November 2023
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

ANCHOR QEA

Task 1 Summary Memorandum – Evaluation of Existing Sun Vista/Sunlight Beach Homeowner’s Association Water System

Prepared for:
Sun Vista/Sunlight Beach Homeowner’s Association

Executive Summary

The following memorandum summarizes the results of Task 1 of the Sun Vista/Sunlight Beach Water Consolidation Feasibility Study (Water Consolidation Feasibility Study) completed for the Sun Vista/Sunlight Beach Homeowner's Association (SV-SLB HOA) Water System (DOH Water System ID 85160). Task 1 represents the first step towards completing a Water Consolidation Feasibility Study funded through a grant provided by the Washington State Department of Health (DOH). The Task 1 work included an evaluation of the existing SV-SLB HOA Water System and the Sunlight Beach Water Association (SBWA) Water System (DOH Water System ID 85270). The purpose of this task was to evaluate the existing water systems and identify improvements that would be needed to maintain adequate water system operations and level of service if the water systems remained in their current configurations with existing water supply and storage facilities at their present locations.

The following is a summary of some of the key findings and recommendations for the SV-SLB HOA Water System summarized in this Task 1 Summary Memorandum:

- The existing water system is supplied by two wells. The wells are located in the SV-SLB HOA pump house located north of Sunlight Beach Road on Old Henry Lane. The well sources deliver up to a maximum of 113 gpm to the SV-SLB HOA Water System.
- Water is pumped from the wells directly to the SV-SLB water storage tanks. There are three water storage tanks with total storage capacity of 115,000 gallons located on the north side of Sunlight Beach Road on an easement with the Kowhles family property.
- A booster pump station delivers water from storage to a pressure system that serves the highest services in the system, on Sun Vista Circle and on Dassel Street.
- Adequate source, pumping, and storage capacity exist to accommodate existing and projected water system demands through the anticipated buildout condition.
- The SV-SLB HOA Water System provides fire protection through a series of hydrants along Sunlight Beach Road, at Lincoln Street, at Dassel Street, and on Sun Vista Circle. The system does not have capacity to provide 500 gpm fire flow at the highest hydrants on Dassel Street and on Sun Vista Circle.
- The SV-SLB HOA Water System currently has enough distribution pipe capacity to convey water from the wells and storage tanks to SV-SLB HOA members for use while maintaining adequate pressure in the system at all SV-SLB HOA member water service meters. However, marginal to low pressures have been observed at services on Lincoln Street.
- The system currently supplies water that meets DOH water quality standards. However, there is a risk of contamination from nitrates/microbials from anticipated development of septic systems on property upslope of the existing SV-SLB HOA water supply wells. There is also risk of contamination from sea water intrusion due to surface flooding during high tide events.

- These risks are sufficiently credible to recommend that affirmative actions be taken to protect the SV-SLB HOA water supply in the future. A prudent alternative will be to pursue construction of wells at a new location that is upslope of these potential contamination risks.
- A model developed by DOH was used by SV-SLB HOA to evaluate the potential for nitrate contamination that will result from development of septic systems upslope of the existing groundwater wells. An independent review of model methodology was completed by Anchor QEA as part of this task. Some adjustments are recommended, but Anchor, QEA believes that these changes do not appear to warrant a change in the conclusion that the potential development of 10 to15 additional septic systems upslope of the existing wells could increase nitrate levels above allowable levels subject to the potential impact of other factors, such as semi-confining soil conditions and aquifer characteristics, which are largely unknown.
- Anchor QEA agrees that seawater intrusion from long-term increases in seawater levels and the potential for upconing both appear to be low risks considering the groundwater levels and current levels of chloride. The SV-SLB HOA wells do have a higher risk of being flooded during extreme high tides (king tides plus low atmospheric pressures plus storm surges). Flooding can damage facilities and would likely require flushing and sanitizing the water system which would result in disruption of the water supply. A "do-nothing" approach is not advisable.
- It is recommended that new wells be considered in an area with reduced contamination risks. The existing wells could continue to be used to provide water in peak demand periods and to mix with water from a new well to reduce water contamination levels.
- Several contributing factors were identified, such as the presence (or consistency) of a semi-confining soil layer and groundwater flow direction, where the current information available is not adequate to make more definitive assessments of contamination risk levels.
- Several components of the SV-SLB HOA water system are aging and will likely require upgrade or replacement within the next 20 years to ensure that the SV-SLB HOA can maintain adequate water system operations and level of service into the future. These include some pipelines, booster pumps, the pressure tank at the booster pumps, the emergency generator, customer service meters, and iron and manganese filter materials.
- Connection of Lincoln Street to the pressure system should be considered if low pressures at customer services persist.
- Several infrastructure replacement and upgrade projects are recommended with associated costs over the next 6 to 20 years. The planning level total costs (in 2023 dollars) were estimated at just over $900,000. Costs for replacing or relocating wells will be evaluated in more detail as part of Tasks 2 and 3.
- A GIS database was generated for existing SV-SLB Water System facilities that will be invaluable in planning future SV-SLB HOA system improvements.

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ANCHOR QEA

Memorandum

December 4, 2023

To: Ed Sheets, John Lovie, Sun Vista/Sunlight Beach Homeowner's Association

From: David Rice, PE; Bob Montgomery, PE; and Josh Sexton, PE, Anchor QEA, LLC

cc: Carol Russo, Cliff Slade, Sunlight Beach Water Association

Re: Sun Vista/Sunlight Beach Water Consolidation Feasibility Study
Task 1: Evaluation of Existing Sun Vista/Sunlight Beach Homeowner's Association Water System

Anchor QEA, LLC, is pleased to present this memorandum summarizing the results of Task 1 of the Sun Vista/Sunlight Beach Water Consolidation Feasibility Study (Water Consolidation Feasibility Study). Task 1 included an evaluation of the existing Sun Vista/Sunlight Beach Homeowner's Association (SV-SLB HOA) and the Sunlight Beach Water Association (SBWA) water systems. This memorandum summarizes the evaluation of the existing SV-SLB HOA Water System. A separate memorandum has been prepared to summarize the evaluation of the existing SBWA Water System. The Task 1 work was completed under contract with the SV-SLB HOA on behalf of a planning committee comprised of representatives of both water systems.

The Washington State Department of Health (DOH) Drinking Water State Revolving Fund (DWSRF) Consolidation Feasibility Grant program was designed to promote consolidation of small Group A water systems into larger entities to improve the management of the water systems and the safety of the drinking water they distribute to the public. The SV-SLB HOA secured a $50,000 grant from the program and entered into an agreement with DOH (Contract CBO27656) for grant funding to complete a feasibility study that will evaluate the potential for consolidating the SV-SLB HOA Water System (DOH Water System ID 85160) with the SBWA Water System (DOH Water System ID 85270). Anchor QEA is an engineering and environmental consulting firm based in Seattle, Washington, and was selected by SV-SLB HOA to complete the Water Consolidation Feasibility Study.

The DOH grant does not require water systems to consolidate. The grant just funds a study that presents consolidation as a potential alternative. Any decision to relocate wells or other facilities would require an affirmative vote of the membership of the SV-SLB HOA water system. A decision to consolidate water systems would require an affirmative vote by the members of both the SV-SLB HOA and SBWA water systems. The study being conducted under the DOH grant will give the two water systems additional information on the options available so that the members of the SV-SLB HOA and the SBWA can make informed decisions about the future of their water systems.

Introduction

Task Scope of Work

Task 1 represents the first step toward completing the Water Consolidation Feasibility Study and included an evaluation of each of the water systems being considered for consolidation. The scope of work for Task 1 included the following:

- Collection and review of pertinent background information on the SV-SLB HOA Water System, including the *SV-SLB Small Water System Management Plan* (SV-SLB HOA 2013), water production and use records, related analysis and calculations, water system mapping, and other reports.
- Participation in kick-off meetings and a site visit. An initial kick-off call was held in May 2023. That was followed by a meeting and site visit, where Anchor QEA's project manager toured water system facilities with the SV-SLB HOA/SBWA planning committee.
- Creation of a system inventory and maps of existing water system facilities in ArcGIS, a geographic information systems (GIS) software package designed to generate maps with data attached to key map features. The map figures presented with this memorandum were generated in ArcGIS and represent some of the information incorporated into the GIS-based water system inventory created for the SV-SLB HOA Water System.
- Evaluation and forecasting of water demands. Well production and metered customer water consumption records were reviewed and evaluated as summarized in this memorandum. The data were then used to quantify existing and future water system demands.
- Evaluation of the existing SV-SLB HOA Water System. The water system was evaluated as follows:
  - Well source, storage, and pumping capacity were evaluated, according to the guidelines provided in the *DOH Water System Design Manual* (DOH 2020).
  - Hydraulic analysis was performed using a hydraulic model created to simulate hydraulic conditions in the SV-SLB HOA Water System.
  - Water deficiencies were identified based on the capacity and hydraulic analyses.
  - Water quality data were reviewed.
  - An independent assessment was completed of the analysis outlined in the *Sun Vista/Sunlight Beach HOA Wellhead Protection Area Report* (Golder Associates 2013).
  - Contamination risks from nitrates/microbials from upslope septic systems and seawater intrusion were assessed based on the background information collected.
  - The potential impact of on-site septic systems proposed for the upslope Kohwles development site was reviewed based on the hydrogeologic information and nitrate transport calculations completed using the DOH Level 1 nitrate balance spreadsheet.
  - The Island County hydrogeologist was contacted to discuss the potential sources of contamination and water quality concerns.

- An independent assessment was completed of potential changes in treatment that may be required in the future to continue to provide water of adequate quality from existing groundwater wells.

- Based on the deficiencies identified, a planning level (order of magnitude) opinion of probable cost was developed to assess costs associated with improvements that are recommended to maintain the water system in its current configuration with existing water supply and storage facilities at their present locations.
- This work is summarized in this memorandum.

Purpose

The purpose of this study is to evaluate the existing SV-SLB HOA Water System to identify improvements that would need to be made to maintain adequate water system operations and level of service if the water system remains in its current configuration with existing water supply and storage facilities at their present locations.

Water System Inventory

Task 1 of the Water Consolidation Feasibility Study included creation of an inventory and maps of existing water system facilities in ArcGIS, a geographic information systems (GIS) software package designed to generate maps with data attached to key map features. The map figures presented in with this memorandum were generated in ArcGIS and present some of the information incorporated into the GIS-based water system inventory created for the SV-SLB HOA Water System. The information presented in the following paragraphs has been attached to the elements of the system inventory map created in ArcGIS. The full water system inventory is also included as Attachment A.

The SV-SLB HOA Water System is located on Whidbey Island in a rural residential area north and east of Useless Bay. The system serves properties along Sunlight Beach and within the Sun Vista Development, as shown in Figure 1. The water system's service area and infrastructure overlap with the service area and water system infrastructure operated by the SBWA. The water system's service area also overlaps with the water system that serves Olympic Marine View Divisions 1 and 2. The SV-SLB HOA Water System comprises the following key pieces of infrastructure, shown in Figure 2:

Wells

The SV-SLB HOA Water System has two wells, as summarized in Table 1. Both wells are operational. Well 1 (Source S01) is the primary well, but both wells are used to supply water to the system. Well 2 (Source S02) is also active and operational. The combined wells operate as S03. An intertie (S04) with an isolation valve connects the SV-SLB HOA Water System with the SBWA Water System. The intertie is only opened when supply to one of the systems is interrupted.

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Figure 1
Location Map
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

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Figure 2
Existing Water System – Sun Vista/Sunlight Beach Homeowner's Association
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Table 1
SV-SLB HOA Wells

Well	Source	Well Number	Well Size (inches)	Well Depth (feet)	Capacity (gpm)	Year Installed	Reported Condition
1	S01	AGA833	8	30	35	1942[1]	Active, Good
2	S02	AGA832	8	50	78	1992	Active Good

Note:
1. Well 1 was constructed in 1947 and rebuilt to its current depth in 1992.
gpm: gallon per minute

Both wells, associated pipes, fittings, and controls are located in a concrete block pump house building located at 6097 Old Henry Lane, just north of the well house owned and operated by the SBWA Water System. The well sources are each chlorinated at the wellhead via sodium hypochlorite injection. Chlorinated well water is then filtered to remove iron and manganese from the water using an ATEC Systems iron and manganese removal system consisting of filter material in three pressure tanks. The filters are backwashed, as recommended by the ATEC Systems. Backwash water is discharged into septic tanks buried adjacent to the building. Wastewater from the septic system then discharges via a drain pipe to a marsh west of Old Henry Lane.

Storage Tanks

The SV-SLB HOA Water System includes three reinforced concrete water storage tanks with a total storage capacity of 115,000 gallons. The tanks are located on an easement the SV-SLB HOA Water System manages within a larger parcel owned by the Kowhles family adjacent to Sunlight Beach Road. The storage tanks include a 7,200-gallon tank constructed when the system was originally built. A second storage tank with a capacity 55,000 gallons was added more than 40 years ago. A 52,800-gallon tank was then constructed in 2008, as summarized in Table 2.

Table 2
SV-SLB HOA Storage Tanks

Tanks	Shape	Dimensions (feet)	Capacity (gallons)	Bottom Elevation (feet)	Overflow Elevation (feet)	Year Installed	Reported Condition[3]
1	Octagonal	Unknown	7,200	Unknown	108[2]	Unknown	Good
2	Circular	26 (diam.)	55,000	94[1]	108[2]	Unknown	Good
3	Circular	30 (diam.)	52,800	98[1]	108[2]	2008	Good

Note:
1. The bottom elevation is approximate. Tank 3 is taller than the other two tanks and the bottom of the tank is lower in elevation. The bottom of Tank 1 is buried.
2. The overflow elevation is approximate. The tops of the tanks are approximately equal. Information provided by SV-SLB HOA indicates that the top of the roof slab over Tank 2 is at an elevation of 109.7 feet. The overflow is at least 18 inches below the top of the roof slab over the tank.
3. The exterior condition was observed, but the tanks have not been inspected and the condition has not been confirmed.
diam.: diameter

Booster Pump Station

A booster pump station is located adjacent to Tank 2. The pump station delivers water from the tanks to the highest parcels in the system, including parcels on Sun Vista Circle and parcels along the upper end of Sunlight Beach Road and Dassel Street. The booster pump station includes four 5-horsepower end-suction centrifugal pumps that are configured in parallel and operate to boost the pressure while supplying water on demand to the parcels served through the pump station. A hydropneumatic pressure tank exterior to the booster pump station helps control pump operation and provides a buffer between the water delivered by the pump station and the demand from the lots served through the pump station. Each pump has the capacity to supply the full water demands of the parcels that are served through the pump station.

Pipelines

The water distribution system primarily consists of the following pipelines:

- A 4-inch PVC pipeline conveys water from the wells to the tank site. The pipeline crosses property owned by the Kowhles family in an easement to Sunlight Beach Road and then runs east along Sunlight Beach Road to the tank site.
- The tank and booster station site include several pipelines that convey water from the well discharge line to the tanks, from the tanks to a "gravity" main, from the tanks to the booster pump station, and from the booster pump station to the "pressure" main.
- An 8-inch PVC "gravity" main pipeline conveys water from the tank site all the way down Sunlight Beach Road to the furthest west user on Sunlight Beach. This pipeline was constructed as part of a major rebuild of the system that was completed in 1995 to 1996.
- A 6-inch PVC "pressure" main line conveys water from the booster pump station to a tee near the intersection of Sunlight Beach Road and Dassel Street.
- An 8-inch PVC "pressure" main conveys water north from Sunlight Beach Road and Dassel Street to the Sun Vista Development. The pipeline crosses property owned by the Kowhles family in an easement.
- A 3-inch PVC "pressure" loop conveys water to parcels on Sun Vista Circle.
- A 6-inch PVC "pressure" pipe that reduces to a 4-inch PVC pipe extends south from Sunlight Beach Road to parcels along Dassel Street.
- A 6-inch PVC "gravity" pipe that reduces to 4-inch PVC pipe conveys water from the 8-inch "gravity" main in Sunlight Beach Road south to parcels along Lincoln Street.
- Two relatively short 2-inch PVC "gravity" pipes also convey water from the 8-inch "gravity" main in Sunlight Beach Road to parcels south of Sunlight Beach Road.
- When the "gravity" main in Sunlight Beach Road was reconstructed in 1995 to 1996, hydrants were added to provide fire flow. There are seven total hydrants, with the furthest east hydrant located near the southwest corner of Dassel Street and Sunlight Beach Road and the furthest west hydrant located near Sunlight Beach Lot 31.

- Customer service meters were also installed when the system was upgraded in 1995 to 1996. SV-SLB has indicated that they have replaced a few meters that have failed, but the majority of the meters are still in place from when they were installed nearly 30 years ago.

Water Use and Projected Water Demands

As an initial step in evaluating the SV-SLB HOA Water System, Anchor QEA reviewed existing water use and projected water demands for the system. Existing and projected water demands were then used to evaluate the capacity of the system and identify improvements needed to address existing deficiencies and accommodate future growth.

Existing Service Area

Service Area and Land Use

The SV-SLB HOA Water System serves an area that primarily consists of single-family residential parcels in Island County zoned rural residential. Land use planning for the SV-SLB HOA is governed by *Island County Comprehensive Plan* (Island County 2016). The service area includes a total of approximately 169 single-family residences located along Sunlight Beach Road, Sun Vista Circle, Dossel Street, and Lincoln Street. As shown in Figure 2, the SV-SLB HOA service area and infrastructure overlap with the service area and water system operated by the SBWA. The SV-SLB HOA service area also overlaps with the service area for the water system that serves Olympic Marine View Divisions 1 and 2.

Service Connections

The SV-SLB HOA Water System currently has 169 active single-family residential service connections. Each service connection serves one single-family residential parcel.

Existing Water Use and Water Demands

Water Use

Table 3 summarizes water consumption metered by SV-SLB at customer services from 2009 through 2017. Total annual consumption ranged from 5,378,202 gallons (16.50 acre-feet) in 2010 to 7,037,277 gallons (21.59 acre-feet) in 2017. The average annual consumption from 2009 through 2017 was 6,212,878 gallons (19.07 acre-feet). Annual consumption was below the average from 2009 through 2013, but water use increased in 2014 and 2015, likely due to drier summertime weather. Metered water consumption was not available for 2018 through 2022, but that data will be obtained from SV-SLB HOA’s water system manager and these numbers will be extended prior to completing the final Water Consolidation Feasibility Study.

Table 3
Metered Water Consumption

Year	Total (gallons)	Total (acre-feet)	Average (gpd)
2009	5,994,868	18.40	16,424.3
2010	5,378,202	16.50	14,734.8
2011	5,725,596	17.57	15,686.6
2012	6,091,413	18.69	16,643.2
2013	6,189,289	18.99	16,957.0
2014	6,577,111	20.18	18,019.5
2015	6,602,880	20.26	18,090.1
2016	6,319,365	19.39	17,266.0
2017	7,037,177	21.59	19,279.9

Note:
gpd: gallon per day

Water Supply

Table 4 summarizes well production metered by SV-SLB HOA on the well discharge line from 2009 through 2022. Total annual well production ranged from 7,459,131 gallons (22.89 acre-feet) in 2011 to 11,247,751 gallons (34.52 acre-feet) in 2009. The annual average well production from 2009 through 2017 was 6,212,878 gallons (25,96 acre-feet).

Table 4
Metered Water Production

Year	Total (gallons)	Total (acre-feet)	Average (gpd)
2009	11,247,751	34.52	30,815.8
2010	8,255,676	25.33	22,618.3
2011	7,459,131	22.89	20,436.0
2012	7,846,071	24.08	21,437.4
2013	7,644,560	23.46	20,944.0
2014	7,583,822	23.27	20,777.6
2015	8,712,405	26.74	23,869.6
2016	8,493,689	26.06	23,206.8
2017	8,879,732	27.25	24,328.0
2018	7,524,880	23.09	20,616.1
2019	6,983,804	21.43	19,133.7

Year	Total (gallons)	Total (acre-feet)	Average (gpd)
2020	7,090,865	21.76	19,373.9
2021	7,401,927	22.71	20,279.3
2022	7,137,033	21.90	19,553.5

Note:
gpd: gallon per day

Equivalent Residential Units

DOH recommends evaluating water use and estimating water demand based on Equivalent Residential Units (ERUs). An ERU equates demand for non-single-family residential use to the average demand generated by a single-family residence. For most small systems like SV-SLB HOA that serve exclusively single-family residential residences, the number of ERUs will be equal to the number of service connections. The SV-SLB HOA Water System currently has 169 active service connections. Of that total, the SV-SLB HOA estimates that 79, or 47%, are transient connections, meaning that those connections serve residences that are used as secondary residences or vacation homes. SV-SLB anticipates that the number of full-time residents will increase in the future as more part-time residents retires and become full-time residents.

The average metered customer water use for all connections was approximately 104 gallons per day (gpd) per ERU from 2009 through 2017. The average metered well production was approximately 135 gpd per ERU from 2009 through 2022.

Distribution System Leakage

The Water Use Efficiency (WUE) Rule, adopted by DOH in 2007, uses the terms “authorized consumption” and “distribution system leakage” (DSL). Authorized consumption includes water use that is billed and/or metered by the water system, as well as other authorized uses such as maintenance flushing, system cleaning, firefighting, etc., as long as the volumes used are tracked. All other water produced by a water system that is not tracked or metered as authorized consumption is considered DSL. DSL typically consists of water lost through system leaks, untracked flushing or hydrant use, and unauthorized use. It can also reflect inconsistencies or inaccuracies in metering between source and customer meters.

Table 5 provides a comparison of annual well production metered on the discharge pipe from the groundwater wells with authorized use measured at customer meters and tracked by the SV-SLB HOA for the period of 2009 through 2022. In addition to authorized use at customer meters, the SV-SLB HOA tracks backwash water use and some other authorized uses. Figure 3 includes a graph comparing metered water production with metered customer water consumption. The data indicate that DSL in the SV-SLB HOA Water System peaked at 34.2% in 2009. DSL was as low as 1.5% in 2020 and was less than 10% in 2013, 2014, and 2018-2023. DSL averaged 11.1% from 2009 through 2022.

The WUE Rule requires that most water systems reduce DSL to less than 10% of metered water production. The SV-SLB HOA has actively been reviewing the system for more than 10 years to detect and repair leaks. The SV-SLB HOA has also replaced customer meters to ensure that customer meters are reading correctly. One of the goals of the ongoing SV-SLB Consolidation Study and subsequent planning efforts will be to develop recommendations for reducing DSL in the SV-SLB HOA distribution system to consistently meet WUE Rule requirements.

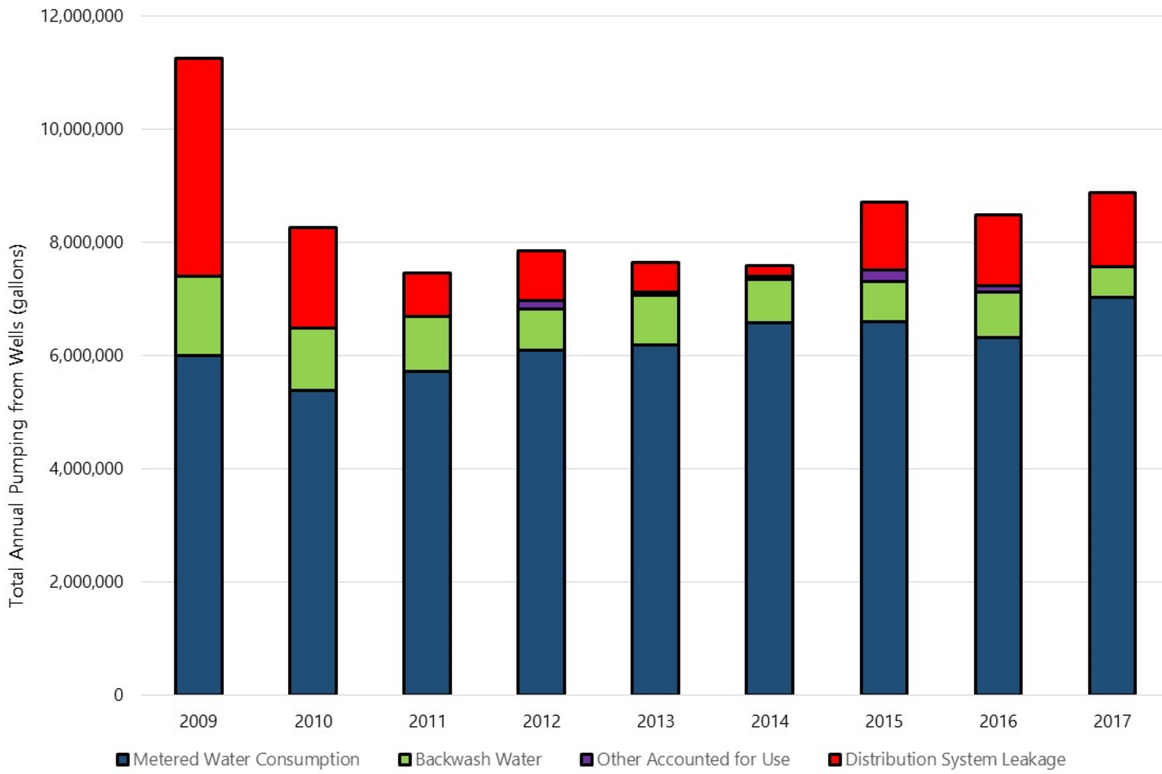
Table 5
SV-SLB Distribution System Leakage

	Water Produced		Metered Consumption (Authorized Use)		Other Authorized Use		DSL[1]	
Year	**gallons**	**gpd/ERU**	**gallons**	**gpd/ERU**	**gallons**	**gpd/ERU**	**gallons**	**%**
2009	11,247,751	189.1	5,994,868	100.8	1,406,300	23.6	3,846,582	34.2%
2010	8,255,676	138.8	5,378,202	90.4	1,106,156	18.6	1,771,317	21.5%
2011	7,459,131	125.4	5,725,596	96.2	962,500	16.2	771,035	10.3%
2012	7,846,071	131.5	6,091,413	102.1	890,500	14.9	864,158	11.0%
2013	7,644,560	128.5	6,189,289	104.0	928,600	15.6	526,671	6.9%
2014	7,583,822	127.5	6,577,111	110.5	821,000	13.8	185,711	2.4%
2015	8,712,405	146.4	6,602,880	111.0	910,500	15.3	1,199,025	13.8%
2016	8,493,689	142.4	6,319,365	105.9	919,800	15.4	1,254,524	14.8%
2017	8,879,732	149.3	7,037,177	118.3	526,585	8.9	1,315,971	14.8%
2018	7,524,880	126.5	Note 2	Note 2	Note 2	Note 2	443,494	5.9%
2019	6,983,804	117.4	Note 2	Note 2	Note 2	Note 2	162,704	2.3%
2020	7,090,865	118.9	Note 2	Note 2	Note 2	Note 2	107,061	1.5%
2021	7,401,927	124.4	Note 2	Note 2	Note 2	Note 2	549,423	7.4%
2022	7,137,033	120.0	Note 2	Note 2	Note 2	Note 2	621,730	8.7%

Notes:

1. DSL = Water Supplied – Authorized Use
2. For 2018 through 2022, data was accessed from annual Water Use Efficiency calculations on file with DOH. Total production, total authorized use, and DSL were reported. However, total authorized use was not broken down into metered consumption and other authorized use.

Figure 3
SV-SLB HOA Metered Water Production, Consumption, and DSL



Existing Water Demand

The *DOH Water System Design Manual* provides guidelines for estimating water demands. Where possible, demands are estimated based on actual water use and water supply data. Three levels of water demand are typically used for evaluating water system capacity and planning for future improvements, as follows:

Average Daily Demand

Average daily demand (ADD) represents the average daily water demand generated by the system throughout the year. It is recommended that water demands used for evaluating system capacity be based on water supplied to the system to account for DSL. The total metered water production ranged from 117.4 gpd per ERU in 2019 to 189.1 gpd per ERU in 2009. The average metered water production was 134.7 gpd per ERU from 2009 through 2022. To provide a conservative basis for evaluating the SV-SLB HOA Water System, it is recommended that system demand be estimated based on the following Equation 1:

Equation 1

$$\text{ADD} = 150 \text{ gpd per ERU}$$

where:
ADD = average daily demand
ERU = equivalent residential unit
gpd = gallon per day

Maximum Daily Demand

Maximum daily demand (MDD) represents the water demand on the day of maximum water use during the year. MDD is estimated by multiplying the ADD by a peaking factor, as follows in Equation 2:

Equation 2

$$\text{MDD} = \text{ADD x Peaking Factor}$$

where:
ADD = average daily demand
MDD = maximum daily demand

The peaking factor, where possible, is selected based on a comparison of daily water production meter records to average annual metered water production. Daily water production records from 2012 through 2017 were reviewed to compare the metered water production on the day of peak use during a given year with the average annual water production for that year. The water production on the day of peak use was, on average, 2.5 times the annual average demand. Based on the evaluation of daily data provided by the SV-SLB HOA, use of an MDD peaking factor of 2.5 is recommended for estimating MDD for the existing SV-SLB HOA Water System, as shown in Equation 3:

Equation 3

$$\text{MDD} = 150 \text{ gpd per ERU x } 2.5 = 375 \text{ gpd per ERU}$$

where:
ERU = equivalent residential unit
gpd = gallon per day
MDD = maximum daily demand

Table 6
Maximum Daily Water Production vs. Average Annual Water Production

Year	Peak Daily Water Production (gpd)	Average Annual Water Production (gpd)	Peaking Factor
2012	21,437.4	53,863.2	2.5
2013	20,944.0	51,444.3	2.5
2014	20,777.6	41,270.2	2.0
2015	23,869.6	51,656.3	2.2
2016	23,206.8	54,274.7	2.3
2017	24,328.0	87,378.1	3.6

Peak Hourly Demand

Peak hourly demand (PHD) represents the demand during the peak hour of water use during the year. In the absence of data that accurately monitor hourly fluctuations in demand, Equation 5-1 from the *DOH Water System Design Manual* is used to estimate PHD. For a system with between 100 and 250 ERUs, the equation is applied as follows in Equation 4:

Equation 4

$$\mathrm{PHD} = \left(\frac{\mathrm{MDD}}{1{,}440}\right)\big((c)(N) + F\big) + 18$$

where:

C	=	2.0
F	=	75
MDD	=	maximum daily demand (in gallons per day per ERU)
N	=	number of ERUs
PHD	=	peak hourly demand (in gallons per minute)

Using the value estimated for existing MDD and the estimated number of existing ERUs, Equation 4 results in the following existing PHD in Equation 5:

Equation 5

$$\text{PHD} = \left(\frac{375}{1{,}440}\right)\big((2.0)(169) + 75\big) + 18 = 125.6 \text{ gpm}$$

where:

gpm = gallons per minute

PHD = peak hourly demand

Existing Demand Summary

Table 7 summarizes the existing water demand estimated for the SV-SLB HOA Water System.

Table 7
Summary of Existing Water Demand

Demand Level	Existing Water Demand (169 ERUs)		
	gpd/ERU	gpd	gpm
ADD	150	25,350	17.6
MDD	375	63,375	44.0
PHD	NA	NA	125.6

Notes
ADD: average daily demand
ERU: equivalent residential units
gpd: gallon per day
NA: not applicable
gpm: gallons per minute
MDD: maximum daily demand
PHD: peak hourly demand

Future Water Service Area

The SV-SLB HOA Water Service Area is not anticipated to change in the future. The only development that is anticipated to occur within the service area is buildout of currently undeveloped parcels. As noted previously, the SV-SLB HOA Water System currently has 169 active service connections serving 169 residential parcels that represent 169 ERUs. There are approximately 19 undeveloped parcels within the SV-SLB HOA Water Service Area. Of the undeveloped parcels, only one is large enough be subdivided. That parcel is adjacent to SV-SLB HOA wells, storage tanks, and booster pump station, and is owned by the Kohlwes family. They have plans to develop 10 additional single-family parcels. This would result in the potential for 28 additional single-family parcels that could be served within the SV-SLB HOA Water Service Area. The SV-SLB HOA has reported that the water system is currently only approved to serve up to 194 ERUs. For the sake of conservatively estimating future water needs, it was assumed that all of parcels available within the service area would develop and be served at buildout, representing 28 additional services connections, which would increase the total number of service connections to 197 and the total ERUs served to 197. Of the 28 additional single-family residential parcels, it was assumed that half the parcels would develop within the next 6 years (by 2029) and the remaining parcels would be built out within the next 20 years (by 2043). Table 8 summarizes the anticipated growth in services connections and ERUs.

Projected Water Demands

A projection of future water demands is needed to evaluate system capacity to determine whether existing water supply, water storage, pumping, and distribution facilities have sufficient capacity to meet future needs. As outlined previously, an ADD of 150 gpd per ERU and an MDD of 375 gpd per ERU were estimated as a basis for estimating existing water demands based on metered water supply delivered to the SV-SLB HOA Water System. The SV-SLB HOA expects that the MDD will increase with the development of the Kohwles property, due to the size of the lots, which are typically larger than the lots currently served by the SV-SLB Water System, and the anticipated increased demand for outdoor water use. To conservatively estimate demands for future use, it is recommended that the peaking factor be increased to 2.8 for future MDD projections. The projected demands are summarized in Table 8.

Table 8
Summary of Existing and Projected Water Demands

		ADD			MDD			PHD
Year	ERUs	gpd/ERU	gpd	gpm	gpd/ERU	gpd	gpm	gpm
2023	169	150	25,350	17.6	375	63,375	44.0	125.6
2029	183	150	27,450	19.1	420	76,860	53.4	146.6
2043	197	150	29,550	20.5	420	82,740	57.5	154.8

Fire Flow Requirements

Fire flow requirements for the SV-SLB service area are governed by the *Island County Code (ICC), 13.03A, Water System and Fire Flow Standards* (Island County 1994). Minimum fire flows for new developments in Island County are listed in Table 9 and are outlined in the Code. The flows shown are in addition to requirements for normal domestic use. Based on the likely type of development that could occur within the SV-SLB HOA Water Service Area, it is anticipated that a minimum fire flow of 500 gpm would need to be available for a duration of 30 minutes to meet the Code requirements.

Since SV-SLB is an existing water system, it is not required to meet the current minimum standards for fire flow, repair or replacement of water system facilities, or addition of services outlined in the Code, so long as no expansion of service area is involved. However, the Code encourages water systems to adhere to the standards set forth in the Code to provide better public water service throughout Island County. SV-SLB's water distribution system currently has the capacity to deliver 500 gpm of fire flow for 30 minutes to all but the highest hydrants within the water system on Sun Vista Circle and at Dassel Street. The hydrants at Lincoln Street, Dassel Street, and on Sun Vista Circle are all marked with red to indicate to fire fighters that they may not deliver the required fire flow.

The original SV-SLB system was not designed to meet fire flow requirements or provide fire protection for the residences it serves. In 1995 to 1996, the gravity main that distributes water from the storage tanks to the system was upgraded to an 8-inch pipe with new hydrants capable of delivering fire protection. In 2008, additional storage was provided to ensure that adequate storage was available for fire protection and other emergencies. These additions have significantly improved the ability of the system to meet fire flow requirements.

Table 9
Minimum Fire Flow Requirements for Pierce County

Land Use	Minimum Fire Flow Required	
	Flow (gpm)	Duration (minutes)
Nine (9) or less lots and/or dwelling units, where all lots are greater than one (1) acre in size	No Fire Flow Required	
Planned residential developments of nine (9) or less lots and/or dwelling units, where the density, including open space, is greater than one (1) dwelling unit per acre	500	30
Nine (9) or less dwelling units and/or lots, where any lot is one (1) acre or less in size	500	30
Over nine (9) lots and/or dwelling units, where any lot is less than two and one-half (2½) acres	500	30
Commercial Development and Multifamily Residential	750	60
Industrial	1,000	60

Water System Analysis

The most recent criteria for transmission and distribution, storage, and booster pump facilities are specified in Washington Administrative Code (WAC) 246-290 and summarized in the DOH *Water System Design Manual*. It should be recognized that existing facilities may not meet all current DOH criteria because water systems are required to have greater capacity now than when the existing facilities were installed. The SV-SLB HOA strives to meet DOH criteria and uses the latest criteria when designing upgrades to the SV-SLB HOA Water System.

System Design Criteria

The criteria listed below are provided for design of new water distribution system facilities. It is recommended that they be designed to maintain the following minimum pressures at all points in the distribution system where service connections are allowed:

- 40 pounds per square inch (psi) during normal demand conditions
- 30 psi during PHD conditions

Compliance with the following criteria is also recommended when sizing new distribution pipelines:

- Pipelines must be sized to limit velocities to 8 feet per second (fps) during PHD conditions. To the extent possible, it is recommended that new pipelines be sized to limit velocities to 5 fps during PHD to limit pressure losses and the potential for high transient pressures.

Design criteria relating to sources of water supply include the following:

- Sources must be able to reliably provide enough water to meet the maximum demand that will be placed on the system.
- Equalizing storage may be provided so that the source water can be stored to supply daily peak demands that exceed the MDD.
- If equalizing storage capacity is not provided, then the source capacity should be sufficient to provide enough water to meet PHD.
- Where storage is provided to supply daily peaking of demand, DOH recommends that source capacity be provided such that the MDD can be supplied within 20 hours of pumping.

System Capacity Analysis

Source Capacity

The SV-SLB Water System is currently supplied through two active wells, as noted earlier in this memorandum. Well 1 (S01) has an estimated capacity of 35 gpm. Well 2 (S02) has an estimated capacity of 78 gpm. Both wells can be operated as S03 to deliver up to 113 gpm. The capacity of the wells is sufficient to deliver the existing MDD of 63,375 gpd with less than 20 hours of total pumping. The capacity of the wells is also sufficient to deliver the projected 20-year (2043) buildout MDD of 82,740 gpd with less than 20 hours of total pumping.

Storage Capacity

DOH storage requirements include five components:

1. **Operational Storage:** Allows for normal cycling on and off of well pumps under normal operating conditions
2. **Equalizing Storage:** Enables the system to meet periodic peaks in demand when demands on the system exceed the source capacity

3. **Standby Storage:** Ensures that adequate water supply exists during power failures and pump outages
4. **Fire Suppression Storage:** Ensures an adequate volume of water to fight fires
5. **Dead Storage:** Includes storage in a reservoir that is not usable

Storage requirements for the SV-SLB HOA Water System were calculated as described in the following paragraphs.

Operational Storage

Operational Storage varies according to pump settings. For the sake of estimating storage requirements, operating storage was assumed to be the top 2 feet of storage in the existing SV-SLB HOA water storage tanks. The top 2 feet of the active storage tanks were estimated to represent a total storage volume of 19,900 gallons.

Equalizing Storage

Equalizing storage is required when the source pumping capacity cannot meet peak demands on the system. The volume of equalizing storage is normally calculated by the following equation:

Equation 6

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

where:

ES	=	equalizing storage, in gallons
PHD	=	peak hourly demand, gpm
Q_S	=	source capacity, gpm (except emergency sources)
min	=	minutes

The active water supply wells deliver water directly to the SV-SLB HOA water storage tanks, as shown in Figure 2. The total source capacity of the active wells is approximately 113 gpm. The estimated PHD for the existing SV-SLB Water System is 126 gpm. The PHD for the SV-SLB Water System is projected to increase to 147 gpm by 2029 and 155 gpm by 2043. Based on these numbers, the total volume of equalizing storage needed to meet existing demands is estimated at 1,883 gallons. The equalizing storage needed to meet projected 2043 demands is 6,269 gallons.

Standby Storage

Standby storage volumes are typically calculated using the following equation for systems with only one source of water supply:

Equation 7 (for systems with multiple sources)

$$SB = 2(ADD) - 1440(Q_S)$$

where:

SB	=	standby storage, in gallons
ADD	=	average daily demand, in gallons
Q_S	=	sum of all source capacities, minus the actual installed capacity of the largest source that is continuously available to the system, in gpm

DOH recommends a minimum of at least 200 gpd per ERU. The SV-SLB has opted to target providing at least a full day of MDD for their water system, as shown in the following equation:

Equation 8 (used for SV-SLB system)

$$SB = MDD$$

where:

SB	=	standby storage, in gallons
ADD	=	average daily demand, in gallons

The volume estimated using this equation results in a larger volume for standby storage than what would normally be required by DOH and represents a conservative approach. Based on this equation, the standby storage (SB) required for existing demand conditions is estimated at 63,375 gallons. The SB required to meet 2043 demand conditions is 82,740 gallons.

Fire Suppression Storage

Fire flow requirements for the SV-SLB Water Service Area were outlined previously. The storage requirement for the minimum fire flow required would be 15,000 gallons, which is equal to the minimum fire flow required (500 gpm) multiplied by the duration (30 minutes).

Total Water Storage Required

The total water storage required for the SB-SLB HOA Water System was calculated as the sum of operating storage, equalizing storage, and the greater of standby storage and fire suppression storage. DOH allows for nesting of standby storage and fire suppression storage together, meaning that only the larger of the two volumes must be provided. Table 10 summarizes the overall results of the storage capacity analysis. The existing storage tanks have capacity (115,000 gallons) to meet both existing and projected (2043) water demand conditions.

Table 10
Total Storage Required

Year	Operating Storage (gallons)	Equalizing Storage (gallons)	SB (gallons)	Fire Suppression Storage (gallons)	Total Storage Required (gallons)
2023	19,900	1,883	63,375	15,000	85,158
2029	19,900	5,044	76,860	15,000	101,804
2043	19,900	6,269	82,740	15,000	108,909

Booster Pump Capacity

The highest parcels in the SV-SLB Water System are served through a booster pump station, as indicated earlier in this memorandum. It is our understanding that the pump station serves parcels on Sun Vista Circle, along the upper end of Sunlight Beach Road, and Dassel Street. The booster pump station includes four 5-horsepower end-suction centrifugal pumps that are configured in parallel and operate to boost the pressure while supplying water on demand to the parcels served through the pump station. The estimated capacity of these pumps has not been reported. However, based on the horsepower and the pumping head that would be required, it is estimated that each pump can deliver at least 100 gpm. There are four pumps that alternate operation and two or more pumps can operate and a time, if necessary. It is estimated that the pumps deliver water to approximately 73 of the 169 parcels served by the SV-SLB Water System. That number has potential to increase to 87 ERUs in the future with the addition of 10 single-family residences on the Kowhles property and four single-family residences on other vacant parcels. The booster pumps have sufficient capacity to deliver the PHD to these parcels, which is estimated at 54 gpm for 73 ERUs and 67 gpm for 87 ERUs. A hydropneumatic pressure tank exterior to the booster pump station helps control pump operation and provides a buffer between the water delivered by the pump station and the demand from the lots served through the pump station.

Overall Capacity

Overall system capacity was estimated in terms of the number of ERUs that can be served by existing water rights, well supply capacity, and storage capacity, as shown in Table 11. The analysis indicates that the storage tanks have the least additional capacity, in terms of ERUs. However, all components have more than enough capacity to meet existing and projected future demand conditions.

Table 11
Existing System Capacity in Terms of Potential ERUs Served

Component	Component Capacity	Existing ERUs Served	Additional Capacity Available (ERUs)	Total Capacity Available (ERUs)
Source Water Rights, Q_a	59.1 acre-feet	169	183	352[1]
Source Water Rights, Q_i	111 gpm	169	244	369[2]
Well Supply	113 gpm	169	181	313[3]
Storage	115,000 gallons	169	39	208[4]

Notes:

1. Represents the maximum ERUs that can be served by the annual water right at an ADD of 150 gpd per ERU.
2. Represents the maximum ERUs that can be served by the instantaneous water right limit, assuming that the total flow rate needs to supply an MDD of 420 gpd per ERU and replenish fire flow storage over 72 hours.
3. Represents the maximum ERUs that can be served with the existing active well capacity, assuming that the well capacity needs to supply an MDD of 420 GPD per ERU within 20 hours of pumping per day and replenish fire flow storage over 72 hours.
4. Represents the maximum ERUs that can be served with the existing storage capacity, assuming existing well capacity and booster pump capacity are unchanged.

Q_a: annual withdrawal limit specified by water right
Q_i: instantaneous withdrawal limit specified by water right

Hydraulic Analysis

Hydraulic analysis of the SV-SLB HOA Water System was performed using WaterCAD hydraulic modeling software from Bentley. WaterCAD is commonly used to model municipal water distribution systems and other pressurized water delivery systems. A WaterCAD model of the SV-SLB HOA Water System was created to evaluate hydraulic conditions, including system pressures and velocities, to determine whether the criteria set forth earlier in this memorandum can be met for a range of demand and flow conditions. The model was not calibrated. Calibration would require more time and effort than could be supported by the current water consolidation grant. The model does include both the SV-SLB HOA Water System and the SV-SLB HOA Water System, to facilitate evaluation of the potential consolidation of the two systems, which will be completed as a future task.

Scenarios

Hydraulic analysis was completed using a series of steady state model scenarios. A steady state model scenario simulates hydraulic conditions at a single point in time based on a set of model inputs. The scenarios were set up to simulate pressures, headlosses, and other hydraulic characteristics of system operation under ADD, MDD with fire flow, and PHD conditions. Table 12 summarizes the scenarios that were evaluated for the SV-SLB HOA Water System. It should be noted that the model was originally set up based on preliminary demand calculations that have been adjusted to updated assumptions about growth and a higher projected MDD, as suggested by the SV-SLB HOA. The updated demand numbers have not been incorporated into the hydraulic model yet. The results would not substantially change with these adjustments to demand. However, the model will be updated as part of Tasks 2 and 3 to reflect the latest demand projections.

Table 12
Hydraulic Analysis Scenarios

Type of Simulation	System	Demands	ERUs Served	Fire Flow	Source of Supply
Steady State	Existing	2023 ADD	169	None	Well 1, off Well 2, 78 gpm
Steady State	Existing	2023 MDD+FF	169	500 gpm	Well 1, off Well 2, off
Steady State	Existing	2023 PHD	169	None	Well 1, 35 gpm Well 2, 78 gpm
Steady State	Existing	2029 ADD	183	None	Well 1, off Well 2, 78 gpm
Steady State	Existing	2029 MDD+FF	183	500 gpm	Well 1, off Well 2, off
Steady State	Existing	2029 PHD	183	None	Well 1, 35 gpm Well 2, 78 gpm
Steady State	Existing	2043 ADD	197	None	Well 1, off Well 2, 78 gpm
Steady State	Existing	2043 MDD+FF	197	500 gpm	Well 1, off Well 2, off
Steady State	Existing	2043 PHD	197	None	Well 1, 35 gpm Well 2, 78 gpm

Results

The capacity analysis and hydraulic analysis results indicate the following:

- The SV-SLB HOA Water System has adequate source and storage capacity to meet existing and projected water demand conditions.
- The SV-SLB HOA Water System has capacity to supply a minimum fire flow of 500 gpm for a duration of 30 minutes at all hydrants except the highest hydrants located on Sun Vista Circle and on the corner of Sunlight Beach Road and Dassel Street.
- The water system model indicates that pressures on Lincoln Street, which includes the highest customer services not currently served through the booster pump station, would be marginal (30 to 40 psi during PHD), but would still meet DOH criteria. The SV-SLB has indicated that pressure on Lincoln Street do drop below 30 psi.

- Otherwise, the SV-SLB HOA Water System, as currently sized and configured, has adequate capacity to meet minimum delivery pressure and velocity criteria that were set forth earlier in this memorandum.

Results from the hydraulic analysis are included as Attachment B to this memorandum.

Water Quality and Groundwater Supply Analysis

The SV-SLB HOA requested that Anchor QEA perform an independent analysis of their groundwater well supplies to assess potential for contamination and adequacy of water supply as noted earlier in this memorandum. The following summarizes the results of this analysis:

Water Quality Monitoring

The SV-SLB HOA monitors the water system for potential contaminants as required by DOH. Water is sampled and tested for coliform bacteria, nitrate, lead and copper, disinfection by-products, inorganic chemicals, volatile organic compounds, and synthetic organic compounds on a regular basis, as required by DOH. These samples are collected at the well sources or from the distribution system. Table 12 summarizes the results of water quality monitoring from 2022. The SV-SLB samples and tests for bacterial and arsenic on a monthly basis. As noted previously, water produced at the wells is chlorinated and filtered through an iron and manganese removal system prior to being delivered to the system. These treatment facilities have proven effective at not only removing iron and manganese from the system, but also treating for arsenic. The SV-SLB did not report any exceedances of DOH maximum contaminant levels (MCLs) in 2022 or 2023. The most recent exceedance reported was an exceedance for arsenic in July 2021. This appears to be anomaly, because prior and subsequent samples showed no exceedance. No other exceedances have been reported in the last 10 years.

Table 13
Water Quality Monitoring Summary

Year	Date	Type of Test	Exceedance?	Sample No.	Sample Location
2022	12/31/22	PFAS	No	05301, 05302	Distribution System
	12/26/22	Microbial	No	85521	Distribution System
	12/02/22	Arsenic	No	81691	Source Wells (S03)
	11/07/22	Arsenic	No	76051	Source Wells (S03)
	11/03/22	Microbial	No	75160	Distribution System
	10/19/22	Microbial	No	71244	Distribution System
	10/14/22	Arsenic	No	70488	Source Wells (S03)
	09/28/22	Lead and Copper	No	Multiple	Distribution System

Year	Date	Type of Test	Exceedance?	Sample No.	Sample Location
	09/27/22	Arsenic	No	65590	Well No. 1 (S01)
	09/27/22	Lead and Copper	No	65638	Distribution System
	09/26/22	Microbial	No	64997	Distribution System
	09/23/22	Arsenic	No	65023	Source Wells (S03)
	8/24/22	Inorganics (Short)	No	56992	Source Wells (S03)
	8/17/22	Inorganics (Short)	No	24883	Source Wells (S03)
	08/03/22	Microbial	No	51053	Distribution System
	07/22/22	Arsenic	No	48348	Source Wells (S03)
	07/11/22	Microbial	No	43778	Distribution System
	06/10/22	Arsenic	No	36143	Source Wells (S03)
	06/09/22	Microbial	No	34745	Distribution System
	05/11/22	Microbial	No	29370	Distribution System
	05/06/22	Arsenic	No	28805	Source Wells (S03)
	04/21/22	Inorganics (Short)	No	24875	Source Wells (S03)
	04/21/22	Arsenic	No	25724	Source Wells (S03)
	04/05/22	Microbial	No	20933	Distribution System
	03/16/22	Arsenic	No	17026	Source Wells (S03)
	03/09/22	Microbial	No	15204	Distribution System
	02/23/22	Arsenic	No	12150	Source Wells (S03)
	02/07/22	Microbial	No	08361	Distribution System
	01/25/22	Arsenic	No	05853	Source Wells (S03)
	01/10/22	Microbial	No	02187	Distribution System

Review of Wellhead Protection Area Report

An independent review was performed of *Sun Vista/Sunlight Beach HOA Wellhead Protection Area Report* (Golder Associates 2013). Anchor QEA offers the following comments:

- The groundwater flow direction appears to be based a comparison of water levels at Well ABD-979 and Sun Vista Well 1. Well ABD-979 is located east of Sun Vista Well 1. Figure 1 of the report shows other wells located north and northeast of Sun Vista Well 1 and it appears they were not included in the assumption of flow direction because their static water level is lower than Well 1, indicating they are completed in a different water-bearing formation. However, the report also states that "The water-level elevation at each well was estimated using the depth to water reported on the well log and the land surface elevation estimated from a 10-meter digital elevation model of the area." The potential error in estimating land surface elevations (up to 30 feet) far exceeds the difference in water levels at wells other than

ABD-979 shown in Figure 1. This could affect their assumption of groundwater flow direction and the delineation of a WHPA.

- The *Wellhead Protection Plan for Sunlight Beach Water Association* (SBWA 2023a) was also reviewed and presents water-level elevations at nearby wells in Figure 2.2 of that report and indicates groundwater flow direction may be in a southwesterly direction and maybe perpendicular to the shoreline. That direction is much different than the assumed westerly flow direction in the Golder report. It is likely the WHPA for Sun Vista Well 1 is wider and extends northeast of the well.
- The analysis assumed a single well withdrawing water at the maximum instantaneous rate (Qi) of 111 gpm (179 acre-feet per year) for the associated water rights for Wells 1 and 2 (Certificate No. 4684; Permit No. 26066). While the maximum combined capacity of Wells 1 and 2 is estimated at 113 gpm, the average combined pumping rate of Wells 1 and 2 is much less than 111 gpm, which would reduce the distance of the times-of-travel and extent of those zones.
- Although the report did not specifically address the potential for additional septic fields immediately east of Well 1 associated with proposed development of single-family residences on the Kohlwes parcel, the parcel was within the mapped zones of the 1- and 5-year travel time. Golder addressed septic fields within those zones by stating "however, surface contamination in these areas could be considered low risk due to the presence of confining material (glacial till) overlying the aquifer east of the wells." The actual extent of glacial till and interface with a more permeable glacial outwash material needs to be confirmed as that would affect the potential for nitrate contamination of downgradient wells.
- The SV-SLB HOA Wellhead Protection Area report states "The WDOH Office of Drinking Water (ODW) Sentry Database indicates nitrate levels remaining relatively constant for the entire period of record, ranging from 1.4 to 2.3 milligrams per liter (mg/L) nitrate-N since 1995; the Safe Drinking Water Act (SDWA) indicates a maximum concentration for nitrate-N of 10 mg/L. No microbiological analyses are available for Well 1 or Well 2 which might identify potential bacterial contamination from septic systems. Aerial photographs dating to 1941 indicate historic cultivation in the fields east of the wells and within the WHPA (Attachment B), indicating the source of low-level nitrate may be from long-term surface application of fertilizers." It is our opinion that nitrate fertilizer applied decades ago would likely have already traveled through the groundwater system. The source of nitrate is probably more recent, perhaps from septic systems upgradient from the wells.
- The analytical methods used to determine the time of travel seem to be reasonable given the amount of data available. However, a range of potential groundwater flow directions should be used to develop a wider potential capture zone. The analysis would also be improved by more accurately measuring water-level elevations within the potential capture zone to improve the estimate of flow direction and hydraulic gradient of groundwater flow.

- Aquifer properties listed in the report (transmissivity, porosity, aquifer thickness) are field measurements or reasonable estimates.
- The report states, "Importantly, travel time boundaries do not include vertical travel times, which is additional time required for a contaminant to migrate from ground surface to the aquifer; this additional time provides for more response time if a contaminant is found near ground surface within the WHPA." This is an important point as the mapped zones of travel time are conservatively large.
- The report states, "Dry sediment and clay was apparent during construction of Well 2 to a depth of approximately 25 ft bgs, indicating at least semi-confining conditions within the aquifer." This important conclusion is relevant to the discussion of the potential risk of contamination to both the SV-SLB HOA and SBWA wells.

Assessment of Contamination Risks from Nitrates/Microbials from Upgradient Septic Systems and Seawater Intrusion

As part of an independent assessment of contamination risks, a review of *Attachment 2 Nitrate, Arsenic and Sea Water Intrusion* (Lovie, 2021) and the *Sunlight Beach Water Association Report on the Assessment of Nitrate Contamination Risks* (SBWA 2023b) was performed. The reports present an analysis of potential nitrate contamination from upslope septic fields. The analyses use the DOH Level 1 Nitrate Balance for Large On-Site Sewage Systems (LOSS) spreadsheet tool. The Lovie report did not contain a listing of input values used in the LOSS model so this review focuses on the SBWA report and compares the listed results of the two reports. Since the wells are close and both downgradient of the Kohlwes parcel the conclusions of the review should be applicable to both SV-SLB HOA and SBWA wells.

The SBWA report estimated nitrate levels for input values obtained from the Golder report and estimated based upon a potential configuration of on-site sewage systems on the Kohlwes property. A sensitivity analysis was also performed that applied ranges to the input values to determine selected input values and for a range of potential on-site septic systems (10 to 15) upgradient from the water supply wells used by the SBWA and the SV-SLB HOA. Anchor QEA offers the following comments regarding input values to the Level 1 Nitrate Balance worksheet supplied by DOH and used by SBWA:

- The LOSS analysis is used for analysis of large on-site sewage systems and is not directly applicable to analyzing single systems that are spaced apart. Assumptions have to be made for the location of a single system that collectively represents all of the potential single septic drainfields.
- The groundwater recharge rate listed in the report is 24 inches, based upon 35% recharge of an annual precipitation value of 69 inches at Clinton. The average annual precipitation at the site is 29 inches (PRISM 2023). Thirty-five percent of 29 inches is 10 inches. Recharge will be

much less than 24 inches. The U.S. Geological Survey (USGS) reported the average recharge rate on Whidbey Island to be about 6 inches (USGS 2003).

- The area of the septic drainfield was estimated to be 385,000 square feet, which is the area of the entire Kohlwes parcel. That, combined with recharge, affects the volume and concentration of flow migrating downgradient. We recommend using a smaller drainfield area approximating the combined size of the potential septic drainfields. To have a conservative analysis the drainfield area can be assumed to be located between the middle and the north end of the Kohlwes parcel, closer to the well.
- The input value used for flow volume of effluent per septic system was 270 gpd. That value is a flow rate used for design of large on-site systems intended to ensure an on-site sewage system can handle peak loadings. It is not an average flow volume. The Washington Department of Ecology recommends a value of 60 gpd per person be used to estimate indoor water use, of which 10% is consumptively used and 90% is discharged to a septic system (Ecology 2018). The average household size in the Clinton Census-Designated Place from the 2010 census was 2.1 (OFM 2023). The resulting flow volume would be 113 gpd per residence. We recommend using a volume of 135 gpd per residence to be conservative. That volume is based upon an average household size of 2.5 using 60 gpd per person with 90% of use discharged to a septic system.
- The aquifer thickness used in the analysis is 20 feet, which is the default value from DOH, even if the aquifer may be thicker. The Golder report describes the aquifer as having a saturated thickness in excess of 25 feet. For the purposes of delineating the wellhead capture zones, Golder used an aquifer thickness of 50 feet as a representative thickness of the aquifer. The aquifer thickness may vary with location.

A test of the spreadsheet using adjusted values for recharge, drainfield area for 10 residences, location of the drainfield, and volume of effluent was performed. A range of potential drainfield areas were estimated using DOH values for design application rates for Type 2 and Type 5 soils. The input values and results of the analysis are summarized in Table 14.

Table 14
LOSS Spreadsheet Analysis for Ten Residences

Input Values	Factor	Units	Values
Nitrate concentration in precipitation	N_R	mg/l as N	0.24
Total nitrogen concentration in wastewater	N_W	mg/l	60
Soil denitrification	d	unitless	0.1
Aquifer thickness	b	ft	20
Drainfield area	A_D	ft^2	4,500
Distance from drainfield to property boundary	D_{pb}	ft	700

Aquifer width	W_A	ft	200
Aquifer hydraulic conductivity	K	ft/day	400
Hydraulic gradient	i	ft/ft	0.002
Recharge	R	in/yr	6.00
Nitrate concentration of upgradient ground water	N_B	mg/l	2
Wastewater volume	V_W	gpd	1,350
Output Value	**Factor**	**Units**	**Values**
Groundwater nitrate value	NGW	mg/l as N	4.8

The result of the groundwater nitrate analysis for 10 residences is 4.8 mg/l as N, an increase of 2.8 mg/l over background levels. An analysis was performed using 20 residences, which results in a concentration of 7.2 mg/l as N, an increase of 5.2 mg/l over background levels. For 30 residences, an increase of 9.5 mg/l as N was obtained. These levels exceed the 2 mg/l increase that indicates a potential moderate to significant impact to groundwater per DOH. That level is used by Island County in their review of on-site sewage systems and land-use applications. The Island County Environmental Health Department reviews all land-use projects that have the potential to impact the quality or quantity of groundwater. A reduction in the number of residences in a development or more intensive treatment may be required to reduce impacts to groundwater.

Anchor QEA tested the input variables and found that changes in Nitrate concentrations were most sensitive to the values of aquifer properties, especially the hydraulic gradient. If refinements to the calculations are made in the future, we recommend obtaining additional data on groundwater levels to confirm the aquifer hydraulic gradient.

The levels estimated by Anchor QEA are slightly less than estimated in the SBWA report but would not change the conclusions of the SBWA report. The SBWA report states, "The sensitivity analysis shows that changes in the values of aquifer characteristics within possible ranges all result in Ni levels that exceed State and Island County allowable limits for 10-15 additional septic systems near-term."

An assumption that is inherent in the conclusions in the SBWA report is the septic effluent will mix with water in the aquifer(s) upgradient of the wells, resulting in an increase in nitrates in groundwater. The Golder report describes surficial geology at the SV-SLB wells as glacial outwash with glacial till mantling the outwash starting about 800 feet east. The well log for SBWA Well 2 indicates a layer of clay from 1 foot below ground surface (bgs) to 16 feet bgs. The well is screened from 16 feet to 21 feet bgs in a gravel formation. The static water level when the well was drilled was slightly above the ground surface, indicating the aquifer Well 1 is developed into is at least semi-confined. The presence of glacial till and a confining layer could restrict the amount of septic effluent entering the aquifer. The wells for SV-SLB HOA appear to also have a confining layer as static water levels are higher in elevation than clay layers indicated on the well log for Well AGA 832.

However, the extent of glacial till in upgradient areas is not well known and may not consistently cover the underlying outwash formation. For example, the Olympic Marine View Water Association well (Ecology number BJK759) drilled in 2015 lists silty coarse sand as being encountered from 0 to 50 feet bgs, without mention of clay or till. That well is at about the same elevation and 0.25 mile west of the Kohlwes parcel. Without a better understanding of the surficial geology, aquifer capture area and the groundwater flow direction, it would be prudent for the SV-SLB HOA to assume an increase in nitrates from on-site sewage systems will occur, either from the Kohlwes parcel or other parcels in the aquifer capture area. The LOSS analysis indicates the increase in Nitrate concentration will exceed levels deemed acceptable by Island County (2 mg/l increase in Nitrate at a point of compliance) with as few as 10 new residences on the Kohlwes parcel. The LOSS analysis indicates Nitrate levels above the State Reporting Level (SRL) of 5 mg/l concentration could occur with more than 10 new residences. The analysis indicates Nitrate levels could approach the Maximum Contaminant Level (MCL) of 10 mg/l with 30 new residences. At that level, babies and people who are pregnant or trying to become pregnant should not drink the water and adults with certain health conditions may be at risk to methemoglobinemia.

The LOSS analysis performed by Lovie indicates only four additional on-site sewage systems can be built before Nitrate levels increase to 5 mg/l. This analysis estimates ten could be built before exceeding 5 mg/l N. The Lovie study also states that shallower wells may be more at risk to Nitrate pollution. The SV-SLB HOA wells are deeper and are at less risk than the SBWA well.

In addition to Nitrates, microbial contamination and other chemicals commonly found in residential wastewater could enter the aquifer if adequate treatment through soil layers does not occur because of the proximity of on-site sewage systems to the SV-SLB HOA wells.

Seawater Intrusion Risks

Anchor QEA agrees with the findings about seawater intrusion from long-term increases in saltwater levels and the potential for upconing described in the *Sunlight Beach Water Association Wellhead Protection Plan* (SBWA 2023a). Both appear to be low risks considering the groundwater levels and current levels of chloride. The SV-SLB HOA wells also appear to have a low risk from long-term increases in saltwater levels and low potential for upconing.

The wells do have a higher risk of being flooded during extreme high tides (king tides plus low atmospheric pressures plus storm surges). Well seals and the clay layers above the water-bearing layer may protect the well from contamination by seawater, as long as the top of the well casing is not submerged and is sealed. In addition, the water level elevations in the wells are higher than mean sea level and the direction of flow is either toward the marsh area or towards Puget Sound.

The SV-SLB HOA wells both have 18-foot-deep seals, meeting current DOH and Department of Ecology standards for protection against surface contamination. However, the condition of the seals is not known and the risk of seawater migrating around the seals if the surface is flooded is also not known. Seawater entering the ground around the well will likely get flushed out by the positive flow from the aquifer.

Anchor QEA is not advocating a "do-nothing" approach to saltwater contamination from flooding. We recognize that the wells, if flooded, would need to be flushed and sanitized before being put back into operation. In addition, components of the well installation may be damaged by flooding, including wiring, piping, pumping and valves with metallic parts. Loss of pressure in the distribution system may require flushing and sanitizing of the pipe distribution system.

Recommendations for Water Supply Wells

Anchor QEA reviewed existing documents describing the potential for contamination and seawater intrusion. We agree with the assessment of the risk to the SV-SLB HOA wells from Nitrate contamination from upgradient septic systems with as few as 10 new residences on the Kohlwes parcel. The Lovie study concluded that only four residences could be constructed without exceeding a Nitrate concentration of 5 mg/l. However, additional data on soils, geology and aquifer properties would be needed to more definitively assess the potential for nitrate contamination. We agree with assessments on the low potential for seawater intrusion and upconing. We have concluded that it is possible seawater contamination from tidal flooding could occur which would also damage facilities at the well house.

With the risks from nitrate and seawater contamination a prudent alternative will be to pursue construction of a well or wells at a new location. The existing wells could be kept as an emergency backup. If the water quality of the well remains adequate in the future, the well could be used during summer peaking periods or used to strategically mix water supplies to reduce water quality treatment needs. Discussions with DOH will be needed to determine whether and how the existing wells can be used.

If nitrate contamination occurs that approaches the MCL, treatment would be cost-prohibitive and securing a new water supply well would be less expensive. Further assessment of changes in treatment that may be required at the existing wells in the future to continue to provide water of adequate quality.

In addition to planning for a new water source, in the interim the SV-SLB HOA can be proactively working with Island County to reduce the potential impact of new residences upgradient. The water systems can request that Island County only approve a development on the Kohlwes parcel that is phased, first with five residences constructed with monitoring of water quality impacts from on-site sewage systems. If, after a period of time, impacts to the SBWA well don't occur, the County could then the remaining lots to be developed. The ability to develop can be linked to understanding of the potential impacts to the SV-SLB HOA and SBWA wells.

Recommended Improvements

The following paragraphs provide recommendations for improvements that will be needed to maintain adequate water system operations and level of service if the SV-SLB Water System remains in its current configuration with existing water supply and storage facilities at their present locations. A prioritized list of recommended improvements was developed to address system deficiencies and includes replacement of facilities that are likely to need replacement due to age and condition within the next 20 years. A planning level opinion of probable costs has also been developed for each of the proposed improvement projects.

Summary of Identified Deficiencies

As noted previously, no capacity-related deficiencies were identified through the capacity analyses. The hydraulic analysis also indicated that the system generally meets DOH criteria, with exception of the following:

- There is other a deficiency in fire flow at the highest hydrants on the SV-SLB HOA Water System, including the hydrants on Sun Vista Circle and the hydrant at the corner of Dassell Street and Sunlight Beach Road. Due to the elevation of these hydrant relative and the limited capacity of the booster pump facilities, these hydrants are unlikely to ever be able to deliver fire flow unless a fire booster pump is added to the system, or a storage tank is located higher up in the system.
- Pressures at customer services along Lincoln Street are marginal. The hydraulic model indicates that 30 psi is maintained at customer services under PHD conditions, but the SV-SLB HOA has indicated that pressures drop below 30 psi under peak demand conditions.

Otherwise, there is adequate source, storage, and distribution system capacity to meet the criteria set forth earlier in this memorandum under existing and projected water demand conditions. However, some of the water system infrastructure is aging and will likely require replacement or upgrade during the next 20 years. The need to replace aging infrastructure has been evaluated and recommended facility upgrades and replacements are included in the prioritized list of improvements recommended below.

The water quality analysis indicated that while the system currently provides water that generally meets water quality standards, the system is at risk of contamination in the future from the following:

- Bacteria and nitrates
- Seawater inundation

Recommended Improvements

Table 15 provides a prioritized list of improvements recommended for the SV-SLB Water System. These improvements are primarily recommended to replace infrastructure and equipment that is anticipated to need replacement due to age and condition within the next 20 years, if the SV-SLB HOA Water System is maintained in its current configuration with the wells and storage tanks in their current locations. An improvement is also included that recommend replacement or relocation of source wells associated to address the risk of contamination to the water supply wells from bacteria and nitrate that will result from development of upslope septic systems and seawater intrusion due to inundation during high tides. In addition, an improvement is included that should be considered, based on observations made by SV-SLB HOA of inadequate pressure along Lincoln Street. This recommended improvement would connect Lincoln Street to the pressure system served through the booster pump station. Recommended timing of improvements is based on our understanding of the age and condition of the infrastructure and equipment that will need to be replaced and timing of development of the adjacent Kohwles property.

Table 15
Recommended Improvements

Project ID	Description	Targeted Year for Completion
P-1	Replace the existing 2-inch PVC pipeline that extends south from Sunlight Beach Road to residences along Kohlwes Road. This pipe was not replaced as part of the 1995–1996 system upgrade project and will likely require replacement due to age and condition within the next 6 years.	2029
P-2	Replace the existing 2-inch PVC pipeline that extends south from Sunlight Beach Road to south of Sunlight Beach Road and west of Lincoln Street. This pipe was not replaced as part of the 1995–1996 system upgrade project and will likely require replacement due to age and condition within the next 6 years.	2029
P-3	Replace or relocate the existing wells to address the risk of bacteria, nitrate, and sweater intrusion contamination. This should be done prior to full development of the Kohwles property. Due to the limited space at the existing well site and location of the well downslope of septic systems that will be installed as part of the development of the Kohwles property, it is recommended that a new well be drilled at a different location, upslope of the Kohwles property and away from the potential risk of seawater intrusion. Relocation of wells will be evaluated in more detail as part of Tasks 2 and 3. A primary and secondary well should be considered for redundancy.	2029
P-4	Replace the existing 3-inch PVC pipelines that loop through the Sun Vista Development in Sun Vista Circle. These pipelines were not replaced as part of the 1995–1996 system upgrade project and will likely require replacement due to age and condition within the next 10 years.	2033
P-5	Replace the booster pumps. It is not clear from the information provided how old the booster pumps are, but they appear to be at least 5 to 10 years old. These types of end-suction centrifugal booster pumps are likely to require	2043

Project ID	Description	Targeted Year for Completion
	replacement or rehabilitation within 25–30 years of installation. We anticipate that these well pumps will likely require replacement due to age and condition within the next 20 years.	
P-6	Replace customer service meters as they fail or become outdated. The customer service meters were installed nearly 30 years ago. The SV-SLB HOA has indicated that only a few meters have been replaced. It is anticipated that up to 90% of the meters will need to be replaced in the next 20 years.	2043
P-7	Replace the pressure tank at the booster pump station. The age and condition of the pressure tank is unknow, but we anticipate the pressure tank will likely require replacement within the next 20 years.	2043
P-8	Replace the backup generator. The age and condition of the generator are unknown, but it is anticipated that the generator will likely require replacement or upgrade within the next 20 years.	2043
P-9	Refurbish the iron and manganese removal system and replace the filter material. The pressure tanks and associated piping appear to be in good shape, but the filter material will likely need to be replaced and other minor upgrades to the filtration system will likely be needed in the next 20 years.	2043
P-10	Connect the 4inch PVC water main in Lincoln Street to the pressure system by constructing a new 6-inch PVC connection from Dassel Street to Lincoln Street.	2043

Opinion of Probable Costs

Planning level opinions of probable costs have been developed for each of the recommended improvement projects shown in Figure 4 and described above. The costs were developed using planning level unit costs and then adding a percentage of the estimated construction cost to account for indirect project costs. Table 16 lists the unit costs and percentages used in developing project costs. Indirect costs include planning and design, project administration, construction services, construction contingency, and taxes. Unit costs for piping projects are intended to include trenching, import and placement of pipe bedding material, furnishing and installing AWWA C900 PVC pipe, placement of backfill, pavement repair, and installation of all equipment appurtenant to the pipe.

Costs for other types of projects not listed in Table 16 were estimated on a case-by-case basis. Construction and indirect costs were added to determine the total project cost. A description of each project, identification of the deficiency or need that is met by the project, and the opinion of probable project implementation costs are summarized in Table 17. These are order of magnitude planning level costs. More refined opinions of cost would need to be developed to inform project budgeting and implementation. All opinions of cost are based on our understand of current (2023 dollars) materials and labor costs. Actual costs at the time of implementation will vary based on the cost of materials and labor at the time of construction.

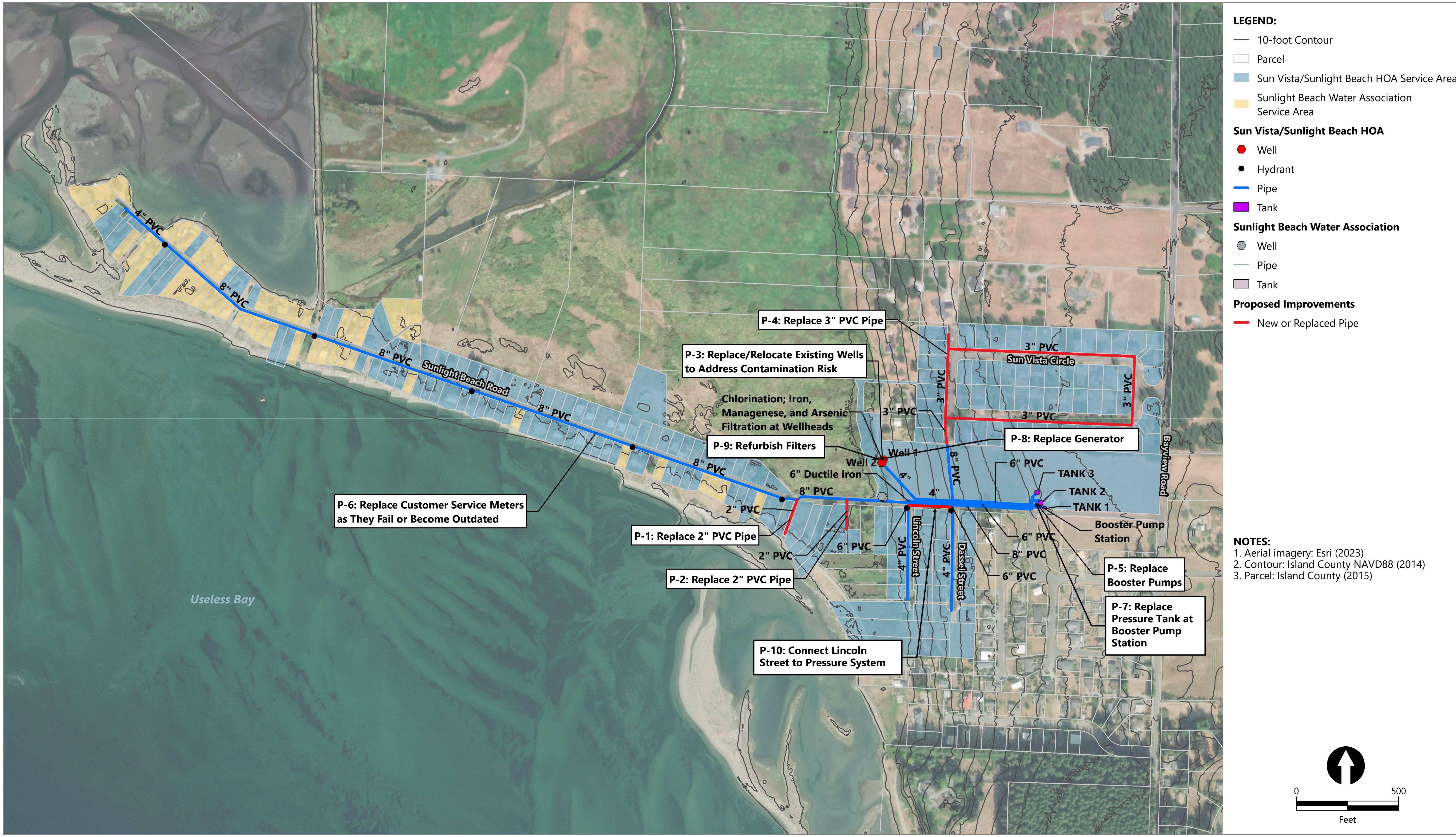


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Figure 4
Proposed Improvements – Sun Vista/Sunlight Beach Homeowner's Association
Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Table 16
Distribution System Unit Costs

AWWA C900 PVC Pipe Diameter (Inches)	Unit Cost ($/foot)
1	$25
2	$35
2-1/2	$50
3	$64
4	$76
6	$92
8	$103
New Water Storage Tank	**Unit Cost ($/gallon)**
<50,000 gallons	$6
50,000 to 100,000 gallons	$4
100,000 to 250,000 gallons	$3
New Well	**Unit Cost**
8-inch Well	$200/foot + $5,000 for screen + Pump, Electrical, Controls
10-inch Well	$300/foot + $8,000 for screen + Pump, Electrical, Controls
Well Pump	**Unit Cost ($/each)**
1-horsepower Submersible Well Pump	$3,000
5-horsepower Submersible Well Pump	$9,500
10-horsepower Submersible Well Pump	$15,000
Booster Pump Replacement	**Unit Cost ($/each)**
5-hp End-Suction Centrifugal Pump	$8,000
Indirect Costs (Percentages of Construction Cost)	
Project Administration	5%
Design & Permitting (including survey and geotech)	10% (average) to 20% (complex)
Contractor Mobilization	10%
Construction Contingency	10% (average) to 30% (complex)
State Sales Tax	8.8%

Notes:

1. Construction unit costs include all work needed to complete the project. Construction unit costs also include a 30% contingency, a 10% allowance for mobilization and demobilization, and sales tax.

Table 17
Opinion of Probable Costs

Project ID	Description	Quantity	Unit	Unit Cost	Construction Cost[1]	Non-construction Cost[2]	Total Project Cost[3]	Summary of Deficiency Addressed
P-1	Replace 2-inch PVC Pipe, South of Sunlight Beach Road	200	LF	$35	$7,000	$1,800	$8,800	Replace aging pipe.
P-2	Replace 2-inch PVC Pipe, South of Sunlight Beach Road	160	LF	$35	$5,600	$1,400	$7,000	Replace aging pipe.
P-3[5]	Replace/Relocate Existing Wells to Address Contamination Risk	1	LS	$350,000	$350,000	$87,500	$437,500	Risk of bacteria, nitrate, and seawater contamination.
P-4	Replace 3-inch PVC Pipe, Sun Vista Circle	2,930	LF	$64	$187,500	$46,900	$234,400	Replace aging pipe.
P-5	Replace Booster Pumps	4	EA	$3,000	$12,000	$3,000	$15,000	Replace aging pumps.
P-6	Replace Customer Service Meters	142	EA	$600	$85,200	$21,300	$106,500	Replace aging meters.
P-7	Replace Pressure Tank	1	LS	$40,000	$40,000	$10,000	$50,000	Replace aging pressure tank.
P-8	Replace Backup Generator	1	LS	$10,000	$10,000	$2,500	$12,500	Replace aging generator
P-9	Refurbish Iron and Manganese Filters	1	LS	$15,000	$15,000	$3,800	$18,800	Refurbish aging filters.
P-10	Connect Lincoln Street to Pressure System, 6-inch	225	LF	$92	$20,700	$5,200	$25,900	Boost pressures on Lincoln Street.
Total – All Projects					**$733,000**	**$183,400**	**$916,400**	

Notes:

1. Construction unit costs include all work needed to complete the project, including labor and materials needed to trench, excavate, backfill, install pipe and other equipment, test, disinfect, and repair and restore surfaces. Construction unit costs also include a 30% contingency, a 10% allowance for mobilization and demobilization, and sales tax.
2. Non-construction costs include allowances for engineering design (15% of the construction cost), permitting and administration (5% of the construction cost), and construction management (5% of the construction cost).
3. The total project cost is the total of the construction and non-construction costs. Costs are reported in 2023 dollars. Costs may vary depending on labor and materials costs at the time the project is constructed.
4. Construction, non-construction, and total costs are rounded to the nearest $100.
5. The cost of replacing or relocating existing wells has not been fully evaluated yet. The cost will be further evaluated as part of Tasks 2 and 3, which will consider what the system would need if the wells and other key infrastructure were relocated. The cost included here should be considered a placeholder and will be refined for inclusion in the final Water Consolidation Feasibility Study report.

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Attachment A

Water System Facility Inventory Data

Table A-1
SV-SLB Well Inventory

ID	System	Source Number	Well Number	Well Size	Well Depth	Well Capacity	Pump HP	Year of Installation	Reported Condition
SV-SLB Well 1	SV-SLB HOA	S01	AGA833	8-inch	30	35 gpm	Unknown	1942 (Rebuilt 1992)	Active, Good
SV-SLB Well 2	SV-SLB HOA	S02	AGA832	8-inch	50	78 gpm	Unknown	1992	Active, Good

Table A-2
SV-SLB Storage Tank Inventory

ID	System	Dimensions	Capacity	Materials	Year of Installation	Bottom Elevation	Overflow Elevation	Reported Condition
SV-SLB-Tank 1	SV-SLB HOA	Unknown	7,200 gallons	Reinf. Concrete	Unknown	Unknown	Approx 108 feet	Good
SV-SLB-Tank 2	SV-SLB HOA	26' Diameter, 15' Tall	55,000 gallons	Reinf. Concrete	Unknown	Approx 94 feet	Approx 108 feet	Good
SV-SLB-Tank 3	SV-SLB HOA	30' Diameter, 10' Tall	52,800 gallons	Reinf. Concrete	2008	Approx 98 feet	Approx 108 feet	Good

Table A-3
SV-SLB HOA Pipeline Inventory

ID	Size	Description	Material	Length	Year of Installation	Reported Condition
SV-SLB-P01	4-inch	Gravity Main Line	PVC	284 feet	1995-1996	Good
SV-SLB-P02	8-inch	Gravity Main Line	PVC	943 feet	1995-1996	Good
SV-SLB-P03	8-inch	Gravity Main Line	PVC	882 feet	1995-1996	Good
SV-SLB-P04	8-inch	Gravity Main Line	PVC	900 feet	1995-1996	Good
SV-SLB-P05	8-inch	Gravity Main Line	PVC	838 feet	1995-1996	Good
SV-SLB-P06	8-inch	Gravity Main Line	PVC	78 feet	1995-1996	Good
SV-SLB-P07	2-inch	Gravity Lateral	PVC	195 feet	Unknown	Good
SV-SLB-P08	8-inch	Gravity Main Line	PVC	270 feet	1995-1996	Good
SV-SLB-P09	2-inch	Gravity Lateral	PVC	158 feet	Unknown	Good
SV-SLB-P10	8-inch	Gravity Main Line	PVC	166 feet	1995-1996	Good
SV-SLB-P11	6-inch	Tee for Future Conn.	PVC	~2 feet	1995-1996	Good
SV-SLB-P12	8-inch	Gravity Main Line	PVC	46 feet	1995-1996	Good
SV-SLB-P13	2-inch	Intertie Conn.	PVC	9 feet	1995-1996	Good
SV-SLB-P14	8-inch	Gravity Main Line	PVC	112 feet	1995-1996	Good
SV-SLB-P15	8-inch	Gravity Main Line	PVC	237 feet	1995-1996	Good
SV-SLB-P16	8-inch	Gravity Main Line	PVC	420 feet	1995-1996	Good
SV-SLB-P17	8-inch	Gravity Main Line	PVC	54 feet	1995-1996	Good
SV-SLB-P18	8-inch	Tank 2 Outlet	PVC	22 feet	1995-1996	Good
SV-SLB-P19	8-inch	Tank 2 Outlet	PVC	18 feet	1995-1996	Good
SV-SLB-P20	8-inch	Tank 3 Outlet	PVC	38 feet	2008	Good
SV-SLB-P21	Unknown	Well Drain Line	Unknown	Unknown	Unknown	Good
SV-SLB-P22	4-inch	Well 1 Discharge	Unknown	Unknown	Unknown	Good
SV-SLB-P23	4-inch	Well 2 Discharge	Unknown	Unknown	Unknown	Good
SV-SLB-P24	4-inch	Wells to Tanks	Unknown	878 feet	Unknown	Good
SV-SLB-P25	2-1/2-inch	Tank 2 Outlet	PVC	17 feet	Unknown	Unknown

ID	Size	Description	Material	Length	Year of Installation	Reported Condition
SV-SLB-P26	6-inch	Tank 2 Outlet	PVC	45 feet	Unknown	Unknown
SV-SLB-P27	6-inch	Tank Outlet Conn.	PVC	5 feet	1995-1996	Good
SV-SLB-P28	6-inch	Tank Inlet/Outlet	PVC	5 feet	Unknown	Unknown
SV-SLB-P29	6-inch	Tank Inlet/Outlet	PVC	2 feet	Unknown	Unknown
SV-SLB-P30	6-inch	Tank Inlet/Outlet	PVC	2 feet	Unknown	Unknown
SV-SLB-P31	6-inch	Tank 2 Inlet	PVC	41 feet	Unknown	Unknown
SV-SLB-P32	6-inch	Tank 2 Drain	A/C	Unknown	Unknown	Unknown
SV-SLB-P33	6-inch	Tank 1 Inlet/Outlet	PVC	71 feet	Unknown	Unknown
SV-SLB-P34	3-inch	Tank 1 Drain	A/C	Unknown	Unknown	Unknown
SV-SLB-P35	6-inch	BPS Suction	Ductile Iron	<5 feet	1995-1996	Good
SV-SLB-P36	6-inch	BPS Suction	Ductile Iron	<5 feet	1995-1996	Good
SV-SLB-P37	6-inch	BPS Suction Conn.	Ductile Iron	22	1995-1996	Good
SV-SLB-P38	2-inch	Pump 1 Suction	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P39	2-inch	Pump 1 Discharge	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P40	2-inch	Pump 2 Suction	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P41	2-inch	Pump 2 Discharge	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P42	2-inch	Pump 3 Suction	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P43	2-inch	Pump 3 Discharge	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P44	2-inch	Pump 4 Suction	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P45	2-inch	Pump 4 Discharge	Galv. Steel	<5 feet	Unknown	Good
SV-SLB-P46	6-inch	BPS Discharge	Ductile Iron	19 feet	Unknown	Good
SV-SLB-P47	6-inch	Pressure Main Line	PVC	456 feet	Unknown	Good
SV-SLB-P48	6-inch	Gravity Main Line	PVC	665 feet	Unknown	Good
SV-SLB-P49	6-inch	Gravity Main Conn.	Ductile Iron	10 feet	1995-1996	Good
SV-SLB-P50	8-inch	Pressure Main Line	PVC	27 feet	1995-1996	Good
SV-SLB-P51	8-inch	Pressure Main Line	PVC	300 feet	1995-1996	Good
SV-SLB-P52	3-inch	Pressure Lateral	PVC	141 feet	Unknown	Unknown

ID	Size	Description	Material	Length	Year of Installation	Reported Condition
SV-SLB-P53	3-inch	Pressure Lateral	PVC	364 feet	Unknown	Unknown
SV-SLB-P54	3-inch	Pressure Lateral	PVC	78 feet	Unknown	Unknown
SV-SLB-P55	3-inch	Pressure Lateral	PVC	987 feet	Unknown	Unknown
SV-SLB-P56	3-inch	Pressure Lateral	PVC	364 feet	Unknown	Unknown
SV-SLB-P57	3-inch	Pressure Lateral	PVC	987 feet	Unknown	Unknown
SV-SLB-P58	6-inch	Pressure Lateral	PVC	27 feet	1995-1996	Good
SV-SLB-P59	4-inch	Pressure Lateral	PVC	529 feet	1995-1996	Good
SV-SLB-P60	6-inch	Gravity Lateral	PVC	28 feet	1995-1996	Good
SV-SLB-P61	4-inch	Gravity Lateral	PVC	485 feet	1995-1996	Good
SV-SLB-PH1	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH2	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH3	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH4	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH5	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH6	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good
SV-SLB-PH7	6-inch	Hydrant Line	Ductile Iron	<10 feet	1995-1996	Good

Table A-4
SV-SLB HOA Hydrant Inventory

ID	Type	Line Valve Size	Year of Installation	Red Low Flow	Yellow High Flow	Reported Condition
SV-SLB-H1	(2) 2" Ports, (1) 4" Port	6 inch	1995	No	Yes	Good
SV-SLB-H2	(2) 2" Ports, (1) 4" Port	6 inch	1995	No	Yes	Good
SV-SLB-H3	(2) 2" Ports, (1) 4" Port	6 inch	1995	No	Yes	Good
SV-SLB-H4	(2) 2" Ports, (1) 4" Port	6 inch	1995	No	Yes	Good
SV-SLB-H5	(2) 2" Ports, (1) 4" Port	6 inch	1995	No	Yes	Good
SV-SLB-H6	(2) 2" Ports, (1) 4" Port	6 inch	1995	Yes	No	Good
SV-SLB-H7	(2) 2" Ports, (1) 4" Port	6 inch	1995	Yes	No	Good

Table A-5
SV-SLB HOA Treatment Inventory

ID	Type	Year of Installation	Reported Condition
SV-SLB-TRMT-1	Chlorination	Unknown	Good
SV-SLB-TRMT-2	Chlorination	Unknown	Good
SV-SLB-TRMT-3	Iron and Manganese Filtration	Unknown	Good

Table A-6
SV-SLB HOA Booster Pump Inventory

ID	Capacity	Pump HP	Year of Installation	Reported Condition
SV-SLB-BP01	Unknown	5	Unknown	Good
SV-SLB-BP02	Unknown	5	Unknown	Good
SV-SLB-BP03	Unknown	5	Unknown	Good
SV-SLB-BP04	Unknown	5	Unknown	Good

Attachment B

Hydraulic Analysis Input and Results

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Inputs - Pipe

Pipe Label	Length (ft)	Nominal Diameter (in)	Material	Hazen-Williams C	Installation Year
SV-SLB-P01	284	4	PVC	140	1996
SV-SLB-P02	943	8	PVC	140	1996
SV-SLB-P03	882	8	PVC	140	1996
SV-SLB-P04	900	8	PVC	140	1996
SV-SLB-P05	838	8	PVC	140	1996
SV-SLB-P06	78	8	PVC	140	1996
SV-SLB-P07	195	2	PVC	140	0
SV-SLB-P08	270	8	PVC	140	1996
SV-SLB-P09	158	2	PVC	140	0
SV-SLB-P10	166	8	PVC	140	1996
SV-SLB-P11	3	6	PVC	140	1996
SV-SLB-P12	46	8	PVC	140	1996
SV-SLB-P13	9	2	PVC	140	1996
SV-SLB-P14	112	8	PVC	140	1996
SV-SLB-P15A	4	8	PVC	140	1996
SV-SLB-P15B	233	8	PVC	140	1996
SV-SLB-P16	420	8	PVC	140	1996
SV-SLB-P17	54	8	PVC	140	1996
SV-SLB-P18	22	8	PVC	140	1996
SV-SLB-P19	18	8	PVC	140	1996
SV-SLB-P19B	1	8	PVC	140	0
SV-SLB-P20	37	8	PVC	140	2008
SV-SLB-P22	15	4	Unknown	130	0
SV-SLB-P23	7	4	Unknown	130	0
SV-SLB-P24	878	4	Unknown	130	0
SV-SLB-P25	16	2.5	PVC	140	0
SV-SLB-P25B	1	2.5	PVC	140	0
SV-SLB-P26	45	6	PVC	140	0
SV-SLB-P27	5	6	PVC	140	0
SV-SLB-P28	5	6	PVC	140	0
SV-SLB-P29	2	6	PVC	140	0
SV-SLB-P30	2	6	PVC	140	0
SV-SLB-P31	41	6	PVC	140	0
SV-SLB-P31B	1	6	PVC	140	0
SV-SLB-P33	73	6	PVC	140	0
SV-SLB-P35	4	6	Ductile Iron	130	1996
SV-SLB-P35	3	6	Ductile Iron	130	0
SV-SLB-P36	4	6	Ductile Iron	130	1996
SV-SLB-P36	4	6	Ductile Iron	130	0
SV-SLB-P37	3	6	Ductile Iron	130	0

SV-SLB-P37A	11	6	Ductile Iron	130	1996
SV-SLB-P37B	3	6	Ductile Iron	130	1996
SV-SLB-P37C	3	6	Ductile Iron	130	1996
SV-SLB-P37D	3	6	Ductile Iron	130	1996
SV-SLB-P38	4	6	Ductile Iron	130	0
SV-SLB-P39	3	6	Ductile Iron	130	0
SV-SLB-P40	4	6	Ductile Iron	130	0
SV-SLB-P41	3	6	Ductile Iron	130	0
SV-SLB-P42	4	6	Ductile Iron	130	0
SV-SLB-P46	9	6	Ductile Iron	130	0
SV-SLB-P46B	3	6	Ductile Iron	130	0
SV-SLB-P46C	3	6	Ductile Iron	130	0
SV-SLB-P46D	3	6	Ductile Iron	130	0
SV-SLB-P47	452	6	PVC	140	0
SV-SLB-P48	665	6	PVC	140	0
SV-SLB-P49	10	6	Ductile Iron	130	1996
SV-SLB-P50	27	8	PVC	140	1996
SV-SLB-P51	300	8	PVC	140	1996
SV-SLB-P52	141	3	PVC	140	0
SV-SLB-P53	364	3	PVC	140	0
SV-SLB-P54	78	3	PVC	140	0
SV-SLB-P55	987	3	PVC	140	0
SV-SLB-P56	364	3	PVC	140	0
SV-SLB-P57	987	3	PVC	140	0
SV-SLB-P58	27	6	PVC	140	1996
SV-SLB-P59	529	4	PVC	140	1996
SV-SLB-P60	28	6	PVC	140	1996
SV-SLB-P61	485	4	PVC	140	1996
SV-SLB-PH1	6	6	Ductile Iron	130	1996
SV-SLB-PH2	6	6	Ductile Iron	130	1996
SV-SLB-PH3	6	6	Ductile Iron	130	1996
SV-SLB-PH4	6	6	Ductile Iron	130	1996
SV-SLB-PH5	6	6	Ductile Iron	130	1996
SV-SLB-PH6	7	6	Ductile Iron	130	1996
SV-SLB-PH7	7	6	Ductile Iron	130	1996

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Inputs - Nodes

Node Label	Elevation (ft)	X (ft)	Y (ft)
J-8	25	1,240,235.69	364,860.23
J-21	25	1,240,189.31	364,856.76
J-22	20	1,240,189.15	364,853.89
J-31	103	1,241,037.61	364,853.67
J-32	103	1,241,022.79	364,856.11
J-33	12	1,240,022.83	364,861.34
J-34	10	1,240,021.15	364,703.59
J-35	8	1,239,759.32	364,862.10
J-36	10	1,239,693.92	364,678.23
J-37	85	1,240,557.95	365,657.46
J-38	96	1,240,561.07	365,735.88
J-39	80	1,240,552.65	365,155.41
J-40	76	1,240,543.49	365,293.41
J-43	128	1,241,544.33	365,618.28
J-44	128	1,241,529.87	365,254.23
J-46	28	1,240,213.41	365,056.51
J-48	11	1,236,204.19	366,400.77
J-49	10	1,236,418.51	366,214.02
J-50	32	1,240,346.83	364,816.55
J-51	25	1,240,341.45	364,331.11
J-52	62	1,240,581.56	364,802.67
J-53	58	1,240,575.69	364,273.37
J-54	103	1,240,997.62	364,830.20
J-55	103	1,240,997.69	364,832.22
J-56	103	1,240,997.53	364,827.93
J-57	103	1,241,025.54	364,854.92
J-58	103	1,241,025.69	364,858.97
J-59	103	1,240,997.87	364,837.07
J-60	103	1,241,002.88	364,836.89
J-62	8	1,238,890.92	365,143.48
J-63	8	1,239,681.75	364,867.29
J-66	10	1,238,041.10	365,440.27
J-69	11	1,237,208.41	365,731.08
J-72	35	1,240,352.10	364,854.47
J-74	103	1,241,027.57	364,834.98
J-75	60	1,240,581.89	364,829.95
J-76	35	1,240,347.03	364,844.99
J-77	103	1,241,037.36	364,833.83
J-81	60	1,240,582.29	364,857.23
J-82	35	1,240,339.09	364,855.20

J-83	103	1,241,041.84	364,853.44
J-84	103	1,241,003.70	364,860.10
J-86	103	1,241,001.95	364,810.37
J-87	60	1,240,582.92	364,831.73
J-103	103	1,241,031.83	364,840.98
J-104	103	1,241,031.92	364,843.97
J-105	103	1,241,032.09	364,847.08
J-106	103	1,241,032.14	364,849.99
J-109	103	1,241,030.89	364,843.52
J-110	103	1,241,030.79	364,840.55
J-111	103	1,241,030.99	364,846.54
J-112	103	1,241,031.11	364,849.56
J-121	36	1,240,351.51	364,844.69
SV-SLB-Well1	21	1,240,213.81	365,071.59
SV-SLB-Well2	21	1,240,206.71	365,056.62

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Inputs - Storage Tanks

Label	Elevation (Base) (ft)	Elevation (Minimum) (ft)	Elevation (Initial-ADD) (ft)	Elevation (Initial-MDD) (ft)	Elevation (Initial-PHD) (ft)	Elevation (Maximum) (ft)	Capacity (gal)	Area (Average) (ft^2)	Diameter (ft)	Section
SV-SLB-TANK-1	100	102.00	106.30	103.20	106.10	108	7,200	28.3	6	Circular
SV-SLB-TANK-2	94.1	95.00	106.30	103.20	106.10	108	55,000	530.9	26	Circular
SV-SLB-TANK-3	98	100.00	106.30	103.20	106.10	108	52,800	706.9	30	Circular

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 1. Existing System 2023 ADD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	0.88	37
J-33	0.88	41
J-34	0.88	42
J-35	0.88	43
J-36	0.88	42
J-37	0.88	96
J-38	0	91
J-39	0	98
J-40	0.88	100
J-43	1.68	77
J-44	0.88	77
J-46	0	36
J-48	0.4	41
J-49	0.4	42
J-50	0.88	32
J-51	0.88	35
J-52	0.88	106
J-53	0.88	107
J-62	0.88	43
J-63	0.88	43
J-66	0.88	42
J-69	0.88	41
J-72	0	31
J-74	0	88
J-75	0	106
J-76	0	31
J-81	0	106
J-82	0	31
J-87	0	20
J-109	0	88
J-110	0	88
J-111	0	88
J-112	0	88
J-121	0	31
SV-SLB-Well1	0	43
SV-SLB-Well2	-78	43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 2. Existing System 2023 MDD+FF

Label	Satisfies Fire Flow Constraints?	Demand (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Is Fire Flow Run Balanced?	Hydraulic Grade (ft)	Junction w/ Minimum Pressure (System)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone)
SV-SLB-H1	TRUE	0	729	20	TRUE	103.15	J-58	30	J-48
SV-SLB-H2	TRUE	0	816	20	TRUE	103.15	J-58	32	J-48
SV-SLB-H3	TRUE	0	936	20	TRUE	103.15	J-58	34	J-48
SV-SLB-H4	TRUE	0	1,000	25	TRUE	103.15	J-58	36	J-48
SV-SLB-H5	TRUE	0	1,000	31	TRUE	103.15	J-58	38	SV-SLB-H6
SV-SLB-H6	TRUE	0	1,000	24	TRUE	103.16	J-58	29	J-50
SV-SLB-H7	FALSE	0	146	50	TRUE	302.24	J-104	-470	J-43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 3. Existing System 2023 PHD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	6.28	37
J-33	6.28	41
J-34	6.28	41
J-35	6.28	42
J-36	6.28	41
J-37	6.28	92
J-38	0	88
J-39	0	95
J-40	6.28	96
J-43	6.28	74
J-44	6.28	74
J-46	0	37
J-48	6.28	41
J-49	6.28	41
J-50	6.28	32
J-51	6.28	35
J-52	6.28	103
J-53	6.28	104
J-62	6.28	42
J-63	6.28	42
J-66	6.28	41
J-69	6.28	41
J-72	0	31
J-74	0	85
J-75	0	103
J-76	0	31
J-81	0	103
J-82	0	31
J-87	0	20
J-109	0	85
J-110	0	85
J-111	0	85
J-112	0	85
J-121	0	30
SV-SLB-Well1	-35	45
SV-SLB-Well2	-78	45

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 4. Existing System 2029 ADD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	0.92	37
J-33	0.92	41
J-34	0.92	42
J-35	0.92	43
J-36	0.92	42
J-37	0.92	96
J-38	0	91
J-39	0	98
J-40	0.92	100
J-43	0.92	77
J-44	0.92	77
J-46	0	36
J-48	0.92	41
J-49	0.92	42
J-50	0.92	32
J-51	0.92	35
J-52	0.92	106
J-53	0.92	107
J-62	0.92	43
J-63	0.92	43
J-66	0.92	42
J-69	0.92	41
J-72	0	31
J-74	0	88
J-75	0	106
J-76	0	31
J-81	0	106
J-82	0	31
J-87	0	20
J-109	0	88
J-110	0	88
J-111	0	88
J-112	0	88
J-121	0	31
SV-SLB-Well1	0	43
SV-SLB-Well2	-78	43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 5. Existing System 2029 MDD+FF

Label	Satisfies Fire Flow Constraints?	Demand (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Is Fire Flow Run Balanced?	Hydraulic Grade (ft)	Junction w/ Minimum Pressure (System)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone)
SV-SLB-H1	TRUE	0	729	20	TRUE	103.15	J-58	30	J-48
SV-SLB-H2	TRUE	0	816	20	TRUE	103.15	J-58	32	J-48
SV-SLB-H3	TRUE	0	936	20	TRUE	103.15	J-58	34	J-48
SV-SLB-H4	TRUE	0	1,000	25	TRUE	103.15	J-58	36	J-48
SV-SLB-H5	TRUE	0	1,000	31	TRUE	103.15	J-58	38	SV-SLB-H6
SV-SLB-H6	TRUE	0	1,000	24	TRUE	103.16	J-58	29	J-50
SV-SLB-H7	FALSE	0	146	50	TRUE	302.24	J-104	-470	J-43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 6. Existing System 2029 PHD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	6.46	37
J-33	6.46	41
J-34	6.46	41
J-35	6.46	42
J-36	6.46	41
J-37	6.46	92
J-38	0	87
J-39	0	95
J-40	6.46	96
J-43	6.46	74
J-44	6.46	74
J-46	0	37
J-48	6.46	41
J-49	6.46	41
J-50	6.46	32
J-51	6.46	35
J-52	6.46	102
J-53	6.46	104
J-62	6.46	42
J-63	6.46	42
J-66	6.46	41
J-69	6.46	41
J-72	0	31
J-74	0	85
J-75	0	103
J-76	0	31
J-81	0	103
J-82	0	31
J-87	0	20
J-109	0	85
J-110	0	85
J-111	0	85
J-112	0	85
J-121	0	30
SV-SLB-Well1	-35	45
SV-SLB-Well2	-78	45

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 7. Existing System 2043 ADD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	1.03	37
J-33	1.03	41
J-34	1.03	42
J-35	1.03	43
J-36	1.03	42
J-37	1.03	96
J-38	0	91
J-39	0	98
J-40	1.03	100
J-43	1.03	77
J-44	1.03	77
J-46	0	36
J-48	1.03	41
J-49	1.03	42
J-50	1.03	32
J-51	1.03	35
J-52	1.03	106
J-53	1.03	107
J-62	1.03	43
J-63	1.03	43
J-66	1.03	42
J-69	1.03	41
J-72	0	31
J-74	0	88
J-75	0	106
J-76	0	31
J-81	0	106
J-82	0	31
J-87	0	20
J-109	0	88
J-110	0	88
J-111	0	88
J-112	0	88
J-121	0	31
SV-SLB-Well1	0	43
SV-SLB-Well2	-78	43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 8. Existing System 2043 MDD+FF

Label	Satisfies Fire Flow Constraints?	Demand (gpm)	Fire Flow (Available) (gpm)	Pressure (Calculated Residual) (psi)	Is Fire Flow Run Balanced?	Hydraulic Grade (ft)	Junction w/ Minimum Pressure (System)	Pressure (Calculated Residual @ Total Flow Needed) (psi)	Junction w/ Minimum Pressure (Zone)
SV-SLB-H1	TRUE	0	729	20	TRUE	103.14	J-58	30	J-48
SV-SLB-H2	TRUE	0	816	20	TRUE	103.15	J-58	32	J-48
SV-SLB-H3	TRUE	0	936	20	TRUE	103.15	J-58	34	J-48
SV-SLB-H4	TRUE	0	1,000	25	TRUE	103.15	J-58	36	J-48
SV-SLB-H5	TRUE	0	1,000	31	TRUE	103.15	J-58	38	SV-SLB-H6
SV-SLB-H6	TRUE	0	1,000	24	TRUE	103.16	J-58	29	J-50
SV-SLB-H7	FALSE	0	146	50	TRUE	302.24	J-104	-470	J-43

Sun Vista/Sunlight Beach Water Consolidation Feasibility Study

Sun Vista/Sunlight Beach HOA

WaterCAD Model Results - 9. Existing System 2043 PHD

Label	Demand (gpm)	Pressure (psi)
J-8	0	35
J-21	0	35
J-22	7.01	37
J-33	7.01	41
J-34	7.01	41
J-35	7.01	42
J-36	7.01	41
J-37	7.01	92
J-38	0	87
J-39	0	94
J-40	7.01	96
J-43	7.01	73
J-44	7.01	73
J-46	0	37
J-48	7.01	41
J-49	7.01	41
J-50	7.01	32
J-51	7.01	35
J-52	7.01	102
J-53	7.01	103
J-62	7.01	42
J-63	7.01	42
J-66	7.01	41
J-69	7.01	41
J-72	0	31
J-74	0	84
J-75	0	103
J-76	0	31
J-81	0	103
J-82	0	31
J-87	0	20
J-109	0	84
J-110	0	84
J-111	0	84
J-112	0	84
J-121	0	30
SV-SLB-Well1	-35	45
SV-SLB-Well2	-78	45