAL BACKWASH VOLUME	5,480 GAL
PERCENTAGE OF WATER LOST TO BACKWASH	6%

Appendix G: Equipment Information and Specifications

Pulse Meter

iMAG 4700 Series
FLANGED MAGMETER


iMAG 4700


iMAG 4700 200/300


iMAG 4700p


iMAG 4700r
(Remote Display)

THE RIGHT METER FOR
- Water & Wastewater Treatment
- Municipal
- Pump skids
- Pump stations
- Packaged plants
- Filtration systems
- Reclaimed water
- Hydraulic fracturing

Features

- Easy setup
- Minimal straight pipe
- Mounted or remote display
- Tamper-evident seal
- Certified to NSF/ANSI standard 61
- IP68 rated
- No moving parts
- Telemetry ready for wireless meter reading. Solutions available now by our sister company SIGNALFIRE — WIRELESS TELEMETRY —

Contact Your Supplier

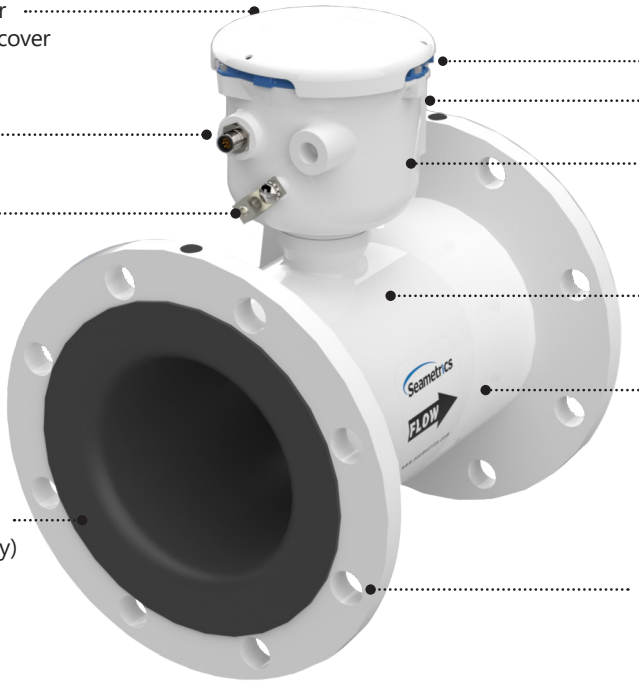
The **iMAG-Series** is the most economical flanged electromagnetic flowmeter on the market. With electrodes designed to discourage fouling, it is available in 2" to 12" pipe in municipal or industrial water, waste and reclaimed water, pump stations, and packaged plant applications. Minimal straight pipe requirements allow iMAG-Series meters to be used in piping configurations where there is little space between the meter and an elbow.

iMAG-Series meters are CE certified, certified to NSF/ANSI standard 61 and are rated IP68 for applications where the meter may be operated under water to a depth of at least 10 feet (3 meters) continuously.

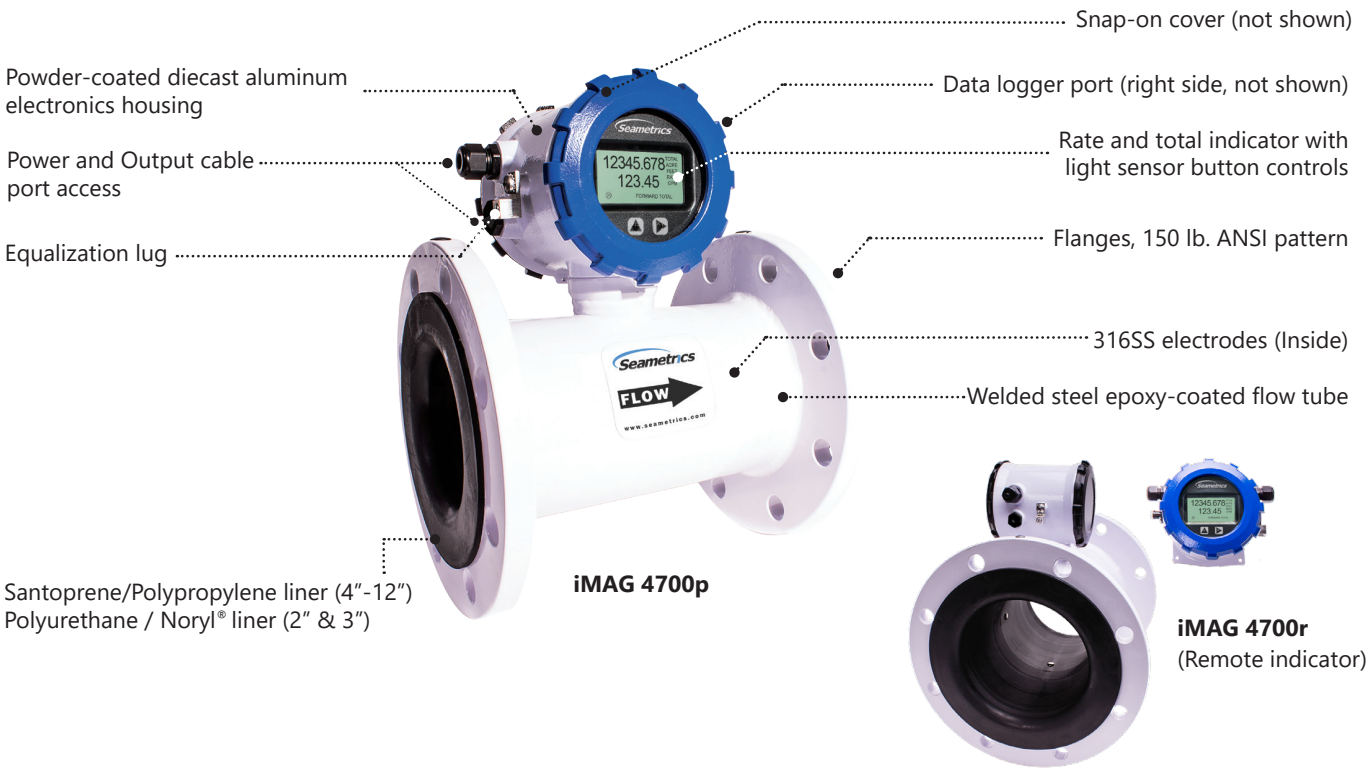
The display can be meter mounted or remote, and both rate and total indication are standard. Rate and total units and pulse scaling can be set via the front panel touch key pad by the user. Bidirectional flow reading is standard with totals available in forward, reverse, net flow, batch forward flow, and batch reverse flow. Built-in data logging is available as an option for secure flow logging.

The iMAG 4700 is also available in either AC or DC powered versions, with battery backup. Pulse output is standard on all models, while 4-20mA passive current loop is also standard on the iMAG 4700p. 4-20mA loop is optional on the iMAG 4700 and iMAG 4700r externally powered meters and Modbus® protocol outputs are optional on all models although battery life will be reduced if ordered on battery powered units. A power/output cable allows outputs for use with a variety of Seametrics displays and other controls for remote reading and telemetry applications.

Features



iMAG 4700



iMAG 4700p

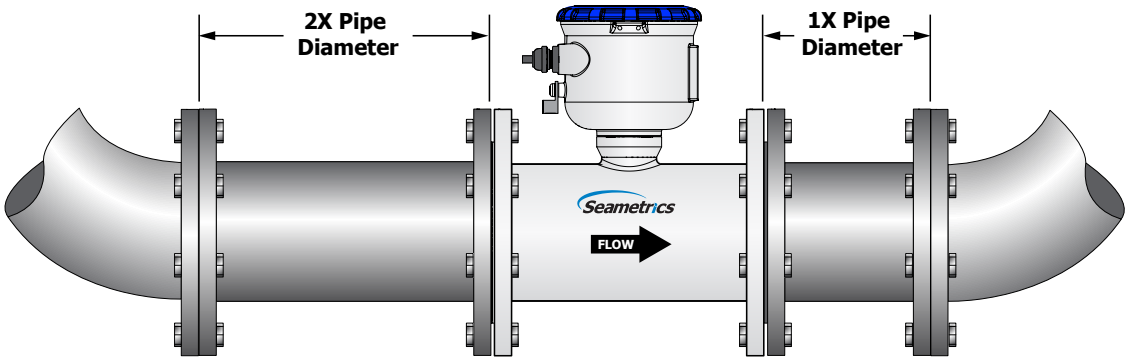
iMAG 4700r
(Remote indicator)

Features

- Built-in Data Logger *(Optional)*
- Bidirectional Flow Reading *(Standard)*
- Pulse Scaled Output *(Standard)*
- 4-20mA Output *(Optional*)*
- Modbus® Protocol Output *(Optional*)*
- High Speed Digital Output *(Optional*)*
- Battery Power *(iMAG 4700 battery model only)*
- External DC Power *(Optional*)*
- Integrated AC Power Supply *(Optional*)*
- Remote Display *(iMAG 4700r)*

Quickly and easily change Total Volume Units, Flow Rate Units, Pulse Output Scaling, and many other settings using the two light sensor button controls on the display panel.

* *Some optional items only available on some configurations. See last page for further details.*



Minimal straight pipe requirements to ease installation in tight quarters.

iMAG 4700 Series
FLANGED MAGMETER

Specifications

Pipe Sizes		2″, 3″, 4″, 6″, 8″, 10″, 12″				
Flanges		150 lb. ANSI Pattern				
Pressure		150 psi (10.3 bar) line pressure				
Temperature	**Operating**	10˚ to 140˚ F (-12˚ to 60˚ C)				
	Storage	-40˚ to 158˚ F (-40˚ to 70˚ C)				
Accuracy		±0.75% of reading on iMAG 4700p and 4700r (±1.0% iMAG 4700), ±0.025% of full-scale flow from low flow cutoff to maxi. flow rate of 10 m/sec				
Low Flow Cutoff		0.5% of maximum flow rate				
Material	**Body** *(2″-12″)*	Welded steel, epoxy-coated				
	Liner *(2″ & 3″)*	Polyurethane/Noryl®				
	Liner *(4″-12″)*	Santoprene flange/Polypropylene liner body				
	Electronics Housing	Powder-coated diecast aluminum				
	Electrodes	316 stainless steel				
Display	**Type**	128x64 dot-matrix LCD				
	Digits	5 Digit Rate			8 Digit Total	
	Units	Rate Volume Units		Rate Time Units	Total Volume Units	
	Please Note: All iMAG meters are factory set for gallons per minute (GPM) rate and gallons total. If other units are required, they can be set in the field.	Gallons Liters Barrels(42 gal) Cubic Feet Cubic Meters	Million Gallons[2] Mega Liters[2] Imperial Gallons Million Imperial Gallons[2]	Second Minute Hour Day	Gallons Gallons x 10 Gallons x 100 Gallons x 1000 Million Gallons Liters Kilo Liters Mega Liters	Barrels (42 gal) Cubic Meters Cubic Meters x 1000 Cubic Feet Cubic Feet x 100 Cubic Feet x 1000 Second Foot Day Million Cubic Feet	Acre Feet Acre Inches Imperial Gallons Imperial Gallons x 1000 Million Imperial Gallons Fluid Ounces
	Bidirectional[1]	Forward Total, Reverse Total, Net Total, Batch Forward Total, Batch Reverse Total[3]				
Power	**DC Power**	9-36 Vdc @ 250 mA max, 30 mA average				
	Battery Backup (Not for use as primary power)	DC powered units: One lithium 7.2V 'D' size battery pack, replaceable. AC powered units: One 9V alkaline battery, replaceable.				
	AC Power	85-264Vac, 50/60Hz, 0.12A *(iMAG 4700r and 4700p only)*				
	Battery	One lithium 7.2V 'D' size battery pack, replaceable. *(iMAG 4700 only)*				
Scaled Pulse Output	**Signal**	Current sinking pulse, isolated, 36 Vdc at 10 mA max				
	Pulse Rates	User-scalable from 0.1 to 99,999.9 volume units/pulse. Pulse width is one-half of pulse period with minimum pulse width of 2.5 ms, 200 pulses/sec max. For battery option meters, pulse width varies with frequency, 150 pulses/sec max.				
Options	**4-20mA Current Loop**	Isolated, passive, 24Vdc, 650 Ω maximum current loop				
	High Speed Digital	Isolated, open collector, 24 Vdc *(iMAG4700p only)*				
	Serial Communications	Isolated, asynchronous serial RS485, Modbus® RTU protocol				
Cable	**Power/Output Cable**	20ft (6m) standard length polyurethane jacketed cable—for power and outputs (lengths up to 200' available).				
	Remote Display Cable	20ft (6m) standard length polyurethane jacketed cable—for connection between meter and remote display (lengths up to 200' available). *(iMAG 4700r)*				
Conductivity		>20 microSiemens/cm				
Empty Pipe Detection		Hardware/software, conductivity-based				
Regulatory		CE (EN 61326), 2″-12″ certified to NSF/ANSI standard 61 60°C (140°F)				
Environmental		NEMA 6P, IP68 (10ft (3m) depth, continuously)				

Modbus is a registered trademark of Schneider Electric.

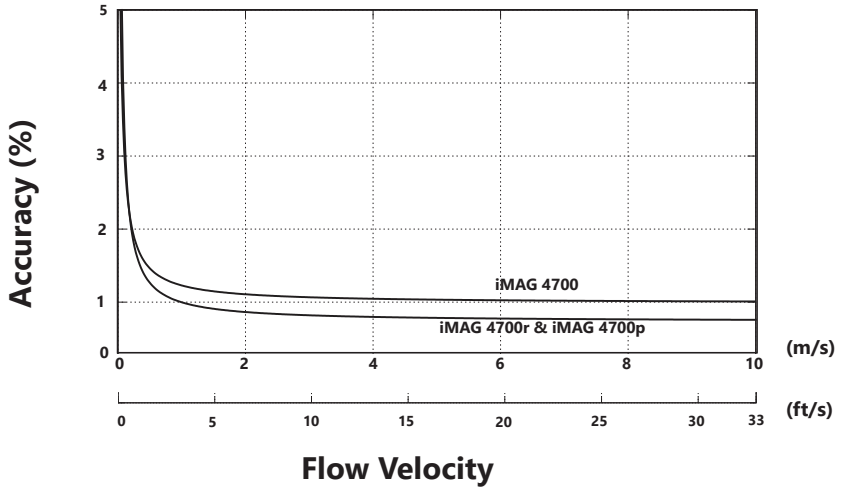
* *Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).*

[1] *If forward and reverse flow data needs to be sent to another device, either the Digital or Modbus output is required.*

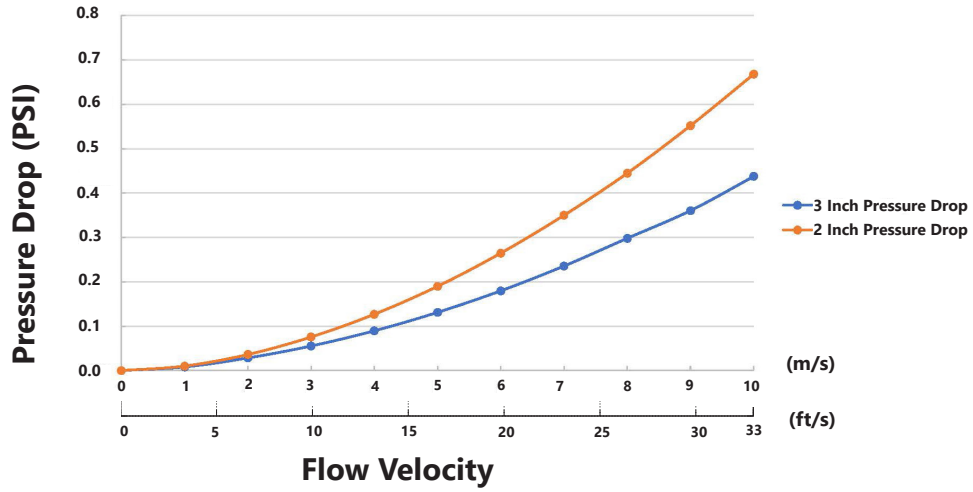
[2] *Rate Time Unit is available in Day only.*

[3] *Forward and reverse flow totals are non-resettable. Batch forward and batch reverse totals can be reset.*

iMAG Accuracy



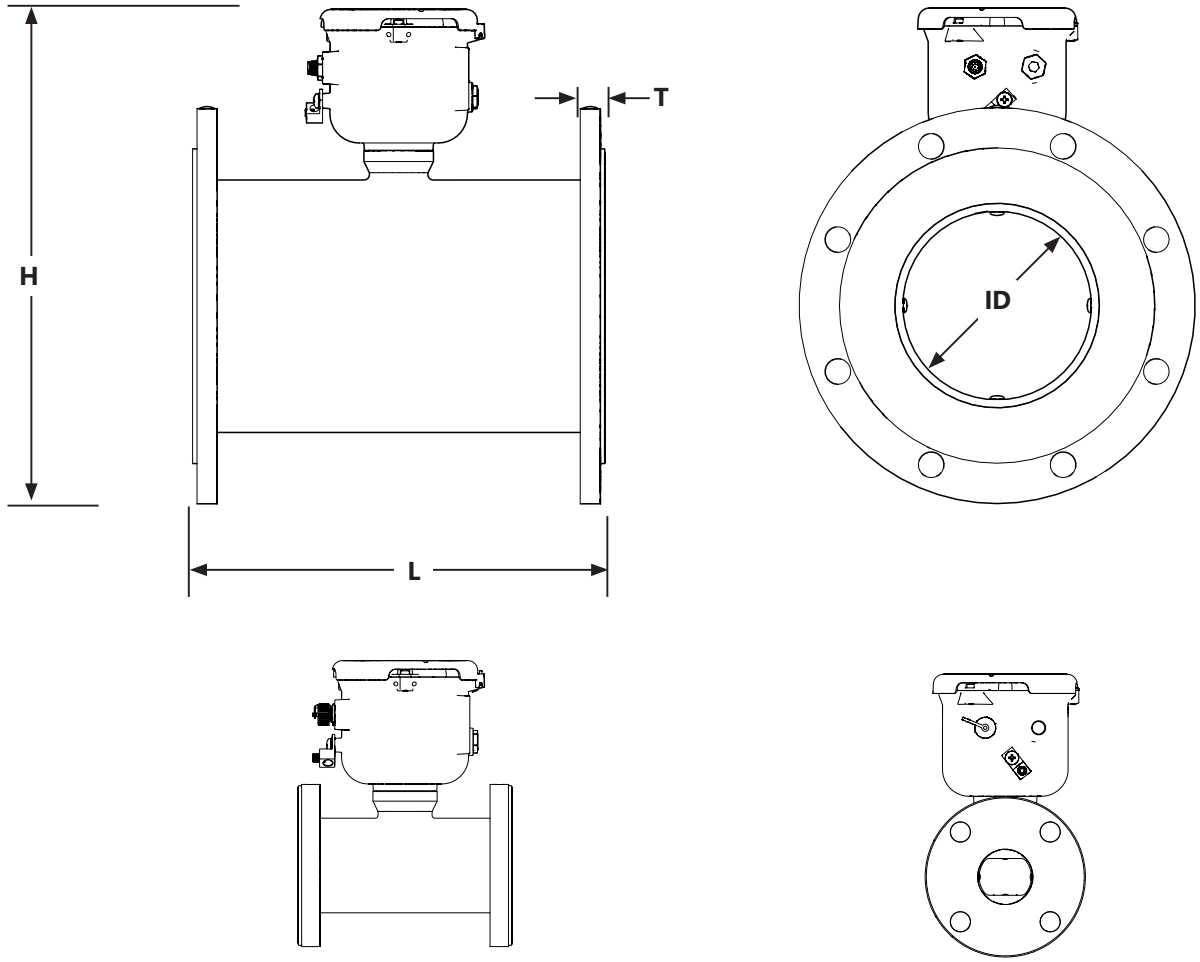
2" & 3" Pressure Drop Curve (No Pressure Drop 4"-12")



Flow Rate (2" - 12")

Pipe Size *(Inches in diameter)*	**2"**	**3"**	**4"**	**6"**	**8"**	**10"**	**12"**
Max Flow Rate *(Gallons/Minute)*	321	722	1285	2891	5140	8031	11565
Cut-off (min) Flow Rate *(Gallons/Minute)*	2	4.0	6.43	14.46	25.70	40.15	57.82
Max Flow Rate *(Liters/Second)*	20.25	46	81	182	324	507	730
Cut-off (min) Flow Rate *(Liters/Second)*	0.13	0.23	0.41	0.91	1.62	2.54	3.65
Max Flow Velocity *(Meters/Second)*	10	10	10	10	10	10	10

Dimensions - iMAG 4700



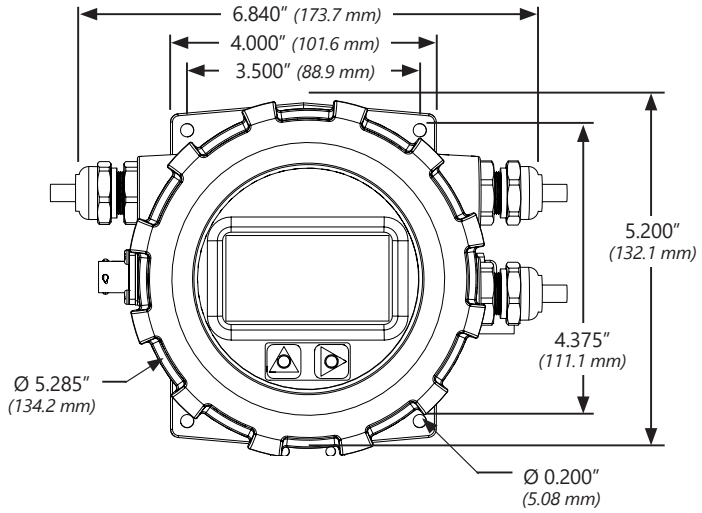
iMAG 4700 Meter Size	L		H		T		ID		Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg
2″	7.9	200	7.6	193	.62	15.7	1.76*	45*	20	9
3″	7.9	200	8.1	206	.62	15.7	2.68*	68*	26	11.8
4″	10.12	257	8.3	211	.62	15.7	3.12	79	33	15
6″	12.09	307	9.1	231	.69	17.5	5.05	128	49	22
8″	14.14	359	10.1	257	.69	17.5	6.44	164	70	32
10″	18.08	459	11.2	284	.69	17.5	8.61	219	130	59
12″	19.68	500	12.2	310	.81	20.6	10.55	268	170	77
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.	

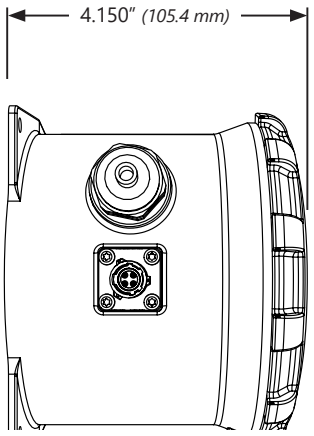
Note: 'L' dimension is total from liner face to liner face

*Average ID

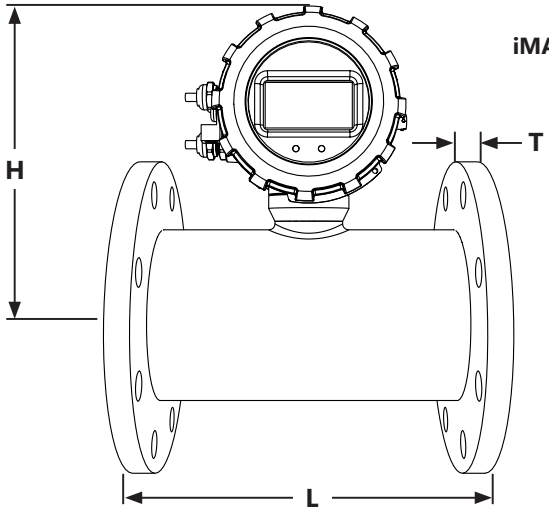
Dimensions - iMAG 4700r and iMAG 4700p

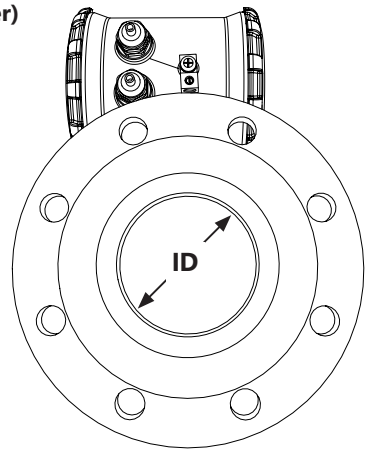
iMAG 4700r (remote display)





iMAG 4700p and iMAG 4700r (remote meter)





iMAG 4700 Meter Size	L		H		T		ID		Shipping Weight			
									iMAG4700p		iMAG4700r	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg	lbs	Kg
2″	7.9	200	7.6	193	.62	15.75	1.76*	45*	21	9.5	22	10
3″	7.9	200	8.1	205.7	.62	15.75	2.68*	68*	27	12.3	28	12.7
4″	10.12	257	8.6	218	.62	15.75	3.12	79	34	15.5	43	19.5
6″	12.09	307	9.4	239	.69	17.5	5.05	128	50	22.5	59	27
8″	14.14	359	10.4	264	.69	17.5	6.44	164	71	32	78	35
10″	18.08	459	11.5	292	.69	17.5	8.61	219	130	59	135	61
12″	19.68	500	12.5	317	.81	20.6	10.55	268	170	77	175	79
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.			

Note: 'L' dimension is total from liner face to liner face

Chemical Injection Pump

PD Series

DATA SHEET

Chemical Metering Pump

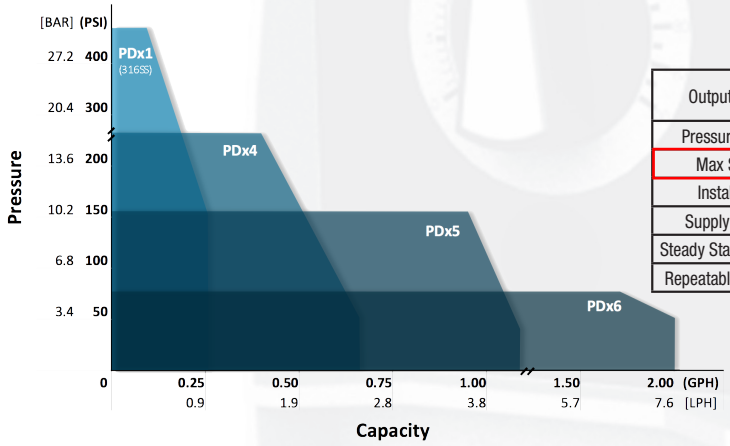
Designed to Last

Introducing the PD Series chemical metering pump, the new standard in water treatment. This upgrade to LMI's most popular pump series includes an improved drive design, all new electronics, and proven FASTPRIME™ liquid ends. Available in Manual or Enhanced control models, the PD Series pump fits seamlessly into your process control application. The Manual model offers straightforward control without the need for tedious calculations. Its split-scale dial ensures precision, even at lower flow rates. The Enhanced model offers external control and a large graphical display to provide intuitive access to advanced features such as calibration assist, system and user totalizers, the new STAYPRIME™ degassing technology, and more.

Trusted by water treatment professionals for more than a generation, the PD Series chemical metering pump will continue to earn your trust for years to come.

Manual Model Enhanced Model

Performance Specifications



Output Range	.002 – 2.0 GPH (.008 – 7.6 LPH)
Pressure Range	50-450 PSI (3.4-30.6 BAR)
Max Stroke	160 SPM
Installation	Indoor/Outdoor
Supply Voltage	115-230V / 50-60Hz
Steady State Accuracy	+/- 3%
Repeatable Accuracy	+/- 3%

FastPrime™ Liquid Ends*

	PSI	GPH	BAR	LPH
PDx1	450	0.10	30.6	0.38
	300	0.20	20.4	0.76
	150	0.25	10.2	0.95
PDx4	250	0.35	17.0	1.32
	150	0.52	10.2	1.97
	50	0.68	3.4	2.57
PDx5	150	0.80	10.2	3.03
	110	1.00	7.5	3.79
	30	1.10	2.0	4.20
PDx6	70	1.70	4.8	6.44
	60	1.85	4.1	7.00
	50	2.00	3.4	7.57

*Standard on PD0 and PD7 models

Features and Benefits

- Shared drive platform with universal 115-230V, 50/60 Hz power supply
- Flows from 2 GPH (7.57 LPH) up to 450 PSI (30.6 BAR)
- Simplified capacity control with constant stroke length to maintain calibration across the adjustable range
- Advanced electronics with dynamic compensation for temperature and voltage conditions
- FastPrime™ liquid ends (standard) that allow fast and easy priming with integrated bleed valve
- AutoPrime™ liquid ends (optional), designed specifically for off-gassing liquids (See page 4 for performance specifications)
- Rugged construction with NEMA 4X/IP 65 housing for the harshest environments and outdoor use
- Compact footprint for efficient use of space in process applications or OEM configuration
- Agency certifications - NSF 61 and 50 (pending), ETL, CE
- Built on decades of experience and fully backed by LMI's two-year warranty

Enhanced Functionality (PD7)

- **2.4" Color LCD** - Intuitive navigation allows you to configure and operate with ease – view status and alerts from a distance to confirm safe operation
- **External Control Inputs** - Automate your process with pulse pacing, remote start/stop, and tank level indication – ideal for proportional dosing
- **Calibration Assist** - Simply draw from a column and adjust the estimated value on-screen to the measured actual – calibration is that easy
- **System & User Totalizers** - An odometer for your pump that logs pump strokes, estimated volume, and power cycles – confirm pump operation between visits
- **StayPrime™ Degassing Technology** - Automates the priming cycle after a period of idle pump time to ensure prime

LMI®
an Accudyne Industries brand

Literature #950015

LMI
an Accudyne Industries brand

OUTPUT CODE 1 — 0.25 GPH (0.95 LPH); 450 psi (30.6 bar)

Drive End									
Control									
PD01	Manual Control	-							
PD71	Enhanced Control with Pulse Input, Remote Stop/Start, and Tank Level Input								
	Power Code								
	X	See Power Code Table							
		Liquid End	**Head**	**Fittings**	**Balls**	**Seat / O-Rings**	**Connections**	**RPM Kit**	
		Machined FastPrime™							
		907NP	316SS	316SS	316SS	316SS / PTFE	1/4" NPT	RPM-907	
PD01	1	-907	N	P					

OUTPUT CODE 4 — 0.68 GPH (2.6 LPH); 250 psi (17.0 bar)

Drive End									
Control									
PD04	Manual Control	-							
PD74	Enhanced Control with Pulse Input, Remote Stop/Start, and Tank Level Input								
	Power Code								
	X	See Power Code Table							
		Liquid End	**Head**	**Fittings**	**Balls**	**Seat / O-Rings**	**RPM Kit**		
		Molded FastPrime™							
		822	PVDF	PVDF	Ceramic	PTFE / Polyprel®	RPM-822		
		823	PVDF	PVDF	Ceramic	PTFE / Polyprel®	RPM-823		
		828	PVC	PVC	Ceramic	PTFE /Polyprel®	RPM-822		
		Machined FastPrime™							
		925	PP	PP	Ceramic	PTFE / Polyprel®	RPM-823		
		927	316SS	316SS	316SS	316SS / PTFE	RPM-927		
		928	PVC	PVC	Ceramic	PTFE / Polyprel®	RPM-822		
		929	Acrylic	PVDF	PTFE	Polyprel®	RPM-929		
		920	Acrylic	PVC	Ceramic	PTFE / Polyprel®	RPM-822		
		AutoPrime™							
		A28	PVC	PVC	Ceramic	PTFE / Polyprel®	RPM-A20A		
		A20	Acrylic	PVC	Ceramic	PTFE / Polyprel®	RPM-A20A		
			FastPrime Valve Code		**AutoPrime Valve Code**				
			S	with 4 Function Valve	H	with 4 Function Valve			
			N	-	A	-			
				Connection Code	**Also sold as**				
				I Imperial	2				
				M Metric	3				
				P Pipe (1/4" NPT, 316SS only)	0				
PD04	1	- 822	S	I					

POWER CODE TABLE

Power Code	Voltage	Frequency	Plug
1	115/230V	50-60 Hz	110-120V US Plug, UL
2	115/230V	50-60 Hz	220-240V US Plug, UL
3	115/230V	50-60 Hz	220-240V DIN Plug, CE
5	115/230V	50-60 Hz	220-240V UK Plug, CE
6	115/230V	50-60 Hz	220-240V Aust/NZ Plug

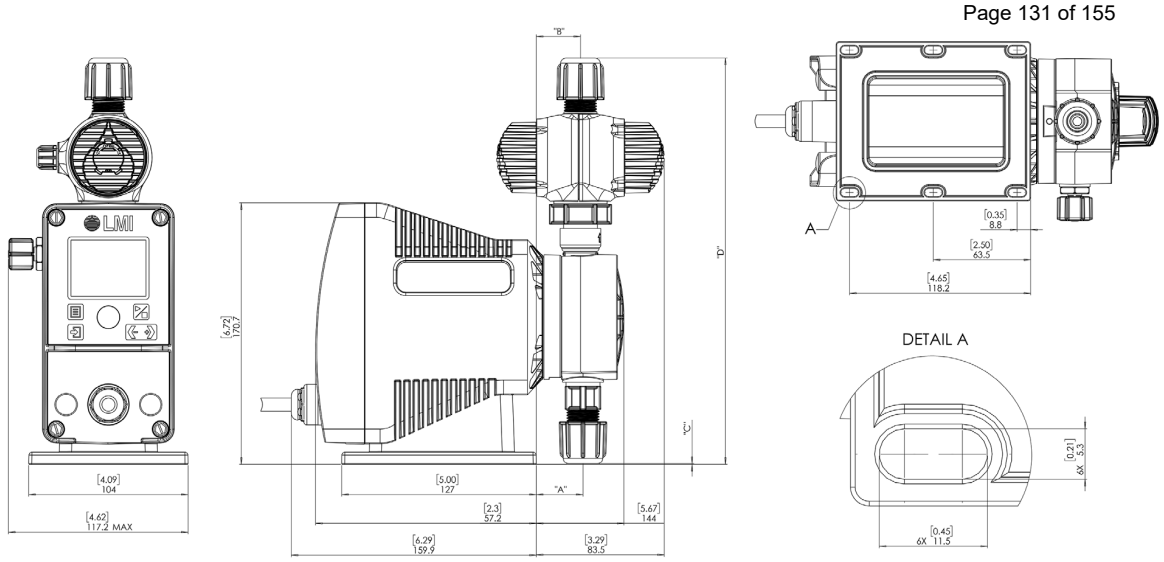
OUTPUT CODE 5 — 1.1 GPH (4.2 LPH); 150 psi (10.2 bar)

Drive End								
Control								
PD05		Manual Control	-					
PD75		Enhanced Control with Pulse Input, Remote Stop/Start, and Tank Level Input						
	Power Code							
	X	See Power Code Table						
		Liquid End	**Head**	**Fittings**	**Balls**	**Seat / O-Rings**	**RPM Kit**	
		Molded FastPrime™						
		832	PVDF	PVDF	Ceramic	Polyprel®	RPM-832	
		833	PVDF	PVDF	Ceramic	PTFE	RPM-833	
		838	PVC	PVC	Ceramic	Polyprel®	RPM-832	
		Machined FastPrime™						
		935	PP	PP	Ceramic	PTFE	RPM-833	
		937	316SS	316SS	316SS	316SS / PTFE	RPM-937	
		938	PVC	PVC	Ceramic	Polyprel®	RPM-832	
		939	Acrylic	PVDF	PTFE	Polyprel®	RPM-939	
		930	Acrylic	PVC	Ceramic	Polyprel®	RPM-832	
		AutoPrime™						
		A38	PVC	PVC	Ceramic	PTFE / Polyprel®	RPM-A30A	
		A30	Acrylic	PVC	Ceramic	PTFE / Polyprel®	RPM-A30A	
			FastPrime Valve Code		**AutoPrime Valve Code**			
			S	with 4 Function Valve	H	with 4 Function Valve		
			N	-	A	-		
				Connection Code	**Also sold as**			
				I Imperial	2			
				M Metric	3			
				P Pipe (1/4" NPT, 316SS only)	0			
PD05	1	- 832	S	I				

OUTPUT CODE 6 — 2.0 GPH (7.6 LPH); 70 psi (4.8 bar)

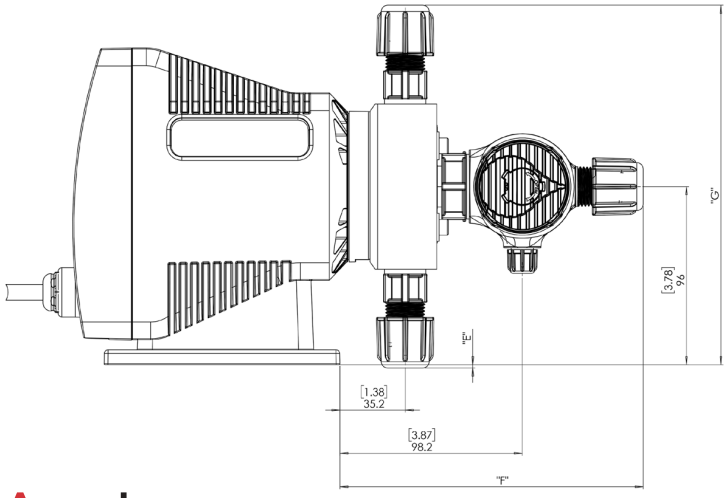
Drive End								
Control								
PD06		Manual Control	-					
PD76		Enhanced Control with Pulse Input, Remote Stop/Start, and Tank Level Input						
	Power Code							
	X	See Power Code Table						
		Liquid End	**Head**	**Fittings**	**Balls**	**Seat / O-Rings**	**RPM Kit**	
		Molded FastPrime™						
		842	PVDF	PVDF	Ceramic	Polyprel®	RPM-842	
		843	PVDF	PVDF	Ceramic	PTFE	RPM-843	
		848	PVC	PVC	Ceramic	Polyprel®	RPM-842	
		Machined FastPrime™						
		945	PP	PP	Ceramic	PTFE	RPM-843	
		947	316SS	316SS	316SS	316SS / PTFE	RPM-947	
		948	PVC	PVC	Ceramic	Polyprel®	RPM-842	
		949	Acrylic	PVDF	PTFE	Polyprel®	RPM-949	
		940	Acrylic	PVC	Ceramic	Polyprel®	RPM-842	
		AutoPrime™						
		A48	PVC	PVC	Ceramic	PTFE / Polyprel®	RPM-A40A	
		A40	Acrylic	PVC	Ceramic	PTFE / Polyprel®	RPM-A40A	
			FastPrime Valve Code		**AutoPrime Valve Code**			
			S	with 4 Function Valve	H	with 4 Function Valve		
			N	-	A	-		
				Connection Code	**Also sold as**			
				I Imperial	2			
				M Metric	3			
				P Pipe (1/4" NPT, 316SS only)	0			
PD06	1	- 842	S	I				

Dimensions



LIQUID END MODEL	"A"		"B"		"C"		"D"	
	INCH	MM	INCH	MM	INCH	MM	INCH	MM
LE-7XXNX	1.20	30.5	1.13	28.8	0.34	8.6	7.84	199.2
LE-7XXNX	1.20	30.5	1.13	28.8	0.34	8.6	10.45	265.4
LE-8XXNX	1.20	30.5	1.13	28.8	0.01	0.3	8.17	207.5
LE-8XXSX	1.20	30.5	1.13	28.8	0.01	0.3	10.45	265.4
LE-90XNX, LE-92XNX, LE-93XNX	1.39	35.2	1.39	35.2	0.10	2.5	7.47	189.7
LE-90XSX, LE-92XSX, LE-93XSX	1.39	35.2	1.39	35.2	0.10	2.5	9.75	247.6
LE-94XNX	1.39	35.2	1.39	35.2	-0.07	-1.8	7.64	194
LE-94XSX	1.39	35.2	1.39	35.2	-0.07	-1.8	9.92	251.9

AUTOPRIME™ LIQUID END



LIQUID END MODEL	"E"		"F"		"G"	
	INCH	MM	INCH	MM	INCH	MM
LE-A1XNX, LE-A2XNX, LE-A3XNX	-0.10	-2.5	4.15	105.4	7.46	189.6
LE-A1XSX, LE-A2XSX, LE-A3XSX	-0.10	-2.5	6.43	163.3	7.46	189.6
LE-A4XNX	0.07	1.8	4.15	105.4	7.63	193.8
LE-A4XSX	0.07	1.8	6.43	163.3	7.63	193.8

Performance Specifications

AutoPrime™ Degassing Liquid Ends

	PSI	GPH	BAR	LPH
PDx4	250	0.20	17.0	0.76
	150	0.30	10.2	1.14
PDx5	110	0.75	7.5	2.84
	50	0.85	3.4	3.22
PDx6	50	1.75	3.4	6.62
	30	1.85	2.0	7.00

Accudyne INDUSTRIES

We are a proud member of Accudyne Industries, a leading global provider of precision-engineered, process-critical and technologically advanced flow control systems and industrial compressors. Delivering consistently high levels of performance, we enable customers in the most important industries and harshest environments around the world to accomplish their missions.

Contact your local representative to find out more about Series PD Chemical Metering Pumps

www.lmipumps.com
www.relyonLMI.com

LMI®
an Accudyne Industries brand

Literature #950015

Appendix H: Soils Information

Soil Map—Island County, Washington
(W&B Waterworks 1)

Map Scale: 1:1,480 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Soil Map—Island County, Washington
(W&B Waterworks 1)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Island County, Washington
Survey Area Data: Version 19, Aug 23, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 21, 2021—Nov 29, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2024	Indianola-Uselessbay complex, 5 to 30 percent slopes	9.1	100.0%
Totals for Area of Interest		**9.1**	**100.0%**

Island County, Washington

2024—Indianola-Uselessbay complex, 5 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2lcxw
Elevation: 0 to 520 feet
Mean annual precipitation: 25 to 40 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 200 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Indianola and similar soils: 55 percent
Uselessbay and similar soils: 35 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Indianola

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Glacial outwash

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 6 inches: loamy sand
Bw1 - 6 to 17 inches: loamy sand
Bw2 - 17 to 27 inches: sand
BC - 27 to 37 inches: sand
C - 37 to 59 inches: sand

Properties and qualities

Slope: 5 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A

Ecological site: F002XN906WA - western hemlock-western redcedar/red huckleberry-salal/western swordfern
Forage suitability group: Droughty Soils (G002XN402WA)
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Description of Uselessbay

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Glacial outwash

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 3 inches: gravelly sandy loam
Bw1 - 3 to 8 inches: gravelly sandy loam
Bw2 - 8 to 15 inches: gravelly loamy sand
C - 15 to 29 inches: gravelly sand
Cg - 29 to 37 inches: gravelly sand
Cd - 37 to 59 inches: gravelly sandy loam

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 12 to 20 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A/D
Ecological site: F002XN906WA - western hemlock-western redcedar/red huckleberry-salal/western swordfern
Forage suitability group: Droughty Soils (G002XN402WA)
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Minor Components

Utsalady

Percent of map unit: 10 percent
Landform: Ridges
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave, linear

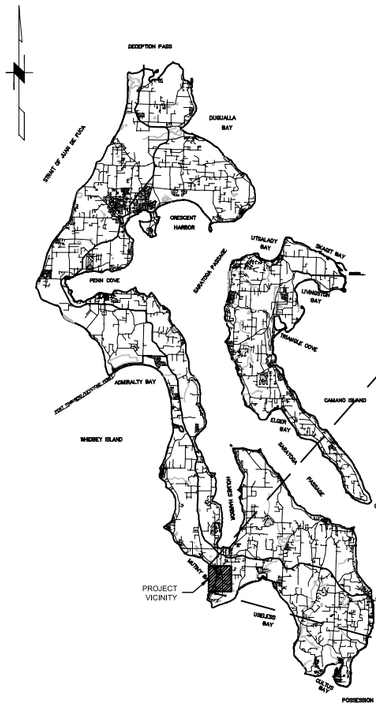
Across-slope shape: Concave, linear
Ecological site: F002XN906WA - western hemlock-western redcedar/red huckleberry-salal/western swordfern
Other vegetative classification: Droughty Soils (G002XN402WA)
Hydric soil rating: No

Data Source Information

Soil Survey Area: Island County, Washington
Survey Area Data: Version 19, Aug 23, 2021

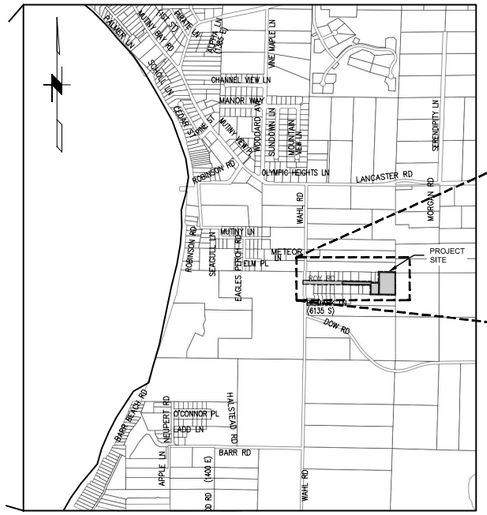
Appendix I: Construction Drawings

W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
FREELAND, WA



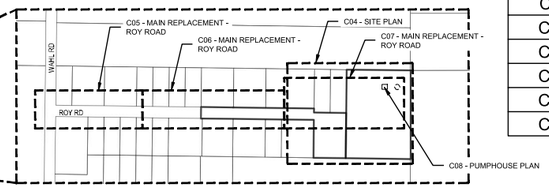
10000 0 10000 20000
SCALE IN FEET

ISLAND COUNTY
SCALE AS SHOWN



500 0 500 1000
SCALE IN FEET

VICINITY MAP
SCALE AS SHOWN



125 0 125 250
SCALE IN FEET

PROJECT KEY MAP
SCALE AS SHOWN

SHEET INDEX	
No.	SHEET TITLE
C01	COVER SHEET
C02	NOTES & ABBREVIATIONS
C03	EXISTING CONDITIONS
C04	SITE PLAN
C05	MAIN REPLACEMENT - ROY ROAD
C06	MAIN REPLACEMENT - ROY ROAD
C07	MAIN REPLACEMENT - ROY ROAD
C08	PUMPHOUSE PLAN
C09	ATEC DETAILS
C10	ATEC DETAILS
C11	TREATMENT SETTINGS
C12	RESERVOIR DETAILS
C13	DETAILS
C14	DETAILS
C15	DETAILS
C16	DETAILS

CONTACT INFORMATION:

APPLICANT:
CASCADIA WATER
PO BOX 549
FREELAND, WA 98249
PH: 360.331.7388

CIVIL ENGINEER:
ROBERT BENNION, P.E.
DAVIDO CONSULTING GROUP, INC.
P.O. BOX 1132
FREELAND, WA 98249
PH: 360.331.4131

SURVEYOR:
RICHARD N. FRAZIER, PLS
FRAZIER SURVEYING, LLC
837 SE JENSEN ST
OAK HARBOR, WA 98277
PH: 360.969.3886
FRAZIERSURVEYING@FRONTIER.COM

PARCEL INFORMATION:

EXISTING RESERVOIR PARCEL:
R22922-370-5000
PROPOSED RESERVOIR PARCEL
R22922-376-5180

TOPOGRAPHIC SURVEY NOTES :

1. HORIZONTAL DATUM BASED ON WASHINGTON COORDINATE SYSTEM, NORTH ZONE, NAD 83/11.
2. VERTICAL DATUM BASED ON NAVD 88.
3. THE PURPOSE OF THIS TOPOGRAPHIC SURVEY IS FOR A WATER SYSTEM DESIGN.
4. CONTOURS DERIVED FROM DIRECT FIELD OBSERVATIONS.
5. THIS SURVEY DOES NOT PURPORT TO SHOW ALL EASEMENTS OF RECORD OR OTHERWISE.
6. DISTANCES ARE IN U.S. SURVEY FEET AND DECIMALS THEREOF.

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY PROFESSIONALS AWARDED THE CREDENTIAL BY THE GREEN BUILDING CERTIFICATION INSTITUTE

P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.5131
www.dcgengr.com

DCG civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
UNDERGROUND UTILITY LOCATIONS ARE APPROX.

ROBERT L. BENNION — STATE OF WASHINGTON — 24994 — REGISTERED PROFESSIONAL ENGINEER — 10/31/2022

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS, DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
COVER SHEET

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV.: -
	SHEET 1 OF 16

SHEET NUMBER
C01

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W1\E WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\RAWINGS WATERWORKS WELL SITE IMPROVEMENTS_00.DWG
LAST MODIFIED BY: ROBERT, - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS--ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

WATER NOTES:

1. WATER MAINS, VALVES, FITTINGS, HYDRANTS, SERVICES, AND ALL OTHER COMPONENTS SHALL BE INSTALLED AND PRESSURE TESTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE AND MUNICIPAL CONSTRUCTION, WASHINGTON STATE DEPARTMENT OF TRANSPORTATION, SECTION 7-09.
2. THE CONTRACTOR SHALL GIVE A MINIMUM OF 72 HOURS NOTICE OF ANY PLANNED CONNECTION TO AN EXISTING PIPELINE. THIS INCLUDES LIVE TAPS. NOTICE IS REQUIRED SO ANY DISRUPTIONS TO EXISTING SERVICES CAN BE SCHEDULED. THE CONTRACTOR SHALL NOTIFY CUSTOMERS INVOLVED OR AFFECTED OF THE WATER SERVICE INTERRUPTION 24 HOURS IN ADVANCE OF THE INTERRUPTION. THE CONTRACTOR SHALL MAKE EVERY EFFORT TO SCHEDULE WATER MAIN CONSTRUCTION WITH A MINIMUM INTERRUPTION OF WATER SERVICE.
3. IN CERTAIN SITUATIONS, THE WATER PURVEYOR MAY DICTATE SCHEDULING OF WATER MAIN SHUTDOWNS SO AS NOT TO IMPOSE UNNECESSARY SHUTDOWNS DURING SPECIFIC PERIODS TO EXISTING CUSTOMERS.
4. ALL WATER MAINS SHALL BE SCH 80 PVC (2" OR LESS), PVC C900, OR DI CLASS 52 PIPE AS SPECIFIED ON THE PLANS, HIGH DENSITY POLYETHYLENE (HDPE) PIPE SDR 9 MAY BE USED IN PLACE OF PVC SPECIFIED ON PLANS, CHECK WITH ENGINEER IF PIPING SIZE NEEDS TO BE INCREASED TO SUPPORT SWITCH TO HDPE. HDPE PIPE SHALL BE BLACK PE 4710 MADE OF NEW RESINS AND MEETING THE REQUIREMENTS OF ATSM D3350 CELL CLASSIFICIATION OF PE445574C/E, TYPE II, GRADE PE47, AS WELL AS: ASTM F714, AWWA C901, AND AWWA C906, PROVISIONS FOR PIPE EXPANSION MUSH BE ACCOUNTED FOR WHEN INSTALLING HDPE PIPING.
5. WATER MAIN FITTINGS SHALL BE DUCTILE IRON. DUCTILE IRON FITTINGS SHALL MEET THE REQUIREMENTS OF AWWA C153 AND JOINTS SHALL MEET THE REQUIREMENTS OF AWWA C111. DUCTILE IRON FITTINGS SHALL BE CEMENT MORTAR LINED, MEETING THE REQUIREMENTS OF AWWA C104. GASKETS FOR FLAT FACED OR RAISED FACED FLANGES SHALL BE 1/8-INCH THICK NEOPRENE HAVING A DUROMETER OF 60 PLUS OR MINUS 5 OR 1/16-CLOTH INSERTED. THE TYPE, MATERIAL, AND IDENTIFICATION MARK FOR BOLTS AND NUTS SHALL BE PROVIDED. BOLTS, NUTS, AND WASHERS USED FOR SECURING FITTINGS SHALL BE OF SIMILAR MATERIALS. STEEL BOLTS SHALL MEET THE REQUIREMENTS OF ASTM A 307 OR ASTM F 568 FOR CARBON STEEL OR ASTM F 593 OR ASTM F 738 FOR STAINLESS STEEL. NUTS SHALL MEET THE REQUIREMENTS OF ASTM A 563 OR ASTM A 563 FOR CARBON STEEL OR ASTM F 594 OR ASTM F 836 FOR STAINLESS STEEL. IRON BOLTS AND NUTS SHALL MEET THE REQUIREMENTS OF ASTM A 536, GRADE 65-45-12.
6. ALL PIPE AND SERVICES SHALL BE INSTALLED WITH CONTINUOUS TRACER TAPE INSTALLED 12 TO 18 INCHES UNDER THE FINAL GROUND SURFACE. NO BREAKS OR SPLICES WILL BE ALLOWED. A CONTINUOUS LOOP SHALL BE PLACED FROM THE MAIN LINE TO THE METER BOX AND BACK TO THE MAIN LINE. THE MARKER SHALL BE PLASTIC NON-BIODEGRADABLE, METAL CORE OR BACKING WHICH CAN BE DETECTED BY A STANDARD METAL DETECTOR. TAPE SHALL BE TERRA TAPE "D" OR APPROVED EQUAL. IN ADDITION TO TRACER TAPE, INSTALL 14 GAUGE COATED COPPER WIRE, TAPED TO THE TOP OF PIPE, BROUGHT UP AND TIED OFF AT VALVE BODY.
7. THE MINIMUM COVER FOR ALL WATER MAINS FROM TOP OF PIPE TO FINISH GRADE SHALL BE 36 INCHES UNLESS OTHERWISE APPROVED BY THE ENGINEER.
8. ALL VALVES AND FITTINGS SHALL BE DUCTILE IRON WITH ANSI FLANGES OR MECHANICAL JOINT ENDS, ALL EXISTING VALVES SHALL BE OPERATED BY WATER SYSTEM PERSONNEL. VALVE BOXES SHALL BE INSTALLED ON ALL BURIED VALVES. THE BOX SHALL BE OF CAST IRON, TWO-PIECE SCREW TYPE, 5-1/4 INCH SHAFT, WITH A BASE CORRESPONDING TO THE SIZE OF THE VALVE. THE COVER SHALL HAVE THE WORD "WATER" CAST IN IT. THE VALVE BOX SHALL BE TYLER UNION PIPE 6855 SERIES OR EQUAL APPROVED BY THE ENGINEER. THE COVER SHALL BE A TYLER UNION PIPE STANDARD DROP LID 145325 OR EQUAL APPROVED BY THE ENGINEER.
9. GATE VALVES, 6 INCH TO 12 INCH. THE DESIGN, MATERIALS AND WORKMANSHIP OF ALL GATE VALVES SHALL CONFORM TO, OR EXCEED THE REQUIREMENTS OF AWWA C509-80 LATEST REVISION. GATES VALVES SHALL BE RESILIENT SEAT NON-RISING STEM (NRS) WITH TWO INTERNAL O-RING STEM SEALS. GATE VALVES SHALL BE MUELLER A-2361. GATE VALVES SHALL BE USED ON ALL 6 TO 12 INCH LINES.
10. VALVE BOX. ALL VALVES SHALL HAVE A STANDARD CAST IRON WATER VALVE BOX SET TO GRADE. IF VALVES ARE NOT SET IN PAVED AREA, A 2' X 2' BY 4 INCH CONCRETE PAD SHALL BE SET AROUND EACH VALVE BOX AT FINISHED GRADE. IN AREAS WHERE VALVE BOX FALLS IN ROAD SHOULDER, THE DITCH AND SHOULDER SHALL BE GRADED BEFORE PLACING ASPHALT OR CONCRETE PAD.
11. VALVE MARKER POST. VALVE MARKER POSTS SHALL BE 4 INCH X 4 INCH REINFORCED CONCRETE OR SCHEDULE 40 STEEL POSTS 5 FEET LONG, WITH 2 FOOT MINIMUM BURY, STAMPED WITH "W" AND DISTANCE TO VALVE. POST SHALL BE PAINTED WITH 1 BASE COAT AND 2 COATS BLUE OIL BASE ENAMEL.
12. ALL FORM RELEASE AGENTS AND ADMIXTURES USED IN THE CONCRETE WORK MUST CONFORM TO NSF 60 REQUIREMENTS.

UNANTICIPATED DISCOVERY PLAN:

1. IN THE EVENT THAT ANY GROUND DISTURBING ACTIVITIES UNCOVER PROTECTED CULTURAL MATERIALS (E.G., BONES, SHELL, STONE, OR ANTLER TOOLS), ALL WORK IN THE IMMEDIATE VICINITY SHOULD STOP, THE AREA SHOULD BE SECURED AND ANY EQUIPMENT MOVED TO A SAFE DISTANCE AWAY FROM THE LOCATION.
2. IF HUMAN REMAINS ARE UNCOVERED, ALL WORK SHALL CEASE IMMEDIATELY IN ACCORDANCE WITH THE NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT OF 1990 (NAGPRA) AND WASHINGTON STATE STATUTES RCW 27.44. THE AREA AROUND THE DISCOVERY SHALL BE SECURED AND THE ISLAND COUNTY ENFORCEMENT AGENCY AND STATE ARCHEOLOGIST AT DAHP SHALL BE NOTIFIED IMMEDIATELY.
3. IT IS ASSUMED THAT NO ARTIFACTS WILL BE FOUND THAT WILL IMPACT THE PROJECT. IMPACTS TO THE PROJECT BASED UP ON FOUND ARTIFACTS WILL BE HANDLED BY A FORCE ACCOUNT.

EROSION AND SEDIMENTATION CONTROL (ESC) NOTES:

1. THE CONTRACTOR SHALL MEET ISLAND COUNTY STANDARDS AND REQUIREMENTS BY USING APPROPRIATE BEST MANAGEMENT PRACTICES (BMPS) FOR EROSION AND SEDIMENTATION CONTROL.
2. EROSION ON- AND OFF-SITE. DURING AND AFTER CONSTRUCTION, THE CONTRACTOR SHALL MINIMIZE EROSION AND SEDIMENTATION ON-SITE AND SHALL PROTECT PROPERTIES AND WATER COURSES DOWNSTREAM FROM THE SITE FROM EROSION DUE TO INCREASES IN THE VELOCITY AND PEAK FLOW RATE OF STORM WATER RUNOFF FROM THE SITE.
3. TRANSPORT OF SEDIMENT. THE CONTRACTOR SHALL PREVENT THE TRANSPORT OF SEDIMENT FROM THE SITE THROUGH MEASURES SUCH AS MULCHING, MATTING, COVERING, SILT FENCES, SEDIMENT TRAPS, SETTLING PONDS AND PROTECTIVE BERMS USING THE FOLLOWING BMPS: FILTER FENCE, STRAW BALE BARRIER, BRUSH BARRIER, GRAVEL FILTER BERM, SEDIMENT TRAP, TEMPORARY SEDIMENT POND, PRESERVING NATURAL VEGETATION, AND/OR BUFFER ZONES. TRANSPORT OF SEDIMENT ONTO PAVED SURFACES SHALL BE MINIMIZED, AND IF SEDIMENT IS TRANSPORTED ONTO A PAVED SURFACE, THE PAVED SURFACE SHALL BE CLEANED AT THE END OF EACH DAY IN ACCORDANCE WITH BMPS IN THE DRAINAGE MANUAL, OR APPROVED BY THE DIRECTOR.
4. STABILIZING EXPOSED SOIL. THE CONTRACTOR SHALL PREVENT ON-SITE EROSION BY STABILIZING ALL SOILS THAT ARE TEMPORARILY EXPOSED AND NOT BEING ACTIVELY WORKED, THROUGH SUCH METHODS AS THE INSTALLATION OF SEEDING, MULCHING, MATTING AND COVERING. CONTRACTOR SHALL APPLY ONE OR MORE OF THE FOLLOWING TEMPORARY ESC BMPS: TEMP SEEDING, MULCHING AND MATTING, CLEAR PLASTIC COVERING, AND/OR DUST CONTROL.
5. DENUDED AREAS SHALL BE STABILIZED AND SOIL STOCKPILES AS ESTABLISHED IN THE DRAINAGE MANUAL.
6. STORM DRAIN INLETS SHALL BE PROTECTED USING BMP STORM DRAIN INLET PROTECTION. THE RECOMMENDED INLET PROTECTION ALTERNATIVES ARE TRIANGULAR SILT DIKES; BIOLOGS; EXERTS (FOSS ENVIRONMENTAL); DANDY BAGS; AND, STRAW WATTLES.
7. NO MORE THAN THREE HUNDRED (300) FEET OF TRENCH MAY REMAIN OPEN AT ONE TIME. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF TRENCHES, UNLESS INCONSISTENT WITH SAFETY OR SITE CONSTRAINTS.
8. DISCHARGE FROM DEWATERING DEVICES. WATER FROM A DEWATERING DEVICE SHALL DISCHARGE INTO A SEDIMENT-RETENTION BMP.
9. MAINTENANCE AND REPAIR OF EROSION AND SEDIMENTATION CONTROL MEASURES. THE CONTRACTOR SHALL MAINTAIN AND REPAIR AS NECESSARY ALL TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROL BMPS TO ASSURE THEIR CONTINUED PERFORMANCE.
10. TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE MAINTAINED UNTIL FINAL SITE STABILIZATION.

GENERAL NOTES:

1. THE CONTRACTOR SHALL NOTIFY THE SYSTEM A MINIMUM OF 24 HOURS PRIOR TO STARTING ANY WORK.
2. THE CONTRACTOR SHALL NOTIFY THE UNDERGROUND UTILITY LOCATE CENTER AT 1-800-424-5555 AT LEAST 48 HOURS PRIOR TO CONSTRUCTION.
3. THE CONTRACTOR SHALL PROTECT IN PLACE, ALL UTILITIES, STRUCTURES AND FEATURES, WHETHER OR NOT SHOWN ON THESE PLANS. ANY DAMAGE TO EXISTING UTILITIES OR FEATURES SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE.
4. LOCATIONS OF EXISTING FEATURES AND UTILITIES AS SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND BASED ON THE BEST AVAILABLE INFORMATION. ACTUAL LOCATIONS SHALL BE DETERMINED BY THE CONTRACTOR.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MEANS, METHODS AND SEQUENCE OF CONSTRUCTION.
6. ALL WORK SHALL CONFORM TO CURRENT APPROVED STANDARD PLANS AND WSDOT/APWA STANDARD SPECIFICATIONS FOR ROAD, BRIDGE, AND MUNICIPAL CONSTRUCTION.
7. THE CONTRACTOR SHALL BE REQUIRED TO KEEP ACCURATE AS-BUILT DRAWINGS AND DELIVER THIS INFORMATION TO THE OWNER FOR PREPARATION OF AS-BUILT DRAWINGS.
8. WATER MAINS SHALL BE PROPERLY DISINFECTED, FLUSHED, AND HAVE A SATISFACTORY BACTERIOLOGICAL TEST RESULT FROM A WATER SAMPLE COLLECTED FROM THE PIPE BEFORE ENTERING SERVICE.
9. UTILITY SERVICE INTERRUPTIONS SHALL NOT EXCEED TWO HOURS.
10. 24 HOUR NOTICE SHALL BE PROVIDED TO ALL PROPERTY OWNERS/OCCUPANTS OF ANY UTILITY SERVICE OR ACCESS INTERRUPTIONS.
11. ONE LANE TRAFFIC MUST BE MAINTAINED AT ALL TIMES ON COUNTY ROADS. ROAD CLOSURES WILL NOT BE ALLOWED UNLESS EXPRESSLY AUTHORIZED AND APPROVED BY ISLAND COUNTY.
12. PROPER SIGNAGE AND FLAGGERS ARE REQUIRED PER THE MUTCD. FLAGGERS SHALL HAVE CURRENT CARDS INDICATING THAT THEY ARE QUALIFIED TO PERFORM THE REQUIRED TRAFFIC CONTROL.
13. ACCESS TO PRIVATE PROPERTY SHALL BE RESTORED DAILY.
14. STREETS SHALL BE SWEPT DAILY OR AS NEEDED.

SURVEY LEGEND/ADDITIONAL NOTES:

EXISTING

- SANITARY SEWER MANHOLE
- CATCH BASIN
- CULVERT
- STORM DRAIN MANHOLE
- WATER METER
- FIRE HYDRANT
- GATE/GENERAL VALVE
- IRRIGATION CONTROL VALVE
- BLOW OFF
- WATER SPIGOT
- WELL HEAD
- UTILITY POLE ANCHOR
- UTILITY POLE
- LUMINAIRE
- ELECTRICAL METER
- JUNCTION BOX
- POWER VAULT
- MAILBOX
- TELEPHONE PEDESTAL
- TELEPHONE MANHOLE
- SIGN
- TRAFFIC SIGN
- CONIFER TREE
- DECIDUOUS TREE

ABBREVIATIONS

AFN - AUDITOR'S FILE NUMBER
BLDG - EXISTING BUILDING
CB - CATCH BASIN
CL - CENTERLINE
CONC. - CONCRETE
CMP - CORRUGATED METAL PIPE
CPP - CORRUGATED PLASTIC PIPE
D/W - DRIVEWAY
DEC. - DECIDUOUS
EOA - EDGE OF ASPHALT
EOG - EDGE OF GRAVEL
EX. - EXISTING
FF - FINISHED FLOOR
FH - FIRE HYDRANT
FM - FORCE MAIN
FOG - FOGLINE
G.E. - GRATE ELEVATION
I.E. - INVERT ELEVATION
OP - OVERHEAD POWER
OT - OVERHEAD TELEPHONE
ROW - RIGHT-OF-WAY
SD - STORM DRAIN LINE
SS - SANITARY SEWER LINE
TP - TELEPHONE PEDESTAL
TV - UNDERGROUND TV
TYP. - TYPICAL
UG - UNDERGROUND GAS
UP - UNDERGROUND POWER
UT - UNDERGROUND TELEPHONE/ FIBER OPTICS
W - WATERLINE

ABBREVIATIONS:

Ø	DIAMETER (SYMBOL)
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
APWA	AMERICAN PUBLIC WORKS ASSOCIATION
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AWWA	AMERICAN WATER WORKS ASSOCIATION
CPEP	CORRUGATED POLYETHYLENE PIPE
CY	CUBIC YARD
DI	DUCTILE IRON
DIA	DIAMETER
DIST	DISTRIBUTION
DRN	DRAIN PIPE
EA	EACH
EX	EXISTING
FL	FLANGE
GAL	GALLON
GI	GALVANIZED IRON
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GV	GATE VALVE
HDPE	HIGH DENSITY POLYETHYLENE
IPT	IRON PIPE THREAD
L	LENGTH
LF	LINEAR FEET
MIN	MINIMUM
MJ	MECHANICAL JOINT
mL	MILLILITER
N/C	NORMALLY CLOSED
N/O	NORMALLY OPEN
NTS	NOT TO SCALE
PPM	PARTS PER MILLION
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
SF	SQARE FEET
SCH	SCHEDULE
SEC	SECTION
SQ	SQUARE
STD	STANDARD
STO	STORAGE
THK	THICKNESS
TYP	TYPICAL
W	WIDTH
W/	WITH
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

PROJECT LEGEND:

- EX WATERLINE (ASSUMED)
- EX WATERLINE (SURVEY)
- PROPOSED WATERLINE
- EX FENCE
- PROPOSED FENCE
- STRAW WATTLES
- PROPOSED DRAIN PIPE
- PROPOSED CONTOURS
- EX GATE VALVE
- PROPOSED GATE VALVE
- PROPOSED MJ BEND W/ THRUST BLOCKING
- PROPOSED FL BEND
- GRAVEL DRIVEWAY
- GRASS LINED CHANNEL
- ASPHALT PAVEMENT
- CONCRETE PAVEMENT
- INFILTRATION TRENCH/DRAINAGE GAZEBO

No.	REVISION	BY	DATE

LEED® AP — LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL® & ARE AWARDED TO INDIVIDUALS WHO HAVE MET THE GREEN BUILDING CERTIFICATION INSTITUTE

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4151
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENGSTON — STATE OF WASHINGTON — 22811 — REGISTERED PROFESSIONAL ENGINEER — APPROVED 11/7/2022

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS, DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

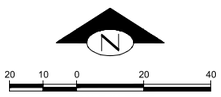
OWNER: CASCADIA WATER PO BOX 549 FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1 WELL SITE IMPROVEMENTS NOTES & ABBREVIATIONS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV.: -
SHEET: 2 OF 16	

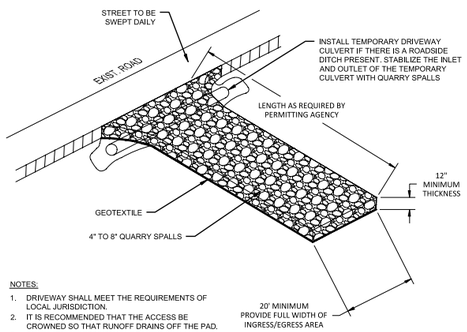
SHEET NUMBER
C02

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\DRAWINGS\W&B WATERWORKS WELL SITE IMPROVEMENTS_30.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: W&B WATERWORKS WELL SITE IMPROVEMENTS--ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



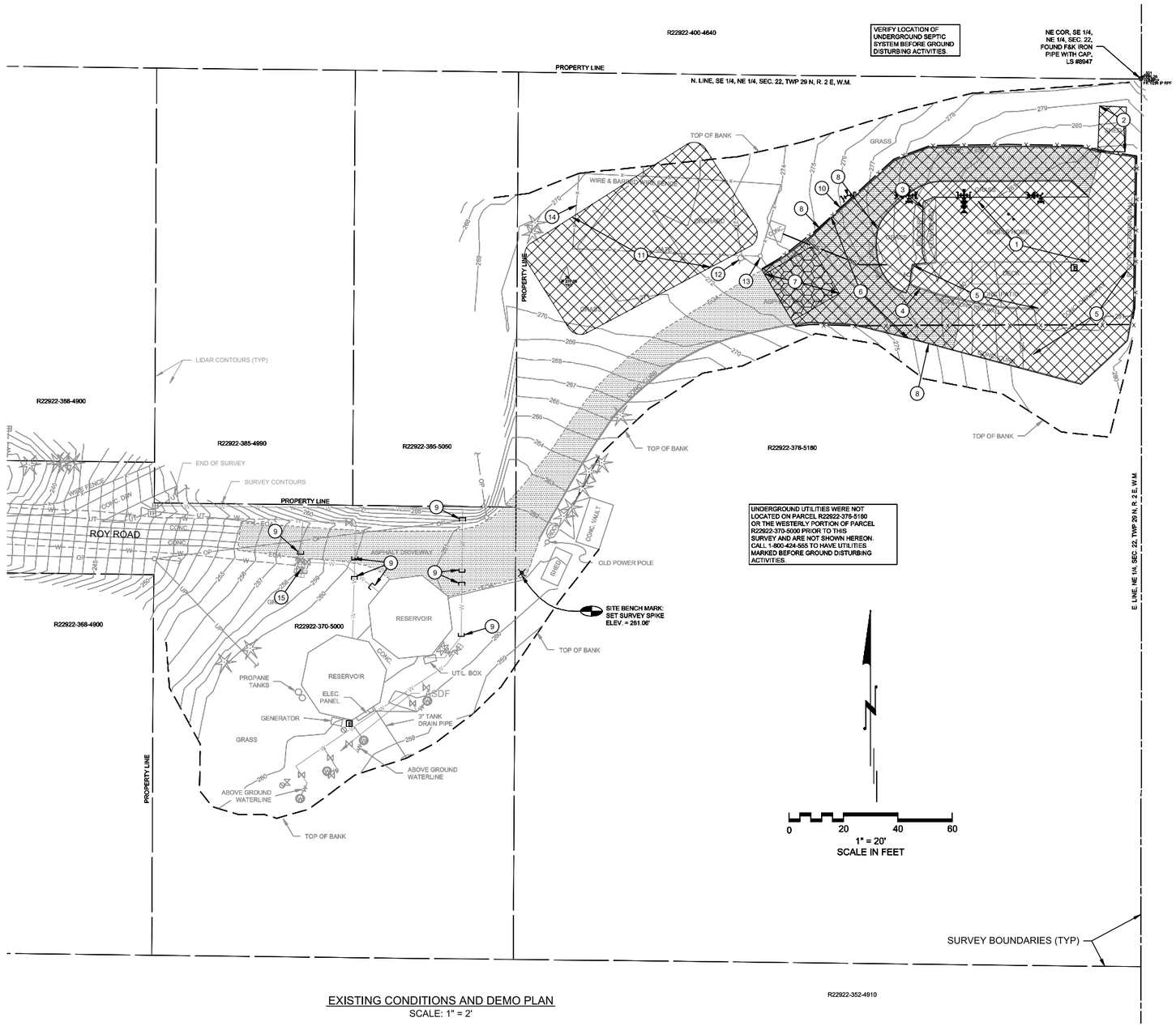
KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	REMOVE AND DISPOSE OF MOBILE HOME, ASSOCIATED DECKING, AND FOUNDATION	-
2	REMOVE AND DISPOSE OF SHED	-
3	REMOVE AND DISPOSE OF ROCK WALL	-
4	REMOVE AND DISPOSE OF CONCRETE WALL	-
5	REMOVE AND DISPOSE OF CONCRETE PAVING - 331 SY (AREA INCLUDES CONC PATIO)	-
6	REMOVE ASPHALT PAVING - 335 SY	-
7	STABILIZED CONSTRUCTION ACCESS PER 2019 WA DOE BMP MANUAL	CE/C03
8	REMOVE CONCRETE CURB - 290 LF	-
9	CUT, CAP AND ABANDON EX WATER MAIN	-
10	INSTALL PERIMETER FENCING	-
11	CLEAR PROPOSED INFILTRATION AREA OF FENCING, GATES, STUMPS, BARBED WIRE AND OTHER DEBRIS	-
12	REMOVE EXISTING DECORATIVE HYDRANT	-
13	DISCONNECT AND DEMOLISH EXISTING LIGHT POLE	-
14	REMOVE ALL ORCHARD FENCING	-
15	REMOVE VALVE CANS AND OTHER SURFACE APPURTENANCES FROM ABANDONED WATER MAIN, TYP	-



NOTES:
1. DRIVEWAY SHALL MEET THE REQUIREMENTS OF LOCAL JURISDICTION.
2. IT IS RECOMMENDED THAT THE ACCESS BE CROWNED SO THAT RUNOFF DRAINS OFF THE PAD.
3. STABILIZED ACCESS SHALL BE USED IN ALL AREAS OF THE SITE WITH VEHICLE TRAFFIC AND PARKING, INCLUDING PLANTING STRIPS. RECYCLED CONCRETE IS NOT ALLOWED.

CONSTRUCTION ENTRANCE
CASCADIA DETAILS
NTS
CE C03



EXISTING CONDITIONS AND DEMO PLAN
SCALE: 1" = 2'

No.	DATE	BY	REVISION

LEED AP

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.5131
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
EXISTING CONDITIONS

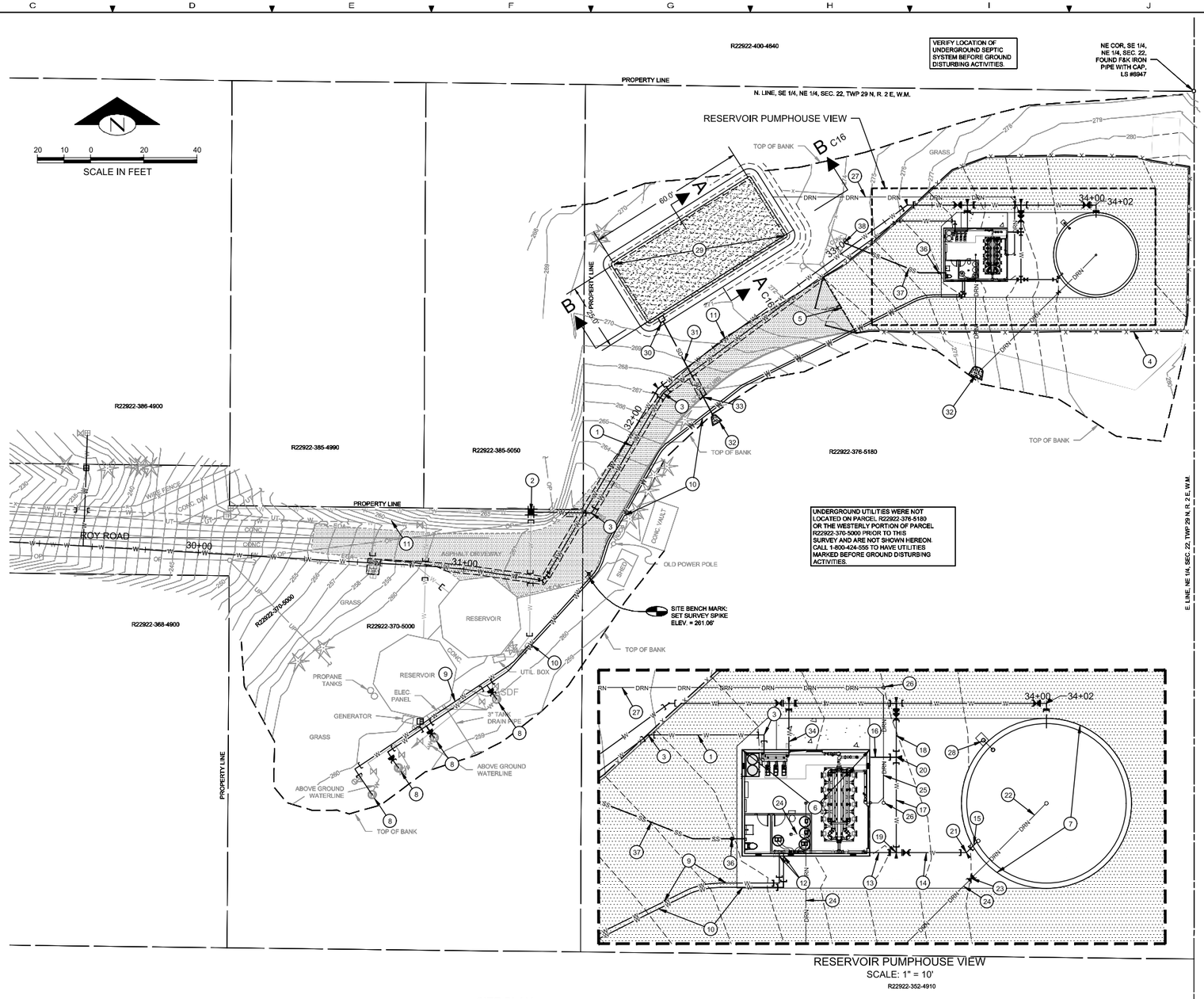
PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/8/2022	REV. -
SHEET 5 OF 16	

SHEET NUMBER
C03

CAD FILE NUMBER: \\DCG-LOCAL\E\EshareDocs\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W8 WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DRAWINGS\W8 WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/8/2022 12:12 PM - SHEET SET: W8 WATERWORKS WELL SITE IMPROVEMENTS-ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	210 LF 2" PVC SCH 80 PRESSURIZED DISTRIBUTION LINE FROM PUMPHOUSE TO POINT OF CONNECTION TO EX MAIN	1/C13 2/C15
2	2" PRESSURIZED DISTRIBUTION LINE POINT OF CONNECTION TO EX MAIN	-
3	PVC 2" BENDS AS NEEDED	-
4	INSTALL 340 LF FENCING AROUND SITE	16/C15
5	INSTALL GATE DOORS	16/C15
6	20'x24" CONCRETE PAD AND PUMPHOUSE	C08
7	185,000-GALLON CONCRETE RESERVOIR 30' DIA x 35' TALL	C12
8	CONNECT EXISTING TO NEW FEED LINE TO PUMPHOUSE, INSTALL NEW CONCRETE PAD, HOT BOX, METER, SAMPLE TAP, AND VALVES. PROVIDE AN ELECTRICAL OUTLET TO EACH HOT BOT. WELL CONTROLS TO BE ROUTED TO NEW PUMPHOUSE. ELECTICAL/CONTROLS CONDUIT CAN SHARE TEH TRENCH WITH THE FEED LINE.	12/C14
9	300 LF 4" HDPE DR 11 FILL LINE FOR WELL 4 FUSED FITTINGS ALONG LENGTH OF LINE	1/C13 2/C13
10	290 LF 4" HDPE DR 11 FILL LINE FOR WELLS 1, 2, & 3 FUSED FITTINGS ALONG LENGTH OF LINE	1/C13 2/C13
11	SEE WATER MAIN PLANS FOR 12" DISTRIBUTION MAIN	C05 - C07
12	CONNECT 4" WELL FILL LINE TO PUMPHOUSE. FITTINGS AND ADAPTERS AS NECESSARY SEE PUMPHOUSE PLANS ON SHEET C08.	-
13	6 LF 4" DI RESERVOIR FILL LINE FROM FILTER BYPASS TO RESERVOIR	2/C13
14	13 LF 4" DI RESERVOIR FILL LINE	2/C13
15	4 LF 4" DI RESERVOIR FILL LINE	2/C13
16	6 LF 4" DI RESERVOIR FILL LINE FROM TREATMENT FILTERS TO RESERVOIR	2/C13
17	18 LF 4" DI RESERVOIR FILL LINE FROM TREATMENT FILTERS TO RESERVOIR	2/C13
18	11 LF 4" DI RESERVOIR BYPASS LINE	2/C13
19	(1) 4" TEE (FLxMJ) (1) 4" GATE VALVE (FLxMJ) (1) 4" FLxMJ ADAPTERS CONC THRUST BLOCKS	3/C13 4/C13
20	(1) 4" TEE (MJ) CONC THRUST BLOCK	3/C13
21	(1) 45° 4" DI BEND CONC THRUST BLOCK	3/C13
22	20 LF 4" DI PIPE	2/C13
23	(1) 4" GATE VALVE (MJ) CONC THRUST BLOCK	3/C13 4/C13
24	42 LF 4" PVC STORM PIPE @ MIN 2% SLOPE DAYLIGHT PIPE ON DISPERSION PAD	2/C13
25	26 LF 6" DRAIN LINE WITH 2% MIN SLOPE	2/C13
26	DRAIN LINE CLEANOUT	21/C16
27	80 LF 6" PVC DRAIN LINE TO INFILTRATION FACILITY. 2% MIN SLOPE, DAYLIGHT TO INFILTRATION TRENCH	2/C13
28	TANK OVERFLOW LINE	-
29	INSTALL BACKWASH INFILTRATION FACILITY	18/C16
30	TYPE 2 CB W/ DEBRIS CAGE RIM: 269.67' 6" IE OUT (SE): 267.17'	20/C16 22/C16
31	43 LF 6" PVC STORM PIPE @ MIN 2% SLOPE DAYLIGHT PIPE ON DISPERSION PAD	2/C13
32	DAYLIGHT PIPE WITH ROCK DISPERSION PAD	19/C16
33	REPLACE ASPHALT AND CURB IN KIND	-
34	6" DI PIPE	1/C13 2/C13
35	(1) 12" GATE VALVE	3/C13 4/C13
36	SANITARY SEWER CLEANOUT	21/C16
37	40 LF 4" PVC SEWER PIPE, 2.0% MIN SLOPE	2/C13
38	CONNECT TO EXISTING SEPTIC TANK	-
39	4 LF 4" PVC STORM PIPE @ MIN 2% SLOPE CONNECT TO DRAIN LINE WITH WYE	-



SITE PLAN
SCALE: 1" = 20'

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS WHO HAVE DEMONSTRATED THE GREEN BUILDING CERTIFICATION INSTITUTE'S

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.1131
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BEVINGTON
STATE OF WASHINGTON
21819
REGISTERED PROFESSIONAL ENGINEER
11/7/2022

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

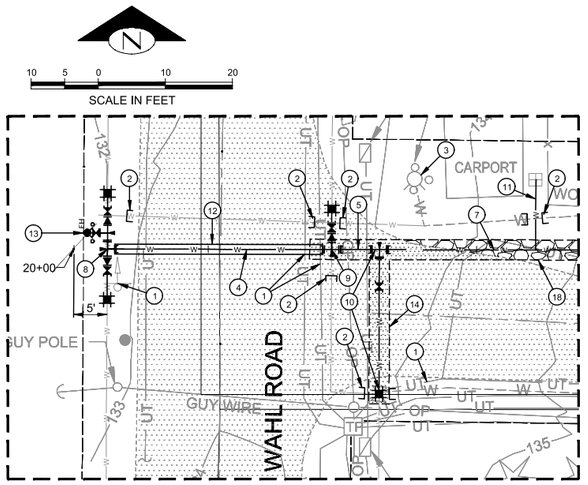
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
SITE PLAN

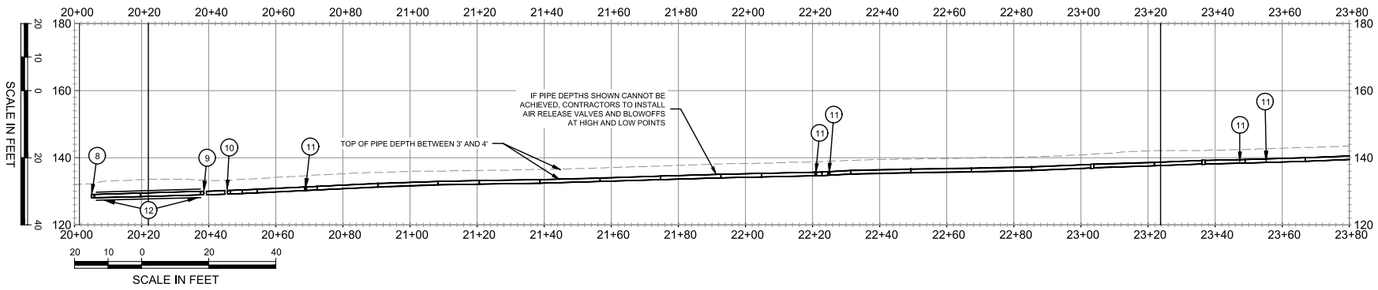
PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV.: -
SHEET: 4 OF 16	

SHEET NUMBER
C04

CAD FILE NUMBER: P:\CLIENTS\WATER\CASCADIA\WATER SYSTEMS\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DRAWINGS\W&B WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: W&B WATERWORKS WELL SITE IMPROVEMENTS- ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

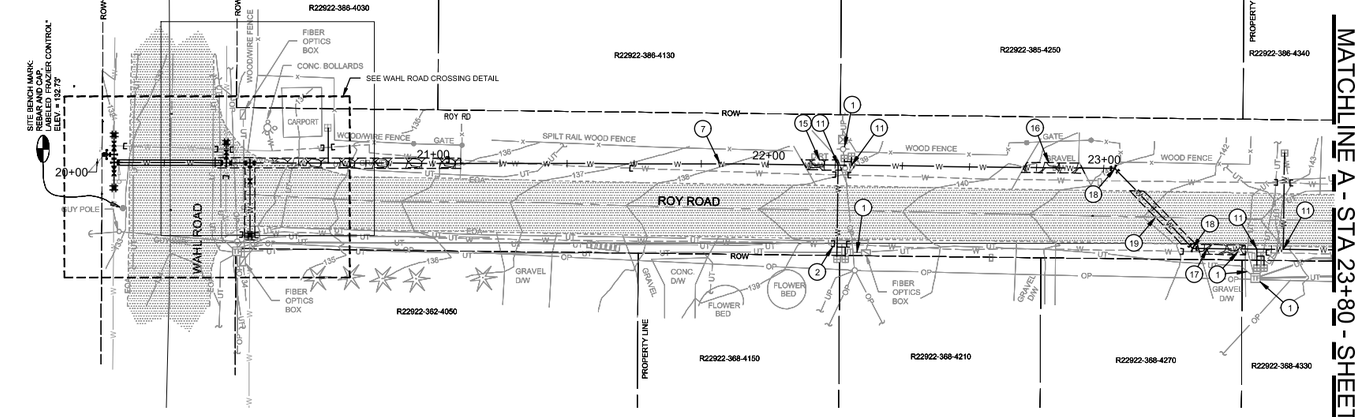


WAHL ROAD CROSSING DETAIL
SCALE: 1" = 10'



KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	PROTECT EX UTILITIES AND SIGNS	-
2	EX WATER MAIN TO BE ABANDONED, CUT, CAP AND ABANDON WHERE UNCOVERED	-
3	REMOVE EX HYDRANT ASSEMBLY AND BOLLARDS	-
4	33 LF 12" PVC C900 (TEE TO TEE)	1/C13 2/C13
5	7 LF 12" PVC C900 (TEE TO TEE)	1/C13 2/C13
6	RESTORE APPROXIMATELY 17 SY OF GRAVEL DRIVEWAY	-
7	332 LF 12" PVC C900 (TEE TO MATCHLINE A)	1/C13 2/C13
8	(1) 12" DI TEE (FL) (1) 12"x6" (FL)(TO HYDRANT ASSEMBLY) (2) 6" GATE VALVES (FLxMJ) (2) 12"x6" REDUCERS (FL) CONC THRUST BLOCKS 6" PIPE, ADAPTERS, COUPLERS, AND FITTINGS AS NECESSARY TO CONNECT TO EX MAINS AND BLOWOFF	3/C13 4/C13
9	(1) 12" DI TEE (MJxFL) (1) 8" GATE VALVE (FLxMJ) (1) 12"x8" REDUCERS (FL) CONC THRUST BLOCKS 8" PIPE, ADAPTERS, COUPLERS, AND FITTINGS AS NECESSARY TO CONNECT TO EX WATER MAIN	3/C13 4/C13
10	(1) 12" DI TEE (MJXFL) (1) 12" BLIND FANGE W/ 2" TAP (NPT) (2) 2" BRASS NIPPLES 12" LENGTH (NPT) (1) 2" GATE VALVE (NPT) 21 LF 2" SCH 80 PVC PIPE 2" PIPE ADAPTERS, COUPLER, AND FITTINGS AS NECESSARY TO CONNECT TO EXISTING WATER MAIN	3/C13 4/C13
11	1" PE SERVICE LINE, CONNECT TO EX METER SETTER	7/C15
12	35 LF BORE 18" HDPE/STEEL CASING PIPE UNDERNEATH WAHL ROAD	8/C14
13	(1) HYDRANT ASSEMBLY (2) BOLLARDS (PER PLAN) INSTALL INSIDE RIGHT OF WAY (SHOWN SCHEMATICALLY IN DRAWING)	5/C13 6/C13
14	RESTORE APPROXIMATELY 14 SY OF ASPHALT ROADWAY (ROY ROAD). NO TRENCHING SHALL BE OPENED IN WAHL ROAD TRAVEL LANES	2/C13
15	RESTORE APPROXIMATELY 17 SY OF GRAVEL DRIVEWAY	2/C13
16	RESTORE APPROXIMATELY 4 SY OF GRAVEL DRIVEWAY	2/C13
17	RESTORE APPROXIMATELY 5 SY OF GRAVEL DRIVEWAY	2/C13
18	12" 45° DI BEND (MJ) CONC THRUST BLOCK	2/C13
19	RESTORE APPROXIMATELY 7 SY OF ASPHALT ROADWAY	2/C13



ROY ROAD MAIN REPLACEMENT PLAN

MATCHLINE A - STA 23+80 - SHEET C06

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS WHO HAVE DEMONSTRATED THE GREEN BUILDING CERTIFICATION INSTITUTE

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4151
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNION — STATE OF WASHINGTON — 49046 — REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

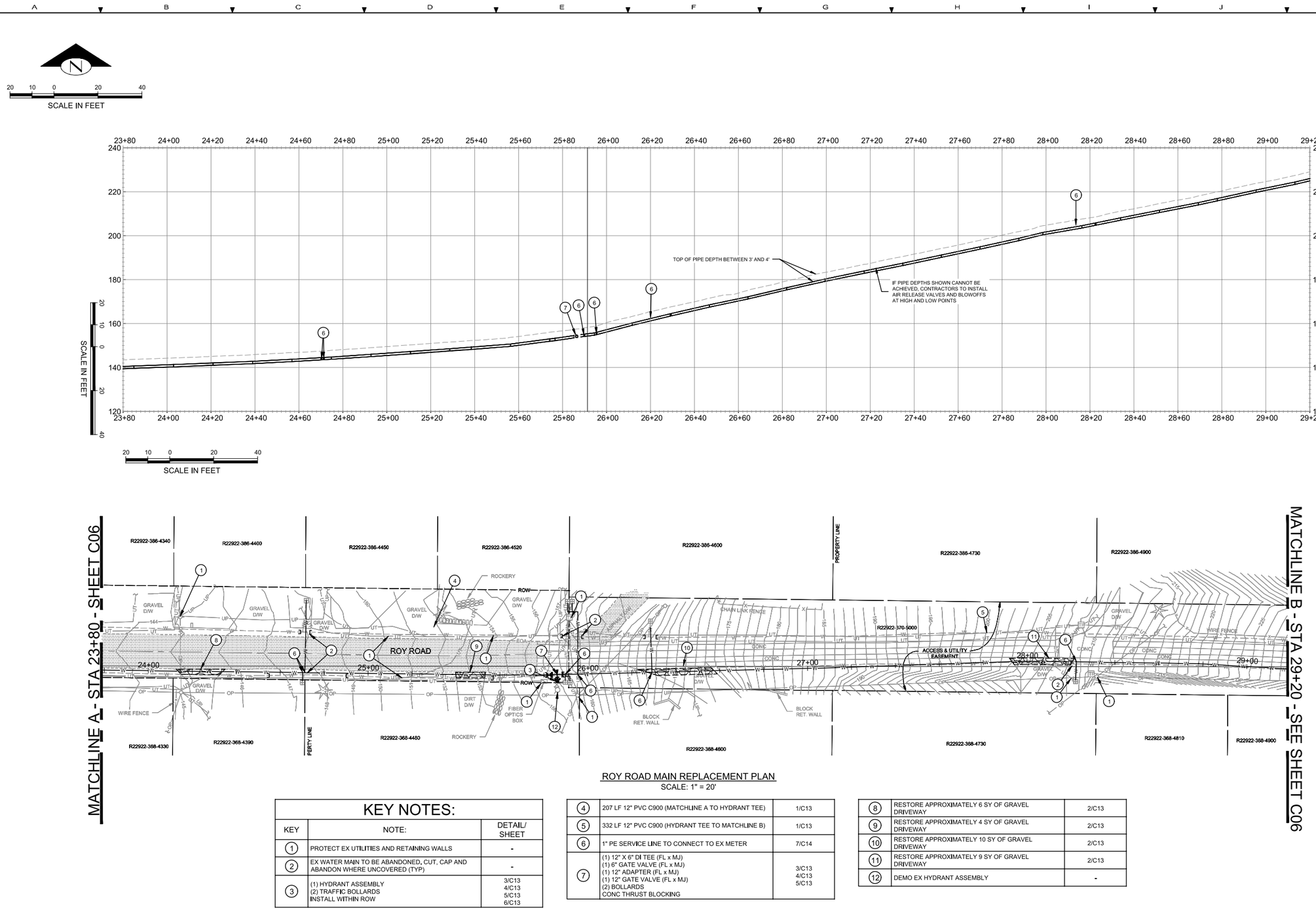
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
MAIN REPLACEMENT - ROY ROAD

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
	SHEET 6 OF 16

SHEET NUMBER
C05

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEM\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DRAWINGS\W&B WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: W& WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



ROY ROAD MAIN REPLACEMENT PLAN
SCALE: 1" = 20'

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	PROTECT EX UTILITIES AND RETAINING WALLS	-
2	EX WATER MAIN TO BE ABANDONED, CUT, CAP AND ABANDON WHERE UNCOVERED (TYP)	-
3	(1) HYDRANT ASSEMBLY (2) TRAFFIC BOLLARDS INSTALL WITHIN ROW	3/C13 4/C13 5/C13 6/C13
4	207 LF 12" PVC C900 (MATCHLINE A TO HYDRANT TEE)	1/C13
5	332 LF 12" PVC C900 (HYDRANT TEE TO MATCHLINE B)	1/C13
6	1" PE SERVICE LINE TO CONNECT TO EX METER	7/C14
7	(1) 12" X 6" DI TEE (FL x MJ) (1) 6" GATE VALVE (FL x MJ) (1) 12" ADAPTER (FL x MJ) (1) 12" GATE VALVE (FL x MJ) (2) BOLLARDS CONC THRUST BLOCKING	3/C13 4/C13 5/C13
8	RESTORE APPROXIMATELY 6 SY OF GRAVEL DRIVEWAY	2/C13
9	RESTORE APPROXIMATELY 4 SY OF GRAVEL DRIVEWAY	2/C13
10	RESTORE APPROXIMATELY 10 SY OF GRAVEL DRIVEWAY	2/C13
11	RESTORE APPROXIMATELY 9 SY OF GRAVEL DRIVEWAY	2/C13
12	DEMO EX HYDRANT ASSEMBLY	-

LEED ACCREDITED PROFESSIONAL & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY PERMISSION. LEED IS A REGISTERED TM AND AWARDED BY THE GREEN BUILDING CERTIFICATION INSTITUTE

No.	DATE	BY	REVISION

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.1151
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNION
STATE OF WASHINGTON
49066
REGISTERED PROFESSIONAL ENGINEER

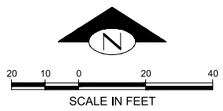
BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

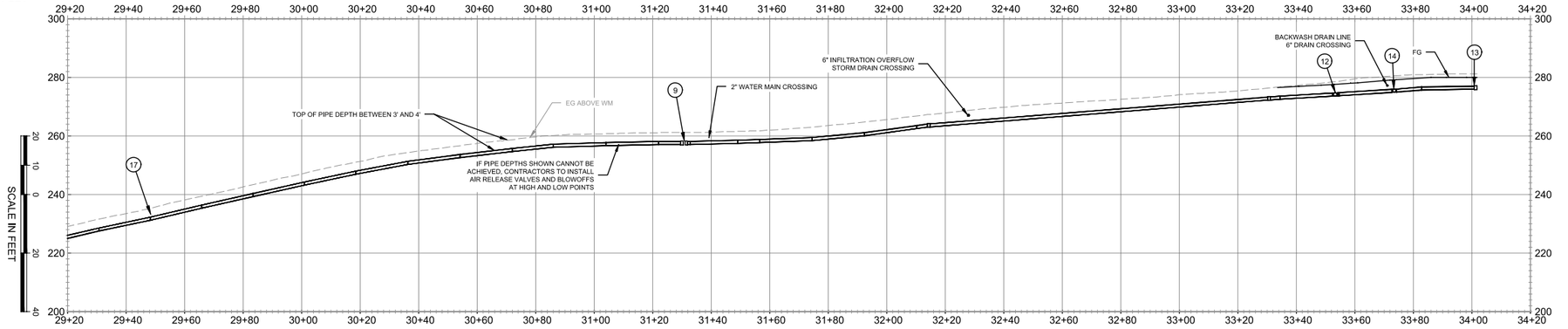
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
MAIN REPLACEMENT - ROY ROAD

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 6 OF 16	
SHEET NUMBER	C06

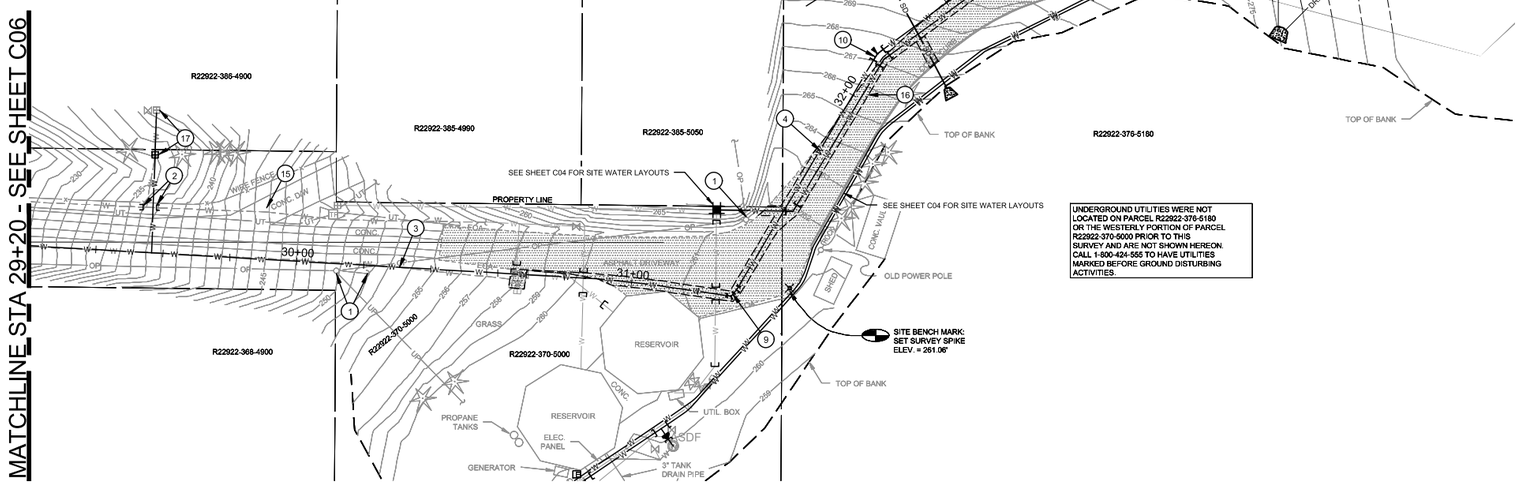
CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEM\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DGN\DRAWINGS\W&B WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018





KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	PROTECT EX UTILITIES AND RETAINING WALLS	-
2	EX WATER MAIN TO BE ABANDONED, CUT, CAP AND ABANDON WHERE UNCOVERED (TYP)	-
3	209 LF 12" PVC C900 (MATCHLINE B TO BENDS)	1/C13
4	83 LF 12" PVC C900	1/C13
5	116 LF 12" PVC C900	1/C13
6	22 LF 12" PVC C900	1/C13
7	21 LF 12" PVC C900	1/C13
8	5 LF 12" DI (BEND TO RESERVOIR OUTLET)	1/C13
9	(1) 45° 12" DI BEND (FLxMJ) (1) 11.25° 12" DI BEND (FLxMJ) CONCRETE THRUST BLOCKS	3/C13
10	(1) 22.5° 12" DI BEND CONCRETE THRUST BLOCK	3/C13
11	(1) 22.5° 12" DI BEND (FLxMJ) (1) 11.25° 12" DI BEND (FLxMJ) CONCRETE THRUST BLOCKS	3/C13
12	(1) 12"x12"x6" TEE (FLxMJ) (1) 12" GATE VALVE (FLxMJ) (1) 12" ADAPTER (FLxMJ) CONCRETE THRUST BLOCKS	3/C13 4/C13
13	(1) 90° 12" DI BEND (FL) (1) 12" GATE VALVE (FLxMJ) (1) 12" ADAPTER (FLxMJ) CONCRETE THRUST BLOCK	3/C13 4/C13
14	(1) 12" TEE (MJxFL) (1) 12" TO 4" REDUCER (FL) (1) 4" GATE VALVE (FLxMJ) CONCRETE THRUST BLOCKS	3/C13 4/C13
15	RESTORE APPROXIMATELY 6 SY OF CONC DRIVEWAY	2/C13
16	RESTORE APPROXIMATELY 58 SY OF ASPHALT DRIVEWAY (ONSITE)	2/C13
17	REMOVE EXISTING METER BOX AND SETTER, INSTALL NEW SETTER, METER BOX, AND RE-ESTABLISH CONNECTION TO EXISTING SERVICE LINE, RELOCATE EXISTING METER	7/C14



UNDERGROUND UTILITIES WERE NOT LOCATED ON PARCEL R22922-376-5180 OR THE WESTERLY PORTION OF PARCEL R22922-370-5000 PRIOR TO THIS SURVEY AND ARE NOT SHOWN HEREON. CALL 1-800-424-555 TO HAVE UTILITIES MARKED BEFORE GROUND DISTURBING ACTIVITIES.

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY THE INSTITUTE UNDER LICENSE. THE GREEN BUILDING CERTIFICATION INSTITUTE

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4151
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENHAM
STATE OF WASHINGTON
49974
REGISTERED
PROFESSIONAL ENGINEER
Robert L Benham
2022.11.07 12:32:46 -08'00'

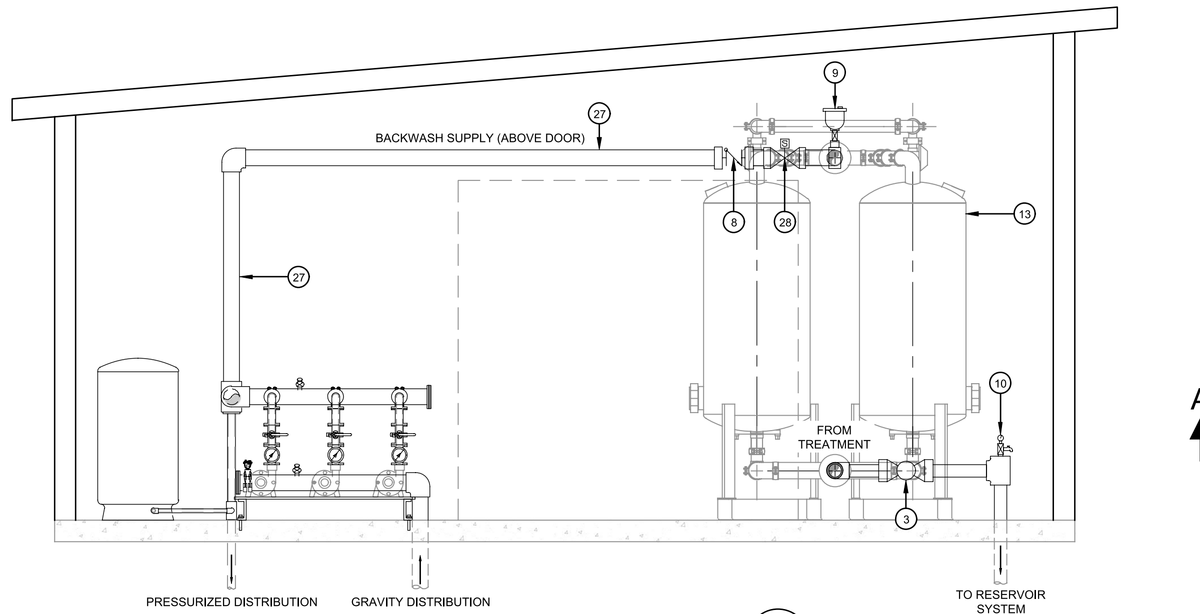
BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

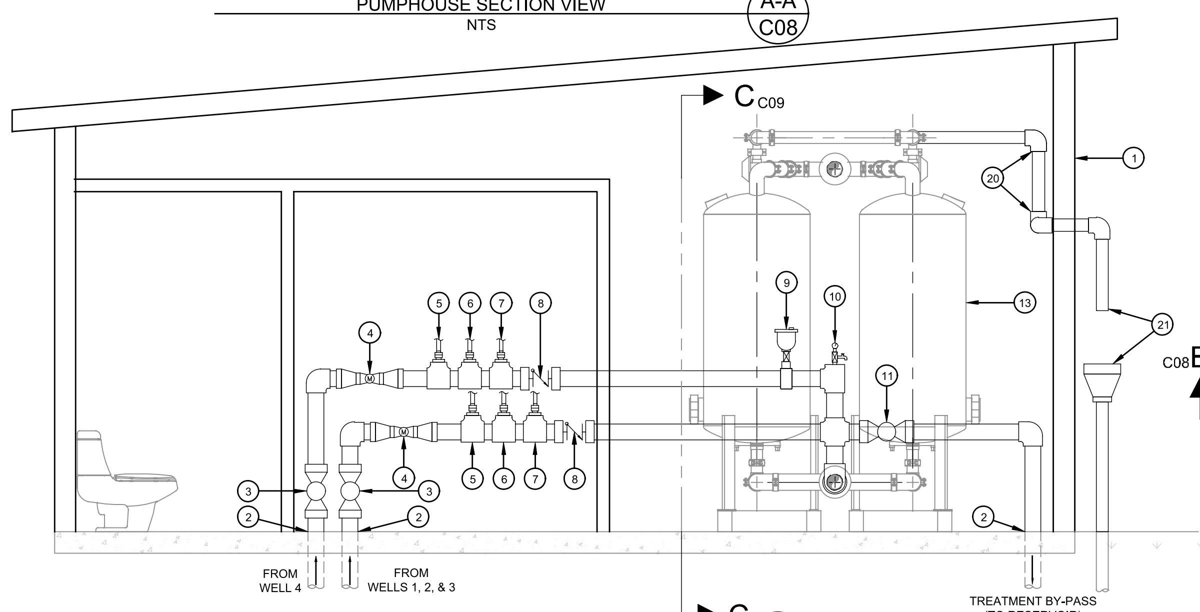
PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
MAIN REPLACEMENT - ROY ROAD

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 7 OF 16	
SHEET NUMBER	C07

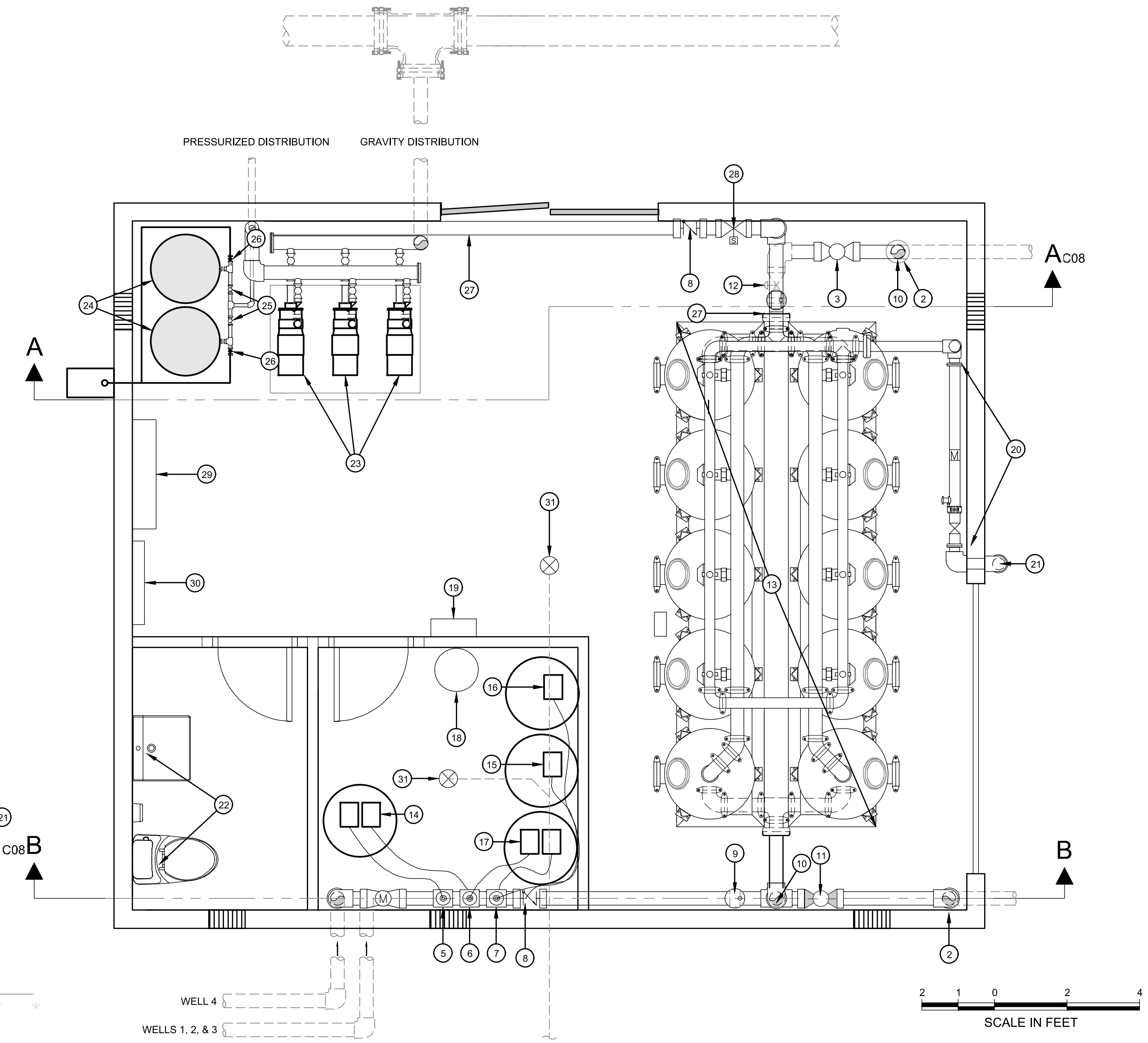
CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEM\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DGN\MAINWORK WELL SITE IMPROVEMENTS_30.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



PUMPHOUSE SECTION VIEW
NTS
A-A / C08



PUMPHOUSE SECTION VIEW
NTS
B-B / C08



PUMPHOUSE PLAN VIEW
SCALE 1" = 2'

KEY NOTES:

KEY	NOTE:	DETAIL/ SHEET
1	20'x24' PUMPHOUSE	-
2	PIPE PASSES THROUGH FLOOR, INSTALL 90° BENDS AND PENETRATION SEAL AS NEEDED	-
3	4" ISOLATION VALVE	-
4	2" SEAMETRICS IMAG 4700 PULSE METER. INSTALL AND SPACE REDUCERS AS REQUIRED BY MANUFACTURER.	-
5	POTTASSIUM INJECTION POINT	10/C14
6	FERRIC CHLORIDE INJECTION POINT	10/C14
7	SODIUM HYPOCHLORITE INJECTION POINT	10/C14
8	4" CHECK VALVE	-
9	AIR RELEASE VALVE WITH SADDLE TAP, ISOLATION BALL VALVE (TYP), FITTINGS AND ADAPTERS AS NEEDED	14/C15
10	4" TEE WITH ADAPTERS AND FITTINGS FOR SAMPLE TAP AND PRESSURE GAUGE	13/C15
11	4" ISOLATION VALVE (N/C) - TREATMENT BYPASS	-
12	3" PRESSURE SUSTAINING SOLENOID VALVE (N/O), SET TO MAINTAIN UPSTREAM PRESSURE OF 20 PSI DURING BACKWASH	-
13	ATEC FILTER SYSTEM, SECURE WITH ANCHOR BOLTS INTO CONCRETE FLOOR	C09 & C10
14	50 GALLON CHEMICAL STORAGE TANK FOR POTASSIUM PERMANGANATE WITH (2) INJECTION PUMPS FOR WELL 4 AND FOR WELLS 1, 2, & 3	10/C14
15	WELL 4 SODIUM HYPOCHLORITE INJECTION PUMP AND 50 GALLON CHEMICAL STORAGE TANK	10/C14
16	WELLS 1, 2 & 3 SODIUM HYPOCHLORITE INJECTION PUMP AND 50 GALLON CHEMICAL STORAGE TANK	10/C14
17	50 GALLON CHEMICAL STORAGE TANK FOR FERRIC CHLORIDE WITH (2) INJECTION PUMPS FOR WELL 4 AND FOR WELLS 1, 2, & 3	10/C14
18	GUARDIAN G1814P EYEWASH STATION MOUNTED TO WALL (OR ENGINEER APPROVED EQUAL)	-
19	EEMAX HA013240 INSTANT HOT WATER HEATER, OR APPROVED EQUAL, SET TO 80° F	-
20	60" BACKWASH ASSEMBLY ASSEMBLY CONTAINS FLOW METER, THROTTLING VALVE FOR SETTING BACKWASH RATE, AND SIGHT GLASS, INSTALL AT SLIGHT UPHILL ANGLE TO ENSURE NO AIR AT METER	C09 & C10
21	BACKWASH AIR GAP	15/C15
22	PROVIDE UTILITY SINK AND TOILET CONNECT TO EXISTING ONSITE SEPTIC TANK	-
23	(3) GRUNDFOS CME 10-1 1.5HP PUMPS 75 GPM AT 20 FEET TOTAL DYNAMIC HEAD (CHECK VALVES, ISOLATION VALVES, AND COUPLERS NOT SHOWN FOR CLARITY)	17/C15
24	(2) 40 GALLON PRESSURE TANKS	-
25	ISOLATION VALVE FOR PRESSURE TANK	-
26	PRESSURE RELIEF VALVE PLUMBED TO THE EXTERIOR WITH 90° FITTING TURNED DOWN AND 24 MESH SCREEN ON OUTLET	-
27	22 LF 4" PIPE TO CONNECT BOOSTER PUMP TO 4" INLET ON TOP OF FILTER SLED	-
28	4" SOLENOID VALVE (N/C)	-
29	WELL AND BOOSTER PUMP CONTROLS	-
30	ELECTRICAL FUSE BOX	-
31	FLOOR DRAIN. PLUMB TO DAYLIGHT. 4 MESH SCREEN ON OUTLET	-

PUMPHOUSE NOTES:

1. INSTALL AIR RELEASE VALVES AT PLUMBING HIGH POINTS.
2. PIPING INSIDE PUMPHOUSE TO BE 4" PVC SCH 80 UNLESS OTHERWISE NOTED. PIPE SHALL BE SECURED AS NECESSARY. SEE DETAIL 11/C14 FOR PIPE SUPPORT DETAIL
3. ALL COMPONENTS IN CONTACT WITH WATER SHALL BE NSF 61 CERTIFIED.
4. DASHED PIPING IS BELOW GRADE/FLOOR.
5. PROVIDE SHUTTER MOUNTED EXHAUST FAN MOUNTED HIGH ON ONE PUMPHOUSE WALL FOR EACH ROOM. PROVIDE LOW MOUNTED AIR INLETS ON EACH PUMPHOUSE WALL. PROVIDE 24 HOUR TIMER FOR VENTILATION FAN.
6. INSTALL WALL MOUNTED HEATER(S) IN PUMPHOSUE SET TO 45° FAHRENHEIT
7. BUILDING WATER PIPING FOR BATHROOM , HEATER AND EYEWASH NOT SHOWN FOR CLARITY. INSTALL FIXTURE PIPING IN CONFORAMNCE WITH PLUMBING CODE.

REVISION | No. | DATE | BY

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.5131
www.dcgengr.com

CALL 811
2 BUSINESS DAYS BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

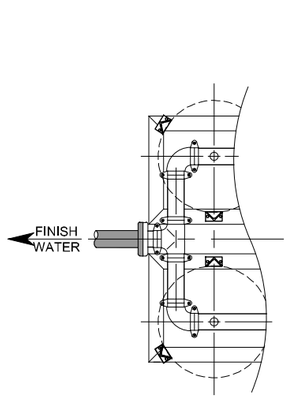
ROBERT L. BEHNKE, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 48094

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

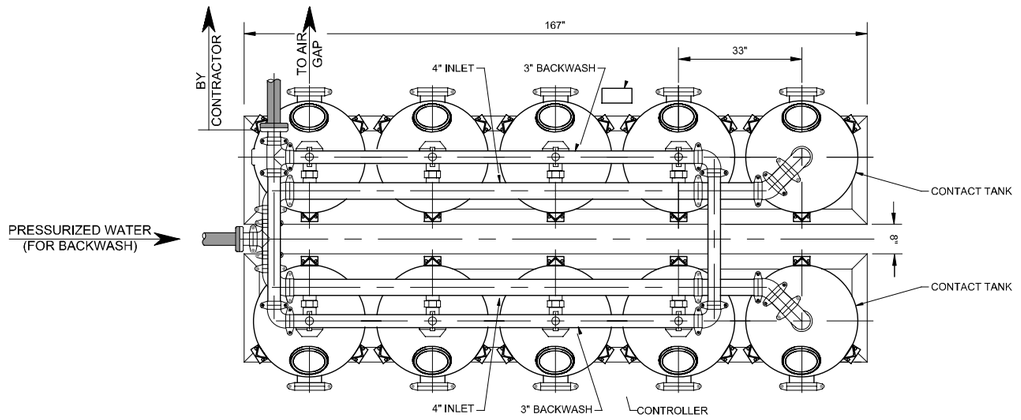
OWNER: CASCADIA WATER, PO BOX 549, FREELAND, WA 98249
PROJECT: W&B WATERWORKS 1 WELL SITE IMPROVEMENTS PUMPHOUSE PLAN

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE:	11/7/2022
REV.	-
SHEET	8 OF 16
SHEET NUMBER	C08

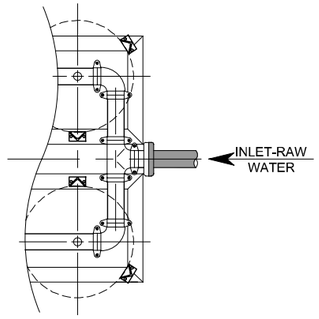
CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\WB WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\DRAWING\WB WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS- ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



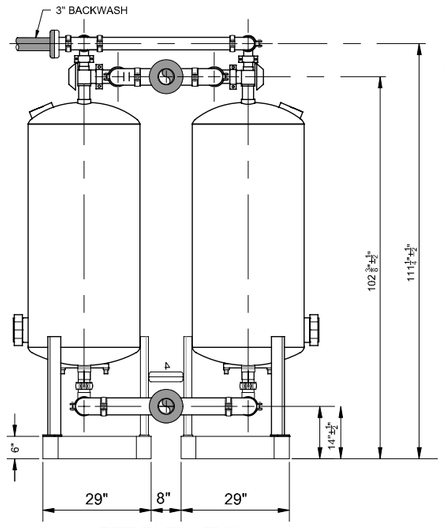
LEFT SIDE, FILTERS REMOVED



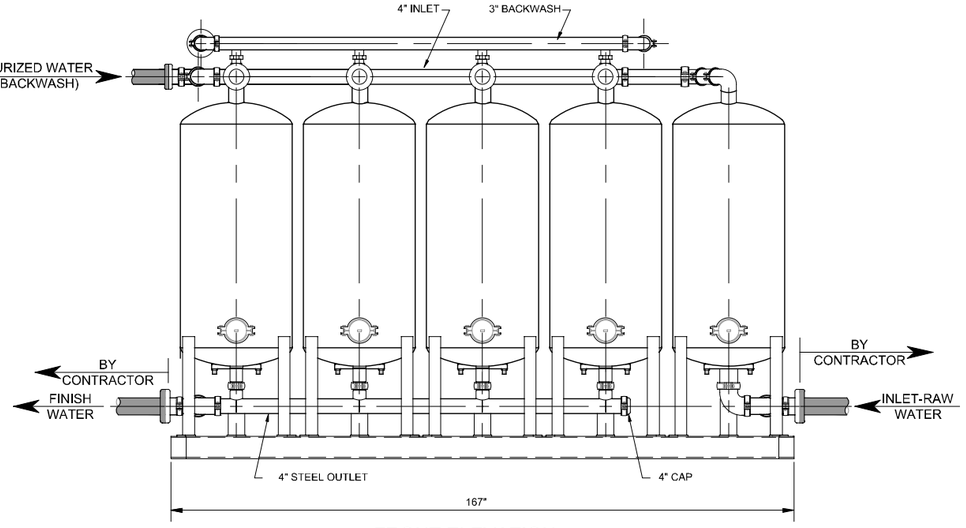
PLAN VIEW



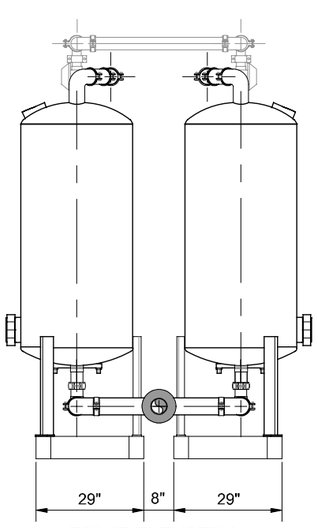
RIGHT SIDE, FILTERS REMOVED



LEFT ELEVATION



FRONT ELEVATION



RIGHT ELEVATION

NOTES:

1. A 60" LONG, 3-INCH BACKWASH FLANGED BACKWASH ASSEMBLY WITH REGULATING VALVE, METER AND SIGHT GLASS CAN BE SHIPPED LOOSE TO REGULATE BACKWASH TO 137 GPM. (EXTRA COST ITEM LINE)

ATEC SECTION VIEW
NTS
C-C
C09

REVISION | BY | DATE | No.

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS WHO HAVE DEMONSTRATED THE GREEN BUILDING CERTIFICATION INSTITUTE

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.5131
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENSON — STATE OF WASHINGTON — 21024 — REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

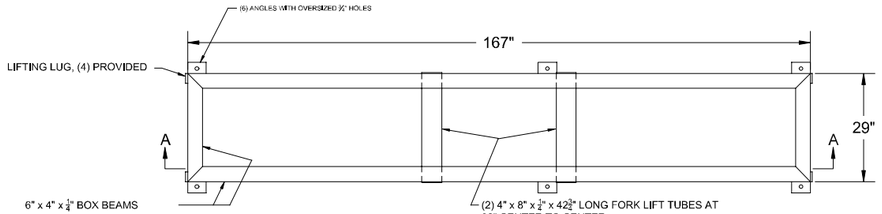
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
ATEC DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/8/2022	REV. -
SHEET	10 OF 16

SHEET NUMBER
C09

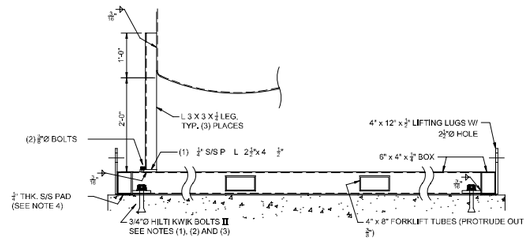
CAD FILE NUMBER: I:\DCG\LOCAL\FLES\HARDDOCS\CLIENTS\HATTER\CASCADIA WATER SYSTEMS\WB WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DRAWINGS\WB WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/8/2022 12:12 PM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



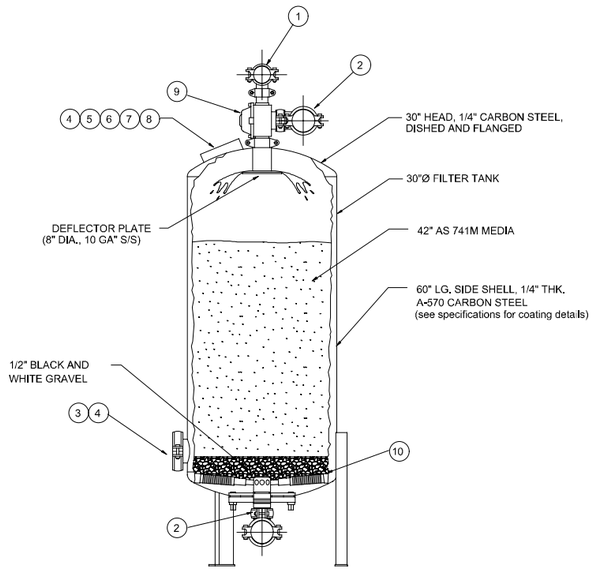
SKID PLAN
(4 FILTER)

BILL OF MATERIAL			
ITEM	QTY	PART NO.	DESCRIPTION
1	1	PFS-CPL03	3" GROOVED COUPLING, CAST IRON W/ BOLTS & GASKET
2	3	PFS-CPL04	4" GROOVED COUPLING, CAST IRON W/ BOLTS & GASKET
3	1	PFS-CAP06	6" GROOVED END CAP
4	1	PFS-CPL06	6" GROOVED COUPLING, CAST IRON W/ BOLTS & NUTS
5	1	PFS-HHP11	6"x8" HAND HOLE PLATE
6	1	PFS-HHG11	6"x8" HAND HOLE GASKET
7	1	PFS-HHGS11	6"x8" HAND HOLE BOLT SET
8	1	PFS-HHCR11	6"x8" HAND HOLE HOLD DOWN CRAB
9	1	UA SS48	3"x3"x3" SERIES 350 BERMAD BACKWASH VALVE
10	1	V-SF4	UNDER-DRAIN ASSEMBLY 316L SS W/ SCH 80 PVC CAP COMPLETE

NOTE: QUANTITIES FOR ONE (1) TANK



SECTION A-A
SCALE 1" = 1'-0"



TANK SECTION
N.T.S.

NOTES: (1) DESIGNER SHALL DETERMINE NO. AND DEPTH OF ANCHOR BOLTS TO SUIT LOCAL CODE REQUIREMENTS.

(2) ANCHOR BOLT HOLES ARE TO BE DRILLED INTO CONCRETE FOUNDATION THROUGH OVERSIZED DRILL HOLES IN GUSSETS IN SKID ASSEMBLY BY INSTALLATION CONTRACTOR.

(3) 1/4" THICK S/S PADS ARE PROVIDED UNDER SKIDS FOR CLEARANCE BETWEEN SKIDS AND CONCRETE FOUNDATION. SIX PADS ARE PROVIDED FOR 2 & 3 FILTER SKIDS, EIGHT PADS FOR 3-14 FILTER SKIDS

NOTE:
DIMENSIONS GIVEN ARE FOR THE CONTRACTOR'S INFORMATION BUT WILL VARY BECAUSE OF NORMAL FABRICATION TOLERANCES. CONTRACTOR SHALL CONNECT EXTERIOR PIPING TO FIT THE ATEC UNIT AS SHIPPED.

FILTER TANKS AND MANIFOLDS ON THIS SHEET SUPPLIED BY ATEC SYSTEMS:

THE CONTRACTOR WILL BE RESPONSIBLE FOR:
1. UNLOADING THE UNITS AND PLACING THEM IN THE CORRECT INSTALLED LOCATION.
2. ATTACH MANIFOLDS CONNECTING THE TWO BANKS OF FILTERS.
3. LOADING THE TWO TYPE OF MEDIA INTO THE FILTER.
4. CONNECTING POWER SUPPLY TO FILTER BACKWASH PLC (120 VAC, SWITCHED CIRCUIT).

No.	DATE	BY	REVISION

LEED® ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS WHO HAVE PASSED THE GREEN BUILDING CERTIFICATION INSTITUTE'S

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.4133
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNICK — STATE OF WASHINGTON — Robert L. Bennick — 2022/11/7 — 45094 — REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
ATEC DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 11 OF 16	

SHEET NUMBER
C10

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W& B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DGN\DRAWDOWN WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

POTASSIUM PERMANGANATE INJECTION SYSTEM SPECIFICATIONS

POTASSIUM PERMANGANATE AMOUNT	1 OUNCE
TOTAL FEED SOLUTION	3 GALLONS
FEED SOLUTION CONCENTRATION	2,497 PPM
RESERVOIR FILL FLOW RATE	200 GPM
REQUIRED INJECTION PUMP RATE	0.48 GPH
FERRIC CHLORIDE INJECTION PUMP	LMI PD75-A30HI
PUMP OUTPUT SETTING	57%
INJECTION PUMP FLOW RANGE	0.0-0.85 GPH

PROPOSED SODIUM HYPOCHLORITE INJECTION SYSTEM SPECIFICATIONS WELLS #1, 2,& 3

STOCK SOLUTION RAW STRENGTH	12.5%
RAW CHLORINE	5 GAL
TOTAL FEED SOLUTION	15 GAL
FEED SOLUTION CONCENTRATION	41,667 PPM
RESERVOIR FILL FLOW RATE	200 GPM
REQUIRED INJECTION PUMP RATE	1.30 GPH
FERRIC CHLORIDE INJECTION PUMP	LMI PD76-A40HI
INJECTION PUMP FLOW RANGE	0.0 - 1.75 GPH
PULSE METER RATE	0.7 PULSE/GAL

PROPOSED FERRIC CHLORIDE INJECTION SYSTEM SPECIFICATIONS WELLS #1, 2,& 3

STOCK SOLUTION RAW STRENGTH	39%
RAW CHLORINE	1 GAL
TOTAL FEED SOLUTION	10 GAL
FEED SOLUTION CONCENTRATION	39,000 PPM
RESERVOIR FILL FLOW RATE	200 GPM
REQUIRED INJECTION PUMP RATE	0.46 GPH
FERRIC CHLORIDE INJECTION PUMP	PD75-A30HI
INJECTION PUMP FLOW RANGE	0.0 - 0.85 GPH
PULSE METER RATE	0.7 PULSE/GAL

PROPOSED SODIUM HYPOCHLORITE INJECTION SYSTEM SPECIFICATIONS WELLS #4

STOCK SOLUTION RAW STRENGTH	12.5%
RAW CHLORINE	5 GAL
TOTAL FEED SOLUTION	15 GAL
FEED SOLUTION CONCENTRATION	41,667 PPM
RESERVOIR FILL FLOW RATE	125 GPM
REQUIRED INJECTION PUMP RATE	0.97 GPH
FERRIC CHLORIDE INJECTION PUMP	LMI PD76-A40HI
PUMP STROKE PERCENTAGE	71%
INJECTION PUMP FLOW RANGE	0.0 - 1.75 GPH
PULSE METER RATE	1 PULSE/GAL

PROPOSED FERRIC CHLORIDE INJECTION SYSTEM SPECIFICATIONS WELL #4

STOCK SOLUTION RAW STRENGTH	39%
RAW CHLORINE	1 GAL
TOTAL FEED SOLUTION	10 GAL
FEED SOLUTION CONCENTRATION	39,000 PPM
RESERVOIR FILL FLOW RATE	125 GPM
REQUIRED INJECTION PUMP RATE	0.43 GPH
FERRIC CHLORIDE INJECTION PUMP	PD75-A30HI
PUMP STROKE PERCENTAGE	65%
INJECTION PUMP FLOW RANGE	0.0 - 0.85 GPH
PULSE METER RATE	1 PULSE/GAL

No.	DATE	BY	REVISION

P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.5131
www.dcgengr.com

DCG civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNION — STATE OF WASHINGTON — 49994 — REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

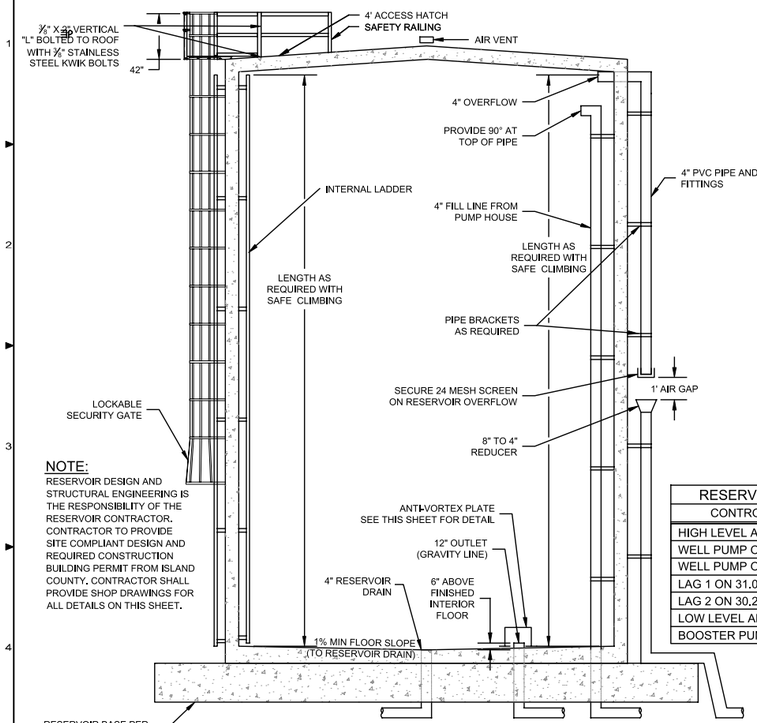
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
TREATMENT SETTINGS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 12 OF 16	

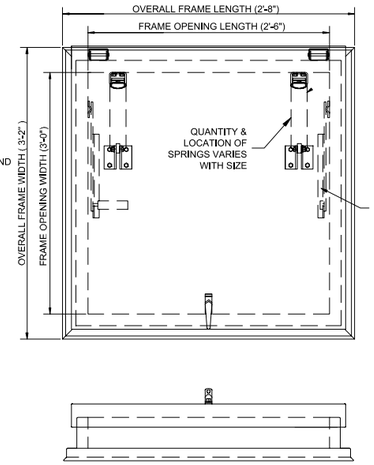
SHEET NUMBER
C11

CAD FILE NUMBER: P:\CLIENTS\WATER\CASCADIA\WATER SYSTEMS\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DGN\DRAWINGS\W&B WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

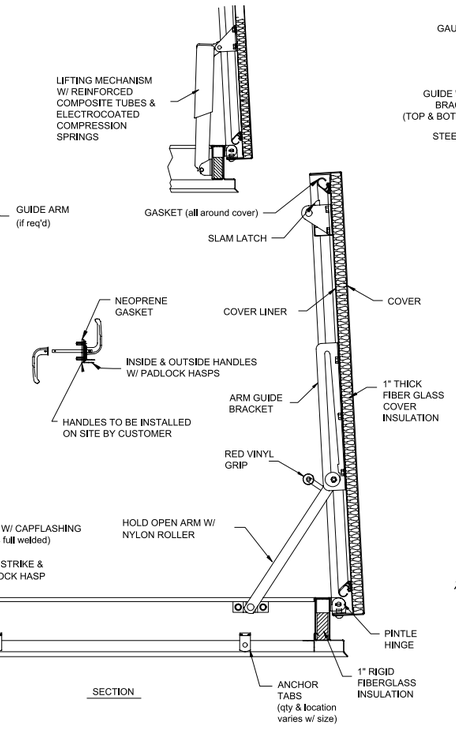


NOTE:
RESERVOIR DESIGN AND STRUCTURAL ENGINEERING IS THE RESPONSIBILITY OF THE RESERVOIR CONTRACTOR. CONTRACTOR TO PROVIDE SITE COMPLIANT DESIGN AND REQUIRED CONSTRUCTION BUILDING PERMIT FROM ISLAND COUNTY. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS FOR ALL DETAILS ON THIS SHEET.

RESERVOIR CROSS SECTION DETAIL WR C04
NTS

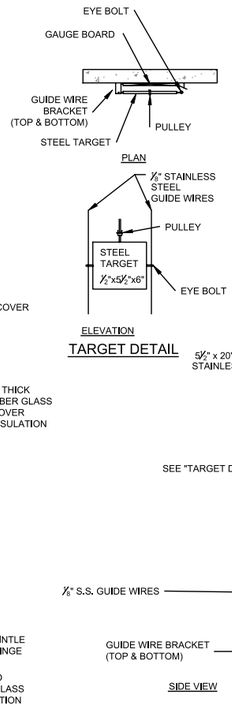


RESERVOIR SET POINTS	
CONTROL POINT	HEIGHT
HIGH LEVEL ALARM	34.5'
WELL PUMP OFF	34.25'
WELL PUMP ON	31.75'
LAG 1 ON 31.0'	31.0'
LAG 2 ON 30.25'	30.25'
LOW LEVEL ALARM	20.0
BOOSTER PUMP SHUT-OFF	0.75'

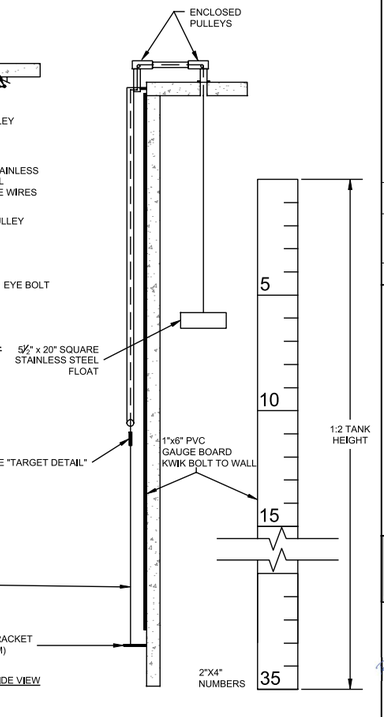


SECTION

ACCESS HATCH DETAIL

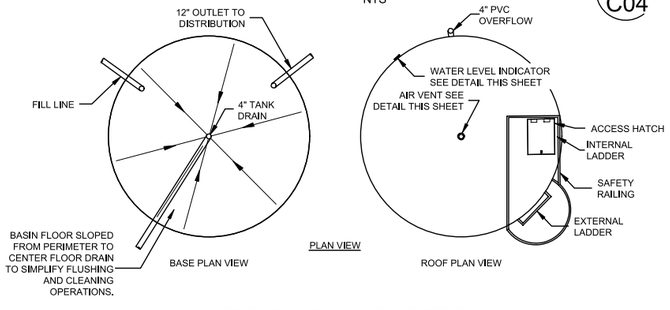


TARGET DETAIL

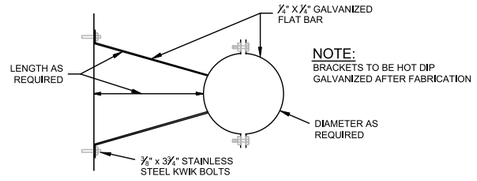


SIDE VIEW

WATER LEVEL INDICATOR DETAIL



RESERVOIR ROOF AND BASE DETAILS
NOT TO SCALE

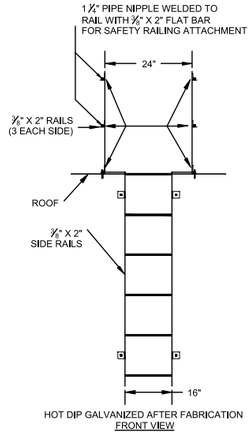


NOTE:
BRACKETS TO BE HOT DIP GALVANIZED AFTER FABRICATION

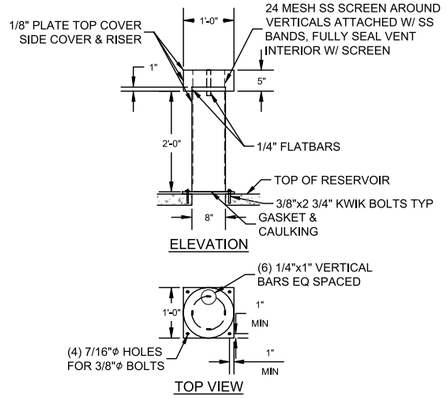
BRACKETS FOR MOUNTING PIPING TO WALL DETAIL

ELEVATION VIEW

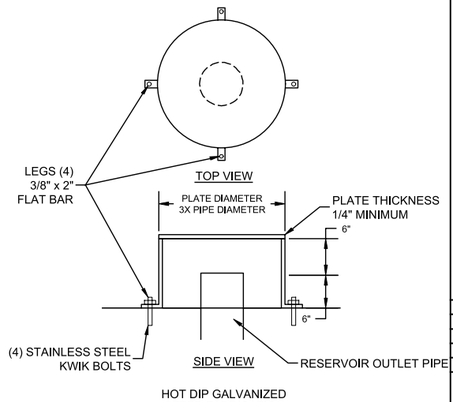
INTERNAL LADDER DETAIL



HOT DIP GALVANIZED AFTER FABRICATION
FRONT VIEW



AIR VENT DETAILS



HOT DIP GALVANIZED AFTER FABRICATION

VORTEX PLATE DETAIL

LEED ACCREDITED PROFESSIONAL & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED TO INDIVIDUALS WHO HAVE DEMONSTRATED THE KNOWLEDGE REQUIRED BY THE GREEN BUILDING CERTIFICATION INSTITUTE.

P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.4153
www.dcgengr.com

D|C|G civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNETT — STATE OF WASHINGTON — 49926 — REGISTERED PROFESSIONAL ENGINEER — Robert L. Bennett — 2022.11.10 09:29:37 -08'00'

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS, DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

No.	DATE	BY	REVISION

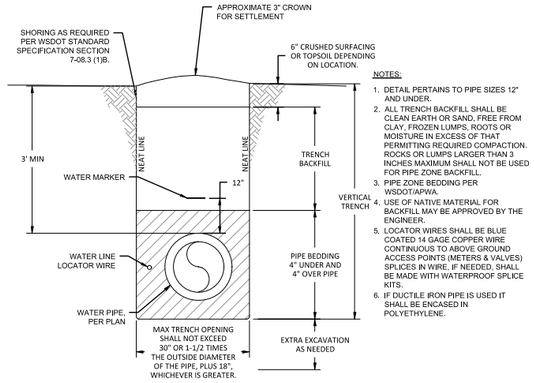
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
RESERVOIR DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 9 OF 16	

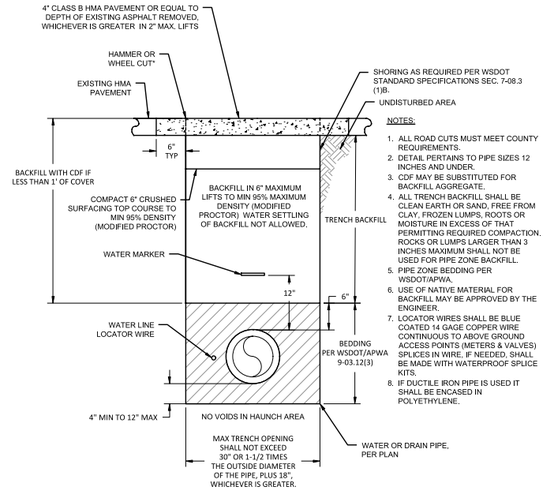
SHEET NUMBER
C12

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\RAW\W&B WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:39 AM - SHEET SET: W&B WATERWORKS WELL SITE IMPROVEMENTS--ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



NOTES:
1. DETAIL PERTAINS TO PIPE SIZES 12" AND UNDER.
2. ALL TRENCH BACKFILL SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, FROZEN LUMPS, ROOTS OR MOISTURE IN EXCESS OF THAT PERMITTING REQUIRED COMPACTION. ROCKS OR LUMPS LARGER THAN 3 INCHES MAXIMUM SHALL NOT BE USED FOR PIPE ZONE BACKFILL.
3. PIPE ZONE BEDDING PER WSDOT/APWA.
4. USE OF NATIVE MATERIAL FOR BACKFILL MAY BE APPROVED BY THE ENGINEER.
5. LOCATOR WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & VALVES) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.
6. IF DUCTILE IRON PIPE IS USED IT SHALL BE ENCASED IN POLYETHYLENE.

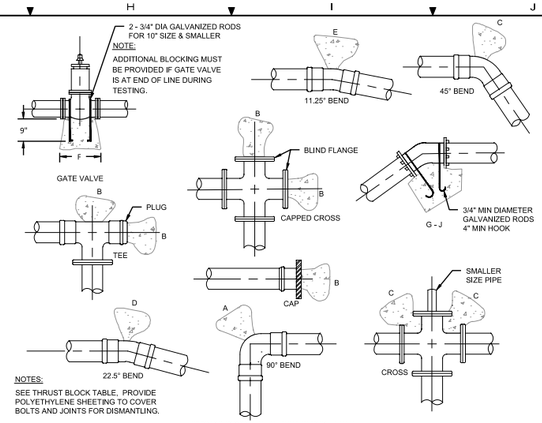
WATER MAIN TRENCH DETAIL (UNPAVED) — 1 — C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS



NOTES:
1. ALL ROAD CUTS MUST MEET COUNTY REQUIREMENTS.
2. DETAIL PERTAINS TO PIPE SIZES 12 INCHES AND UNDER.
3. CDF MAY BE SUBSTITUTED FOR BACKFILL AGGREGATE.
4. ALL TRENCH BACKFILL SHALL BE CLEAN EARTH OR SAND, FREE FROM CLAY, FROZEN LUMPS, ROOTS OR MOISTURE IN EXCESS OF THAT PERMITTING REQUIRED COMPACTION. ROCKS OR LUMPS LARGER THAN 3 INCHES MAXIMUM SHALL NOT BE USED FOR PIPE ZONE BACKFILL.
5. PIPE ZONE BEDDING PER WSDOT/APWA.
6. USE OF NATIVE MATERIAL FOR BACKFILL MAY BE APPROVED BY THE ENGINEER.
7. LOCATOR WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METERS & VALVES) SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.
8. IF DUCTILE IRON PIPE IS USED IT SHALL BE ENCASED IN POLYETHYLENE.

*SAWCUT BOTH SIDES BACK TO UNDISTURBED PAVEMENT. SQUARE ALL EDGES AND TACK PRIOR TO PAVING, SEAL ALL JOINTS W/LIQUID ASPHALT AFTER PAVING. COVER IMMEDIATELY W/ SAND.

WATER MAIN TRENCH DETAIL (PAVED) — 2 — C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS



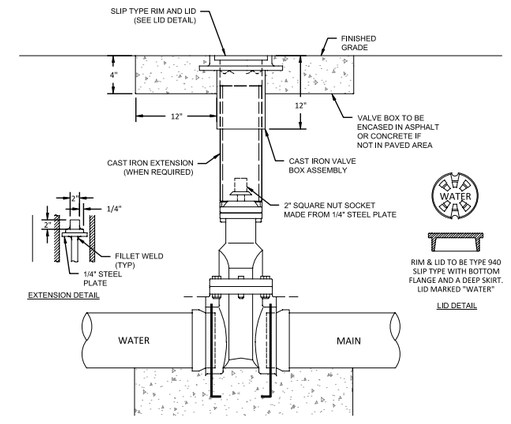
NOTES:
SEE THRUST BLOCK TABLE. PROVIDE POLYETHYLENE SHEETING TO COVER BOLTS AND JOINTS FOR DISMANTLING.

2000 PSI CONCRETE THRUST BLOCK - TABLE

	MIN. BEARING AGAINST UNDISTURBED SOIL						VERTICAL THRUST BLOCKING			
PIPE SIZE	A - 90° (SF)	B - TEE* (SF)	C - 45° (SF)	D - 22.5° (SF)	E -11.25° (SF)	F - GV* (SF)	A - 90° (CY)	A - 90° (CY)	A - 90° (CY)	A - 90° (CY)
4"	4	4	4	4	4	-	-	-	-	-
6"	10	7	6	3	2	-	2	-	-	-
8"	18	12	10	5	3	3	4	2	-	-
10"	24	22	14	8	5	4	8	3	-	-

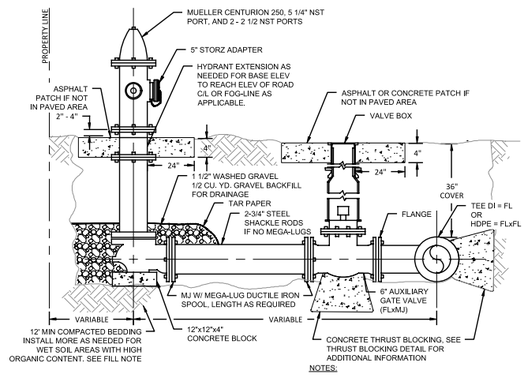
NOTES:
1. BEARING AREA OF CONCRETE THRUST-BLOCK BASED ON 250 PSI PRESSURE AND SAFE SOIL BEARING LOAD OF 1,000 POUNDS PER SQUARE FOOT.
2. AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZES, PRESSURES AND SOIL CONDITIONS.
3. CONCRETE BLOCKING SHALL BE CAST IN PLACE AND HAVE A MINIMUM OF 36 SQUARE INCHES BEARING AGAINST THE FITTING.
4. BLOCK SHALL BEAR AGAINST FITTINGS ONLY AND SHALL BE CLEAR OF JOINTS TO PERMIT TAKING UP OR DISMANTLING OF JOINT.
5. CONTRACTORS SHALL INSTALL BLOCKING ADEQUATE TO WITHSTAND FULL TEST PRESSURE AS WELL AS TO CONTINUOUSLY WITHSTAND OPERATION PRESSURE UNDER ALL CONDITIONS OF SERVICE. TEST NOT TO EXCEED 250 PSI AT LOWEST POINT.

WATER MAIN THRUST BLOCKING DETAIL — 3 — C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS



NOTES:
1. VALVE BOXES SHALL BE CENTERED DIRECTLY OVER THE VALVE NUT IN A VERTICAL POSITION.
2. VALVE BOX TOP SHALL BE ADJUSTED TO MEET FINISHED GRADE.
3. EXTENSION PIECES MUST FIT INTO THE TOP SECTION OF THE VALVE BOX AND OVER THE BOTTOM SECTION OF THE VALVE ASSEMBLY.
4. ALIGN PICK HOLES SLOTS OF THE RIM TO BE ALIGNED WITH DIRECTION OF THE WATER MAIN.
5. SEE THRUST BLOCK DETAIL FOR ADDITIONAL SPECIFICATIONS.

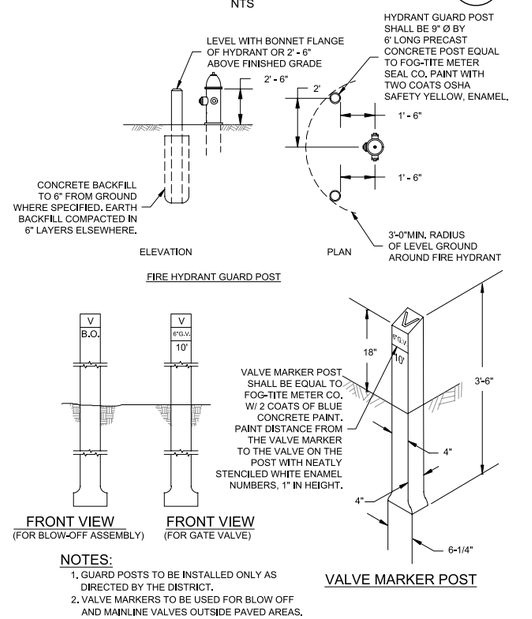
WATER MAIN GATE VALVE DETAIL — 4 — C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS



NOTES:
1. FIRE HYDRANT AND BOLLARD TO BE YELLOW (OSHA SAFETY YELLOW) INSTALL BLUE PAVEMENT MARKER IF HYDRANT IS IN RIGHT-OF-WAY.

SPECIAL FILL NOTE:
1. AREAS OF WET OR HIGHLY ORGANIC NATIVE SOILS WILL REQUIRE A MINIMUM 2 FEET DEEP COMPACTED FOUNDATION BED, 3 FEET AROUND TOTAL ASSEMBLY. CONSULT ENGINEER IF FOUND.

HYDRANT ASSEMBLY DETAIL — 5 — C06-C07
CASCADIA WATER SYSTEM DETAILS
NTS



NOTES:
1. GUARD POSTS TO BE INSTALLED ONLY AS DIRECTED BY THE DISTRICT.
2. VALVE MARKERS TO BE USED FOR BLOW OFF AND MAINLINE VALVES OUTSIDE PAVED AREAS.

VALVE AND HYDRANT MARKERS AND PROTECTION — 6 — C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE AWARDED BY LICENSE AGREEMENT. USE OF THE GREEN BUILDING CERTIFICATION INSTITUTE

D|C|G civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4141
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

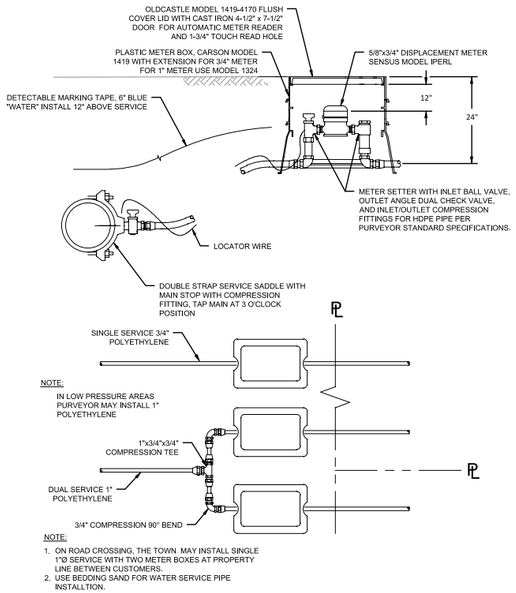
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 13 OF 16	

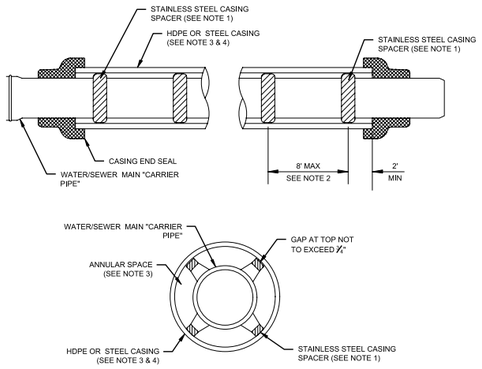
SHEET NUMBER
C13

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\WB WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\DRAWINGS\WB WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:26 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



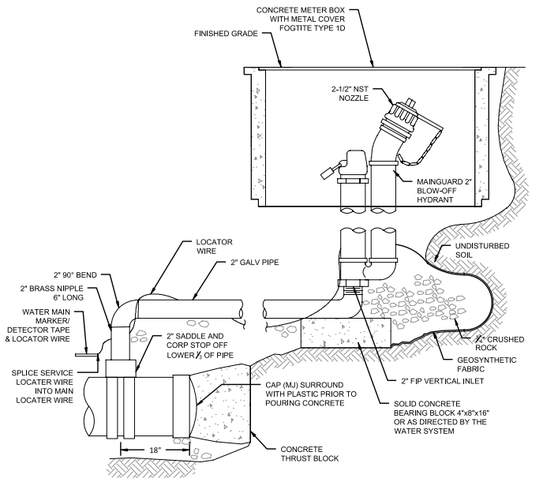
NOTE:
1. ON ROAD CROSSING, THE TOWN MAY INSTALL SINGLE 1"Ø SERVICE WITH TWO METER BOXES AT PROPERTY LINE BETWEEN CUSTOMERS.
2. USE BEDDING SAND FOR WATER SERVICE PIPE INSTALLTION.

SINGLE/ DOUBLEWATER SERVICE METER DETAIL — 7 C04-C07
CASCADIA WATER SYSTEM DETAILS
NTS



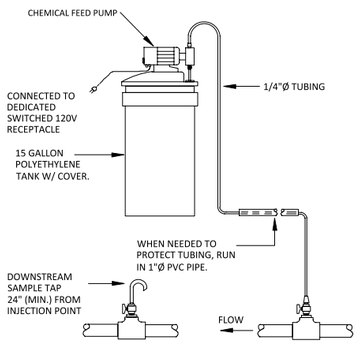
NOTES:
1. CASING SPACERS SHALL BE CENTER RESTRAINED POSITION TYPE.
2. INSTALL A MINIMUM OF 3 SPACERS PER 20 FEET OF CARRIER PIPE SECTION EQUALLY SPACED.
3. THE ANNULAR SPACE BETWEEN THE CARRIER PIPE AND THE CASING SHALL NOT BE FILLED WITH ANY MATERIAL UNLESS OTHERWISE NOTED ON PLANS.
4. IN AREAS WHERE A STEEL CASING IS TO BE USED, THE INSTALLATION SHALL INCLUDE AN ANODE AND/OR A TEST STATION.
5. INSTALL WARNING/IDENTIFICATION TAPE AND TRACER WIRE.

WATER MAIN CASING PIPE — 8 C06
CASCADIA WATER SYSTEM DETAILS
NTS

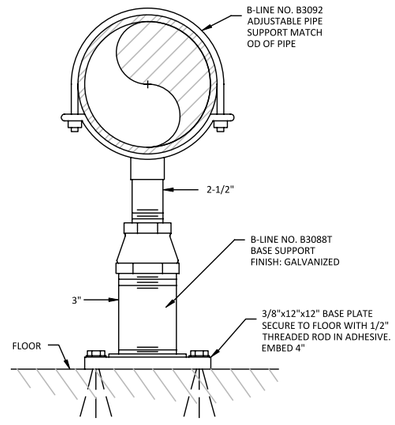


NOTES:
1. LOCATOR WIRES SHALL BE BLUE COATED 14 GAGE COPPER WIRE CONTINUOUS TO ABOVE GROUND ACCESS POINTS (METER BOX). SPLICES IN WIRE, IF NEEDED, SHALL BE MADE WITH WATERPROOF SPLICE KITS.
2. BLOW-OFF HYDRANTS SHALL BE A NON-FREEZING, SELF DRAINING TYPE WITH A MIN. DEPTH OF BURY OF 3 FEET. SET UNDERGROUND IN A CONCRETE METER BOX. HYDRANTS SHALL BE FURNISHED WITH A 2" FIP INLET. A NON-TURNING OPERATING ROD, AND SHALL OPEN TO THE LEFT. ALL OF THE WORKING PARTS SHALL BE OF BRONZE-TO-BRONZE DESIGN WITH AN ALUMINUM PLUNGER AND SERVICEABLE FROM ABOVE GRADE WITH NO DIGGING. THE OUTLET SHALL BE BRONZE AND 2-1/2" NST. BLOW-OFF SHALL BE LOCKABLE TO PREVENT UNAUTHORIZED USE.

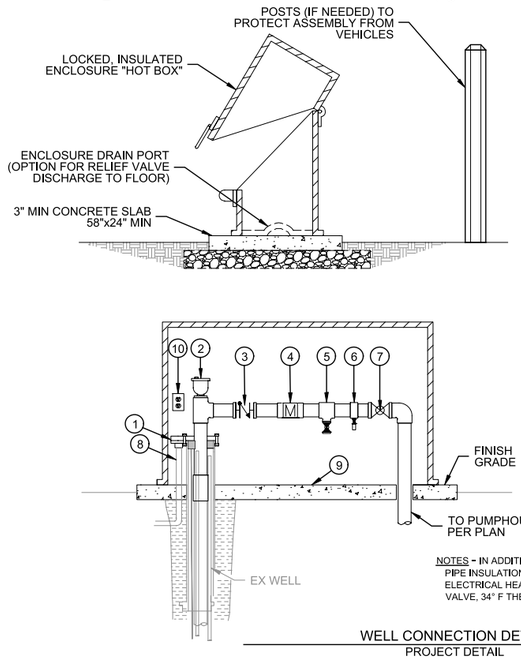
WATER MAIN BLOW OFF ASSEMBLY — 9 C06
CASCADIA WATER SYSTEM DETAILS
NTS



CHEMICAL FEED PUMP AND INJECTOR DETAIL — 10 C08
CASCADIA WATER SYSTEM DETAILS
NTS



PIPE SUPPORT DETAIL — 11 C08
CASCADIA WATER SYSTEM DETAILS
NTS



NOTES - IN ADDITION TO THE ENCLOSURE INSULATION, PROVIDE CLOSED CELL PIPE INSULATION, AND WRAP PIPE WITH FIBERGLASS PIPE WRAP. PROVIDE ELECTRICAL HEAT TAPE OR INSTALL "COMBRACO 40-PFV" FREEZE PROTECTION VALVE, 34° F THERMAL ACTUATOR ON DOWNSTREAM TEST COCK

WELL CONNECTION DETAIL — 12 C04
PROJECT DETAIL
NTS

WELL IMPROVEMENTS

KN	DESCRIPTION
1	EXISTING WELL CAP
2	AIR RELEASE WITH ISOLATION VALVE
3	CHECK VALVE
4	WATER METER
5	2" TEE WITH ISOLATION BALL VALVE FOR FLUSHING OF WELL
6	SAMPLE TAP
7	ISOLATION BALL VALVE
8	CONNECT WELL CONTROLS TO PUMPHOUSE
9	INSTALL HOT BOX ON CONCRETE SLAB, SLOPE CONCRETE SLAB TO EXTERIOR
10	INSTALL ELECTRICAL OUTLET

No.	DATE	BY	REVISION

LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY PROFESSIONALS WHO HAVE BEEN AWARDED THE LEED AP CREDENTIAL BY THE GREEN BUILDING CERTIFICATION INSTITUTE.

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4141
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

PROFESSIONAL ENGINEER — ROBERT L. BRENNEMAN — STATE OF WASHINGTON — 49941 — REGISTERED

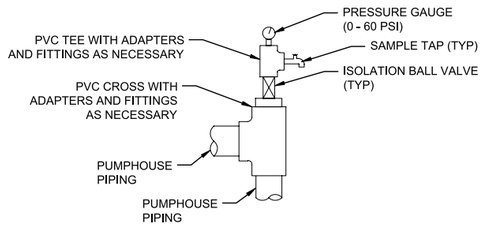
BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

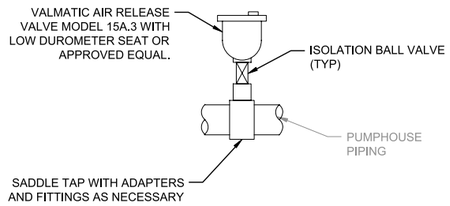
PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 14 OF 16	
SHEET NUMBER	C14

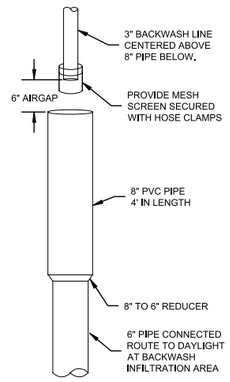
CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W6 WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:26 AM - SHEET SET: W6 WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018



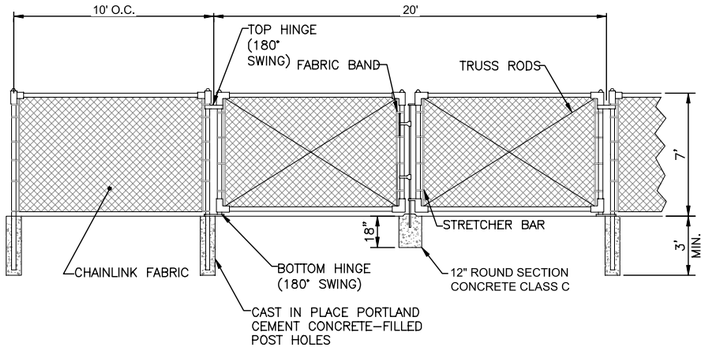
SAMPLE TAP & PRESSURE GAUGE DETAIL 13 / C08
PROJECT DETAIL
NTS



AIR RELEASE VALVE DETAIL 14 / C08
PROJECT DETAIL
NTS



AIR GAP DETAIL 15 / C08
PROJECT DETAIL
NTS

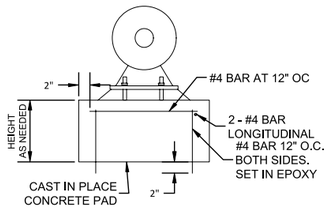


CHAINLINK FENCE & 20 FOOT ENTRY GATE DETAIL 16 / C04
PROJECT DETAIL
NTS

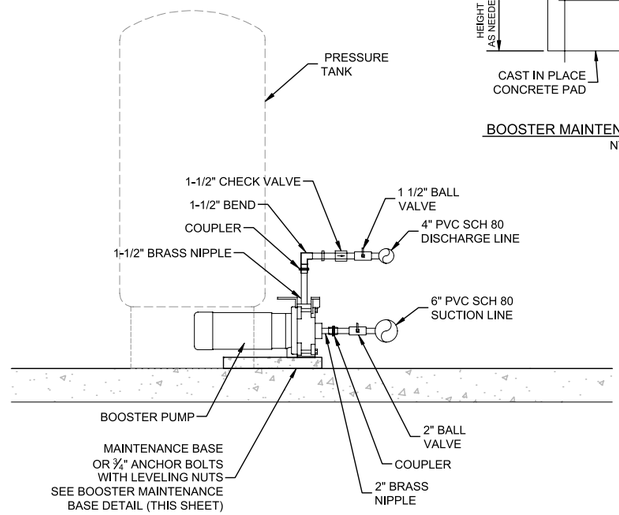
POST SCHEDULE:
GATE POSTS - 4" DIA.
CORNER & END POSTS - 2 7/8" DIA.
LINE POSTS - 2 3/8" DIA. TOP
RAILS - 1 5/8" DIA.

GENERAL NOTES:

1. FENCE FABRIC SHALL BE SECURED TO GATE FRAMES WITH KNUCKLED SELVAGE ALONG TOP EDGE FOR TYPES 4 & 6 CHAIN-LINK FENCE INSTALLATION.
2. MINIMUM POST LENGTH: 10'
3. ALL GATE, CORNER & END POSTS SHALL BE TRUSSED AND BRACED. ALL GATES SHALL BE TRUSSED. ALL POSTS & RAILS SHALL BE ROUND SCHEDULE 40 STEEL WITH GALVANIZED COATING.
4. FENCING SHALL MEET THE PORT OF ANACORTES SPECIFICATIONS PER BID DOCUMENTS. SHOULD AN DISCREPANCIES ARISE BETWEEN THIS DETAIL AND THE SPECIFICATIONS, THE SPECIFICATIONS SHALL TAKE PRECEDENCE.
5. ALL FENCING SHALL BE SLATTED WITH GREY COLORED SLATS PER POA REQUIREMENTS.



BOOSTER MAINTENANCE BASE DETAIL
NTS



BOOSTER PUMP DETAIL 17 / VARIES
PROJECT DETAIL
NTS

REVISION | BY | DATE | No.

LEED ACCREDITED PROFESSIONAL & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY PERMISSION. LEED ACCREDITATION IS THE GREEN BUILDING CERTIFICATION INSTITUTE

P.O. Box 1132
Freeland, WA 98249
P. 360.331.4131
F. 360.331.4153
www.dcgengr.com

DCG civil structural

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENNION — STATE OF WASHINGTON — 49094 — REGISTERED PROFESSIONAL ENGINEER

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

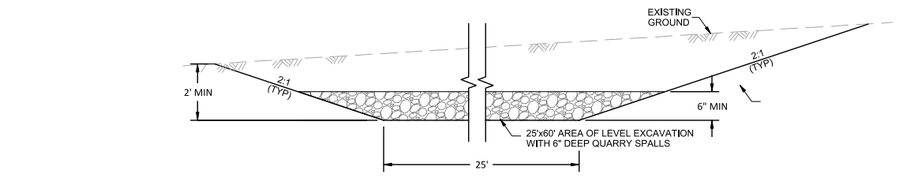
OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
DETAILS

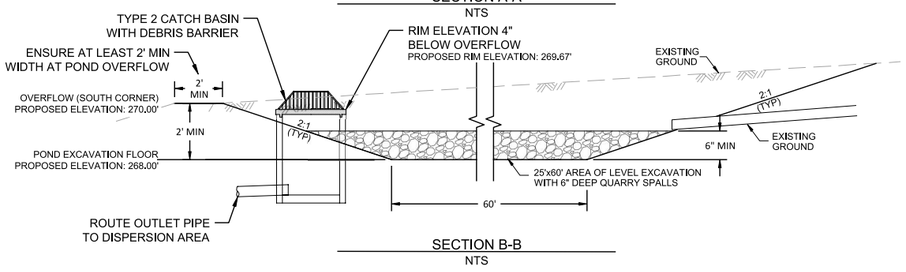
PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV. -
SHEET 15 OF 16	

SHEET NUMBER
C15

CAD FILE NUMBER: P:\CLIENTS-WATER\CASCADIA\WATER SYSTEMS\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\MAIN\WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: WB WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018

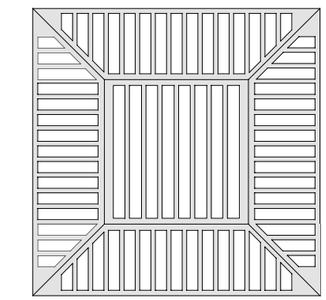


SECTION A-A
NTS



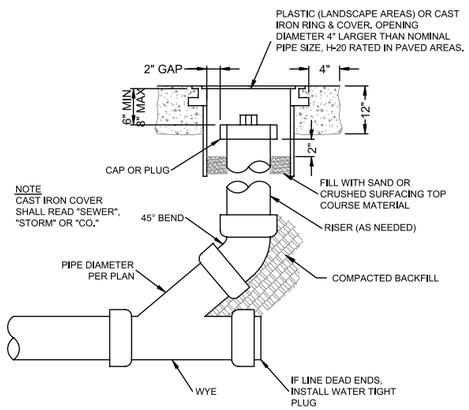
SECTION B-B
NTS

BACKWASH INFILTRATION POND DETAIL 18 C04
PROJECT DETAIL
NTS

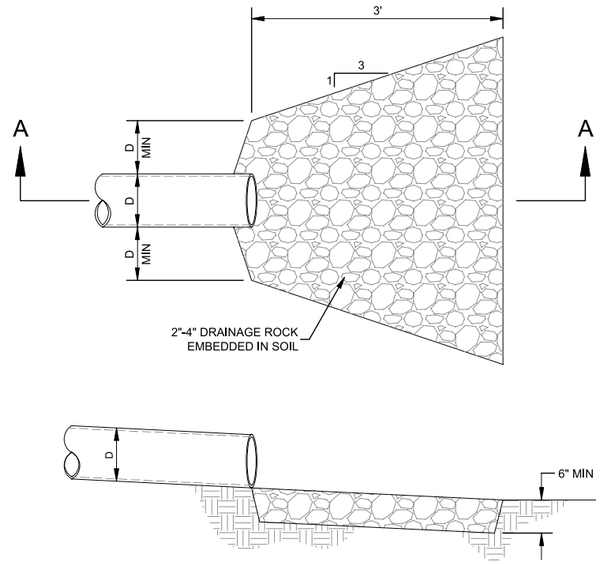


MATERIAL: DUCTILE IRON ASTM A536, CL 80-55-06
APPROXIMATE WEIGHT: 100 LBS "BEEHIVE GRATE"
FOR USE WITH SM60 20" x 24" REV FRAME

LIGHTWEIGHT DEBRIS BARRIER 20 C04
NOT TO SCALE

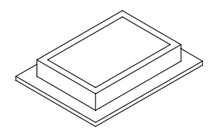


DRAIN CLEANOUT DETAIL 21 C04
PROJECT DETAIL
NTS

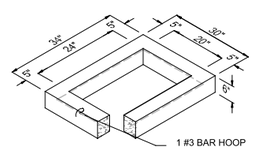


SECTION A-A

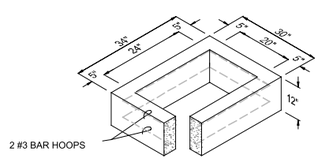
ROCK DISPERSAL PAD DETAIL 18 19
PROJECT DETAIL
NTS



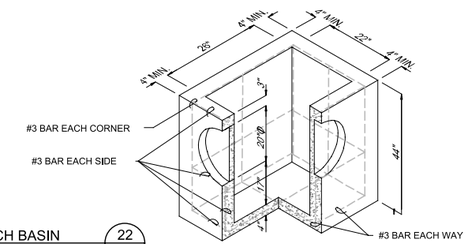
FRAME AND GRATE SEE STANDARD DETAILS D.11 - D.16



6" RISER SECTION



1. CATCH BASINS SHALL BE CONSTRUCTED IN ACCORDANCE WITH ASTM C478 (AASHTO M 199) & C890 UNLESS OTHERWISE SHOWN ON PLANS OR NOTED IN THE STANDARD SPECIFICATIONS.
2. AS AN ACCEPTABLE ALTERNATIVE TO REBAR, WELDED WIRE FABRIC HAVING A MIN. AREA OF 0.12 SQUARE INCHES PER FOOT MAY BE USED. WELDED WIRE FABRIC SHALL COMPLY TO ASTM A497 (AASHTO M 221). WIRE FABRIC SHALL NOT BE PLACED IN KNOCKOUTS.
3. ALL REINFORCED CAST-IN-PLACE CONCRETE SHALL BE CLASS 4000.
4. PRECAST BASES SHALL BE FURNISHED WITH CUTOUTS OR KNOCKOUTS. KNOCKOUTS SHALL HAVE A WALL THICKNESS OF 2" MIN. ALL PIPE SHALL BE INSTALLED IN FACTORY PROVIDED KNOCKOUTS. UNUSED KNOCKOUTS NEED NOT BE GROUTED IF WALL IS LEFT INTACT.
5. KNOCKOUT OR CUTOUT HOLE SIZE IS EQUAL TO PIPE OUTER DIAM. PLUS CATCH BASIN WALL THICKNESS.
6. ROUND KNOCKOUTS MAY BE ON ALL 4 SIDES, WITH MAX. DIAM. OF 20". KNOCKOUTS MAY BE EITHER ROUND OR "D" SHAPE.
7. THE MAX. DEPTH FROM THE FINISHED GRADE TO THE PIPE INVERT IS 5'-0".
8. THE TAPER ON THE SIDES OF THE PRECAST BASE SECTION AND RISER SECTION SHALL NOT EXCEED 1/2"/FT.
9. CATCH BASIN FRAME AND GRATE SHALL BE IN ACCORDANCE WITH STANDARD SPECIFICATIONS. MATING SURFACES SHALL BE FINISHED TO ASSURE NON-ROCKING FIT WITH ANY COVER POSITION.
10. FRAME AND GRATE MAY BE INSTALLED WITH FLANGE DOWN OR CAST INTO RISER.
11. EDGE OF RISER OR BRICK SHALL NOT BE MORE THAN 2" FROM VERTICAL EDGE OF CATCH BASIN WALL.



PRECAST BASE SECTION
(MEASUREMENT AT THE TOP OF THE BASE)

TYPE 1 CATCH BASIN 22 C04
NOT TO SCALE

No.	DATE	BY	REVISION

LEED® AP
LEED ACCREDITED PROFESSIONAL® & THE RELATED ACRONYM, & THE LEGACY LEED AP LOGO ARE TRADEMARKS OWNED BY THE U.S. GREEN BUILDING COUNCIL & ARE USED BY PERMISSION. LEED® IS A REGISTERED MARK OF THE GREEN BUILDING CERTIFICATION INSTITUTE.

DCG civil structural
P.O. Box 1132
Freeland, WA 98249
P: 360.331.4131
F: 360.331.1131
www.dcgengr.com

CALL 811
2 BUSINESS DAYS
BEFORE YOU DIG
(UNDERGROUND UTILITY LOCATIONS ARE APPROX.)

ROBERT L. BENSON
STATE OF WASHINGTON
49094
REGISTERED PROFESSIONAL ENGINEER
Robert L. Benson
11/7/2022

BASE MAP/TOPOGRAPHY PROVIDED BY OTHERS. DCG CANNOT BE HELD LIABLE FOR ACCURACY. CONTRACTOR SHALL FIELD VERIFY GRADES, UTILITIES, & ALL OTHER EX FEATURES & CONDITIONS. IF CONDITIONS ARE NOT AS SHOWN &/OR PLANS CANNOT BE CONSTRUCTED AS SHOWN, CONTACT DCG PRIOR TO CONSTRUCTION.

OWNER: CASCADIA WATER
PO BOX 549
FREELAND, WA 98249

PROJECT: W&B WATERWORKS 1
WELL SITE IMPROVEMENTS
DETAILS

PROJ. MANAGER:	RLB
DESIGNED BY:	SD/KK/RLB
DRAWN BY:	JS
CHECKED BY:	JMT
SCALE:	AS SHOWN
DATE: 11/7/2022	REV.: -
	SHEET 16 OF 16

SHEET NUMBER
C16

CAD FILE NUMBER: P:\CLIENTS\WATER\CASCADIA\WATER SYSTEM\W&B WATERWORKS\PROJECTS\WELL SITE IMPROVEMENTS\DWG\DRAWINGS\W&B WATERWORKS WELL SITE IMPROVEMENTS_20.DWG
LAST MODIFIED BY: ROBERT - SAVE DATE: 11/4/2022 11:28 AM - SHEET SET: W& WATERWORKS WELL SITE IMPROVEMENTS - ORIGINAL SHEET SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)
AUTOCAD VERSION: CIVIL 3D 2018